Musculoskeletal morbidity: the growing burden of shoulder pain and disability and poor quality of life in diabetic outpatients

L.L. Laslett[1], S.P. Burnet[1], J.A. Jones[2,3], C.L. Redmond[1], J.D. McNeil[1]

[1]The University of Adelaide Discipline of Medicine, Modbury Public Hospital, Modbury;
[2]Biometrics SA, South Australian Research and Development Institute, Adelaide;
[3]The University of Adelaide, South Australia, Australia.

Abstract

Objective

To investigate shoulder pain and disability and quality of life (QoL) over 12 months in patients with diabetes and in a non-diabetic control group.

Methods

Cross-sectional study with 12-month follow-up in diabetic (n = 189) and medical (n = 99) outpatients employing the Shoulder Pain and Disability Index (SPADI) and SF-36 version 2. The results were analysed using restricted maximum likelihood (REML).

Results

The prevalence of current shoulder symptoms was 35% in diabetics and 17% in controls. Shoulder pain and disability as calculated by the SPADI were independently associated with diabetes (vs controls) and current shoulder symptoms, and worsened over 12 months. Disability scores worsened with age in diabetics, and pain scores were higher in diabetics than controls among patients reporting current shoulder symptoms.
Poor physical QoL worsened over time in patients with diabetes and was worse in patients with current shoulder symptoms, whether they had diabetes or not. Mental QoL was worse only in patients with current shoulder symptoms.

Conclusions

Shoulder symptoms are common, affecting 1 in every 3 diabetic patients and 1 in every 6 control patients. In this study shoulder pain, disability and physical QoL were poorer among diabetics and patients reporting current shoulder symptoms, and worsened over time. Mental QoL was worse in patients reporting current shoulder symptoms and was independent of diabetes. Therefore, shoulder symptoms are common, are associated with poor physical and mental QoL in addition to shoulder pain and disability, and are worse in patients with diabetes, even in a population with relatively moderate shoulder pain and disability.

Key words

Diabetes mellitus/complications, shoulders, musculoskeletal, quality of life, Shoulder Pain and Disability Index.

Laura L. Laslett, MMedSc; Simon P. Burnet, FRACP; Janine A. Jones, BCom, BEco (Hons); Christine L. Redmond, MAppSc (Physiotherapy); Julian D. McNeil, PhD, FRACP.

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Please address correspondence to: Laura Laslett (laura.laslett@adelaide.edu.au).

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Introduction

Diabetes is a common, chronic condition that is associated with a poor quality of life (1, 2) and is a leading underlying cause of death (3), Musculoskeletal conditions are common in diabetics (4-6), but are less well-known and less thoroughly studied than other diabetic complications. Shoulder symptoms are common in patients with diabetes, with earlier estimates from our centre of 27% having current shoulder pain and 44% having shoulder pain in the preceding 6 months (7). The prevalence of one specific pathology – adhesive capsulitis or frozen shoulder – is estimated to be 11-30% in people with diabetes and 0-10% in people without diabetes (5, 8-12), with the highest prevalence observed in studies using patient groups sourced from older, more acutely ill patients. The prevalence of diabetes is also higher in patients with shoulder symptoms than in controls (13). Shoulder complaints are typically chronic in nature, with 41-50% of patients still reporting shoulder symptoms 1-3 years later (14-17). In addition, they are more resistant to treatment in patients with diabetes (18, 19) and in many cases are associated with disability (17), and therefore psychological distress (20).

The aim of this study was to quantify pain, disability and quality of life in a group of Australian patients attending a diabetic outpatient clinic and to compare them to a group of medical outpatients who were as similar as possible to the diabetic outpatients in the hospital setting. We envisaged that this would assist in clarifying the contributory role of diabetes in shoulder pain and disability and quality of life.

Materials and methods

We conducted a cross-sectional study with follow-up at 6 months and 12 months. Ethical approval in accordance with the Declaration of Helsinki was obtained from Modbury Public Hospital's (MPH) Research and Ethics Committee. All participants provided their informed consent.

Study population

Diabetic patients were recruited from the diabetic outpatient clinic and control patients from a hospital-based control group over the period 2002-2003. Consecutive patients with and without shoulder symptoms were approached in both outpatient settings. Control patients with previously diagnosed diabetes were excluded. Case notes were reviewed to confirm the diagnosis of diabetes in patients attending the diabetic clinic.

Data collection

Baseline demographic information and information on shoulder symptoms were collected during the course of an outpatient clinic visit. Diabetic complications were assessed by the collection of HbA1c and serum creatinine results from the case notes. Self-reported eye laser surgery was also used as a proxy marker for diabetic retinopathy. Data on age and gender was collected in patients who did not consent to complete the study questionnaires. All consenting patients were given the Shoulder Pain and Disability (SPADI) questionnaires during the baseline visit. A subset of these patients also received the SF-36. Patients who completed the baseline questionnaires were sent follow-up questionnaires at 6 and 12 months by post. The order in which the SPADI questionnaires were compiled for completion was varied so as to ensure that patients did not always answer questions on the same shoulder first. Recruiting was carried out by one investigator (LLL). Patients who had difficulty with the questionnaires due to problems with literacy, language, or numbers were assisted by family or friends. Interpreters were used for the initial interviews with patients whose English was limited. Diabetic patients with current shoulder symptoms were offered an assessment by a rheumatologist (SPB) to arrive at a clinical diagnosis of their symptoms.

Instrument descriptions

Pain is the most prominent symptom in people with musculoskeletal disorders (21) and we therefore chose a shoulder-specific questionnaire that includes a measurement of pain associated with shoulder symptoms, in addition to the

SF-36v2 which measures quality of life in general.

Shoulder-specific questionnaire
The Shoulder Pain and Disability Index is a 13-item, self-administered instrument that measures functional status relating to the shoulder region. It has good internal consistency, test-retest reliability, and criterion validity (22), it can detect change over time, and it accurately discriminates between patients who have improved or worsened (23). The visual analogue scale version is scored 0-100, with the anchors of 0 being "no difficulty" and 100 "so difficult it required help". Higher scores indicate worse function. There are two subscales: pain (5 items) and disability (8 items). Scores were generated for each shoulder separately. There were no significant differences between the left and right shoulders on the pain or disability scales; therefore the scores for the two shoulders were averaged to determine the final scores.

General quality of life questionnaire
The SF-36 Health Survey (IQOLA SF-36 Australia (English) Standard Version 2.0) (SF-36v2) (24) is a 36-item, self-administered generic measure of health status with recall over the last month. It has four scales each to describe the physical and mental quality of life and two summary measures: the Physical Component Summary Score (PCS) and the Mental Component Summary Score (MCS). Responses were recorded, transformed into 0-100 scales, and then standardised to a "norm-based" score using population means to create a Z distribution with a mean of 50 and a standard deviation of 10 (25). Scores above 50 indicate an above average quality of life (QoL) and scores below 50 indicate a below average QoL. Only the PCS and MCS are presented in this report. A subset of patients completed both the SPADI and the SF-36v2 (24).

Statistical analysis
Restricted maximum likelihood (REML) was used for the statistical analysis. Tests of effects were performed using the Wald test statistic. A significant result ($\alpha = 0.05$ or the 5% level) indicated that at least two means of the categorical variable were significantly different on average. If the categorical variable had more than two levels, a least significant difference test (LSD) was performed. Significant results were obtained if the absolute difference between the means was greater than the LSD. All analyses were based on intent to treat.
The REML assumptions of normally distributed residuals and constant variance were checked with diagnostic plots and were satisfied. Box's symmetry test was performed on each outcome to assess whether the assumption of uniform variances and co-variances between the time periods required for compound symmetry was satisfied. None of the SF-36v2 outcomes rejected the null hypothesis of equal covariance, whereas all of the SPADI outcomes did. Therefore the SF-36 outcomes were analysed using REML assuming uniform variances and co-variance, while the SPADI outcomes were all analysed using REML, specifying non-uniform variances and co-variances between time points.
Data was entered into Microsoft Access 2000 (Microsoft Corporation, USA) and statistical analysis was undertaken using Stata 8 (StataCorp, USA). REML analyses were conducted using GenStat 7 (VSN International Ltd, UK).

Results

Baseline cross-sectional data
Comparison between diabetic and control outpatients. Table I shows that the diabetic outpatients were older than the control patients; therefore, the analyses were age-adjusted where appropriate. Among the participants with no current shoulder symptoms, the BMI was significantly higher in diabetics than controls; among the participants with current shoulder symptoms the differences in BMI were not statistically significant. In the diabetic group there were more males than females with no current shoulder symptoms, although the significance of this is unclear. Among the diabetic outpatients, those with shoulder symptoms were more likely to be women. In the control group the proportion of men and women with and without shoulder symptoms was similar. In the diabetic group the number of males and females was equal, whereas there was a higher F/M ratio in the control group (data not shown).

Differences between diabetic patients with and without current shoulder symptoms. Table II shows that among diabetic outpatients, there were no differences in the duration or type of diabetes, or in the method of treatment among patients with type 2 diabetes.

Table I. Demographic data[#] at baseline by current shoulder symptoms.

	Current shoulder symptoms						No current shoulder symptoms					
	Diabetic patients (N = 67)			Control patients (N = 17)			Diabetic patients (N = 122)			Control patients (N = 82)		
Variable	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Age (years)*	62	12	36-83	50	16	20-76	62	15	20 - 83	55	17	18-93
BMI*	30	5	20-45	27	5	18-36	30	6	19 - 52	26	4	15-41
Gender* (% Female)	60%			65%			37%			62%		

*Significant differences at the 5% level
[#]consenters only

Table II. Baseline data[#] on diabetic patients by current shoulder symptoms.

Variable	Current shoulder symptoms (N = 67)			No current shoulder symptoms (N = 122)		
	Mean	SD	Range	Mean	SD	Range
Diabetes duration (years)	15	11	0.15 - 50	14	13	0.4 - 65
Patients with Type 2 diabetes (%)	79%			76%		
Treatment type: (Type 2's only)						
Diet only	8%			12%		
Tablets	58%			54%		
Insulin	34%			33%		
HbA1c (%)	8.3	1.4	5.7-12.8	8.1	1.6	5.1-13.2
Normal	3%			3%		
Good control	16%			20%		
Moderate control	46%			51%		
Poor control	34%			25%		
Serum creatinine (mmol/L)	0.092	0.05	0.05-0.49	0.1	0.06	0.04-0.61
Eye laser surgery for retinopathy	21%			15%		

*Significant difference at the 5% level.
between diabetic patients with symptomatic and non-symptomatic shoulders.
between diabetic patients and control patients with non-symptomatic shoulders.
[#]consenters only.

Table III. Duration and prevalence of shoulder symptoms.

	Diabetic patients				Control patients			
	N	%	Median duration (years)	Min-max (years)	N	%	Median duration (years)	Min-max (years)
Current shoulder symptoms								
Either shoulder*	67	35%	1.5	0.005 - 26	17	17%	3	0-49
Unilateral	39	58%			9	53%		
Left	23		3	0-10	5		3	0.25 - 28
Right	16		1.3	0.25-28	4		5.25	0.4 - 35
Bilateral	28	42%			8	47%		
Left			5	0.16 - 25			5.75	0-49
Right			5	0.16 - 30			10.5	0-49
Past shoulder symptoms	18	10%			13	13%		
Ever had shoulder symptoms*	85	45%			30	30%		

*Significant difference between diabetic and control patients at the 5% level.

There was a trend towards larger numbers of patients whose diabetes was under moderate to poor control (HbA1c) among patients with current shoulder symptoms, but this trend was not statistically significant. There was no difference between the groups in two measures of diabetic complications – kidney damage (serum creatinine) and retinopathy (eye laser surgery).

Characteristics of patients who refused or withdrew consent.

Among the diabetic outpatients, non-consenters (n = 9) were significantly older (mean age 70 *vs* 62 years). Those who withdrew consent (n = 32) were significantly older at the 10% level (mean age 67 *vs* 60 years) and had a longer duration of diabetes (17 *vs* 13 years). There were no differences in BMI, HbA1c, or gender.

Among the control patients, there were no differences at the 10% level between non-consenters (n = 9) and consenters in age, BMI or gender. All the patients who withdrew their consent during the course of the study (n = 6) were female (6 *vs* 0), but they were not significantly different in BMI or age.

Most of the consenting participants also completed the SPADI questionnaire. More diabetics completed the SPADI at baseline than the controls (94 vs 68%, $p < 0.05$), and most patients who completed the baseline SPADI also completed the 12-month follow-up questionnaire (63 and 75%, $p = 0.08$). There was a trend to the control patients being more likely to post back their baseline questionnaires if they had current shoulder symptoms, but this did not reach statistical significance (82% vs 65%, $p = 0.12$).

Duration and prevalence of shoulder symptoms. Table III shows that among diabetic outpatients, 35% currently had shoulder symptoms and 10% had previously had shoulder symptoms, giving an overall prevalence of ever having shoulder symptoms of 45%. Control patients had a lower prevalence of current symptoms, current unilateral symptoms, or ever having had symptoms, but there were no significant differences in the proportions of patients with past symptoms or bilateral symptoms.

Diagnosis of shoulder pathology. Diabetic patients with current shoulder symptoms were invited to have their shoulders examined by a rheumatologist (SPB). Forty patients (60%) consented, and a total of 33 symptomatic right shoulders and 29 symptomatic left shoulders were detected. Abnormality of the rotator cuff was the most common primary diagnosis, being present in 31/40 of patients (70% of left, 72% of right shoulders). The next most common was frozen shoulder, present in 8/40 patients (18% of the left and 10% of the right shoulders). Patients who agreed to the shoulder examination had a shorter duration of diabetes (12 vs 17 years, $p = 0.09$), and higher baseline pain scores (43 *vs* 32/100, $p = 0.08$). There were no other differences in age, gender, BMI or baseline disability score at the 10% level between the diabetic patients with current shoulder symptoms who did and those who did not consent to further shoulder examination. If we apply these prevalence estimates to the diabetic sample as a whole, we estimate that the prevalence of adhesive capsulitis was 7.0% and the prevalence of rotator cuff pathology was 35.6%.

Diabetic outpatients: Differences between patients with type 1 and 2 diabetes. The prevalence of current shoulder symptoms was similar in patients

Table IV. Wald test probability values for the effect of age, diabetes status, current shoulder symptoms and time on SPADI and SF-36 outcomes.

Effect	Shoulder Pain and Disability Index		Quality of life (SF-36)	
	Pain score	Disability score	Physical QoL (PCS)	Mental QoL (MCS)
Age[¥]	0.14	<.01*	<.01*	0.01*
Age x diabetes status[§]	0.19	0.05	0.36	0.37
Diabetes status (diabetic or control)	<.01*	0.04*	NA	0.24
Diabetes status x time[§]	0.11	0.51	0.02*	0.68
Diabetes status x current shoulder symptoms[§]	0.05	0.16	0.88	0.34
Diabetes status x current shoulder symptoms x time[§]	0.56	0.71	0.82	0.84
Current shoulder symptoms	<.01*	<.01*	<.01*	0.01*
Time (baseline, six month, twelve month follow up)	<.01*	<.01*	NA	0.18
Current shoulder symptoms x time[§]	0.15	0.46	0.91	0.14

*Wald test significant at the 5% level.
[§] Interaction terms – where these are significant there exists significant interaction between the stated variables.
[¥] Where age is significant, the remaining effects have been adjusted for age.
The interaction between diabetes and time in PCS is highly significant; therefore the main effects should not be considered separately.

Table V. Difference in predicted mean SPADI and SF-36 scores due to diabetes, current shoulder symptoms and elapsing time.

Variable		Shoulder Pain and Disability Index		Quality of life (SF-36)	
		Pain score	Disability score	Physical QoL (PCS)	Mental QoL (MCS)
Diabetes status	Control	22.14 (2.18)	19.37 (2.34)		
	Diabetes	26.27 (1.39)	24.86 (1.43)		
Current shoulder symptoms	No symptoms	9.44 (1.45)	10.19 (1.50)	43.27 (0.94)	47.56 (1.18)
	Symptoms	38.97 (2.09)	34.03 (2.22)	37.83 (1.65)	42.10 (1.68)
Time	Baseline	18.89 (1.37)	18.60 (1.42)		
	6 months	23.78 (1.79)	23.81 (1.81)		
	12 months	26.88 (1.88)	23.92 (1.69)		

[§]did not reach statistical significance.
The interaction between diabetes and time in PCS is highly significant (Table IV); therefore the main effects should not be considered separately.
Data is presented as mean (standard deviation).

with type 1 (33%) and type 2 diabetes (37%). However, type 1 and 2 diabetes showed different patterns for the prevalence of current shoulder symptoms by age ($p < 0.05$), with current symptoms being more common among type 1 diabetics in the 25-54 year age range and more common among type 2 diabetics in patients aged over 55 years.The diagnosis of adhesive capsulitis was more common in patients with type 1 (4/8) compared to type 2 diabetes (4/32), ($p < 0.05$), but there were no differences between type 1 and type 2 diabetes in the other diagnoses, including rotator cuff disease. In comparison to patients with type 2 diabetes, patients with type 1 diabetes were younger (51 *vs* 64 years), had a lower body mass index (27 vs 30.5), a longer duration of diabetes (21 vs 12 years), poorer glycaemic control (HbA1C 8.8% *vs* 8.1%), and a higher incidence of diabetic retinopathy (40% **vs** 11%, as measured by patient recall of laser eye surgery), but serum creatinine levels were similar in the two groups.

Shoulder pain and disability index

Table IV shows that diabetes status (i.e., whether the patient was from the diabetic or control group), current shoulder symptoms, and time had significant effects on SPADI outcomes. The predicted means based on these effects are shown in Table V. Patients with diabetes and patients with current shoulder symptoms had higher SPADI scores and hence more pain and disability than controls or patients without current shoulder symptoms. Pain scores increased over the 6 and 12 months of follow-up. Disability scores worsened in the first 6 months, but remained stable from 6 to 12 months.

The interaction between age and diabetes on the disability score and between diabetes and current shoulder symptoms on the pain score were borderline (significant at the 10% level but not at the 5% level); hence there is evidence that among patients with sore shoulders, diabetics have higher pain scores and older diabetics have more shoulder difficulty than younger diabetics. Since no other interaction terms were significant, the main effects were additive. In other words, the presence of diabetes or shoulder symptoms independently contribute to increases in shoulder pain and disability.

Most patients had no clinically important change (± 10/100) (23) between baseline and the 12-month follow-up in their pain or disability scores, with 57% of diabetics experiencing no change in their pain score and 60% no change in their disability score. Approximately one-third experienced more pain (38%) and more disability (32%), while only 5% had improved pain and 7% had improved disability. Results were similar for the control patients, with 79% experiencing no change in their pain score and 89% no change in their disability score, 21% and 11% experiencing worse pain and disability scores, and only 5% and 0% improving.

In diabetic patients, changing shoulder pain and disability were positively correlated with glycated haemoglobin (HbA1c), but this reached statistical significance only in patients with current shoulder symptoms for the change in pain score over 12 months ($p = 0.05$) (Fig. 1).

Quality of life (SF-36)

Table IV presents the probability values of each effect on the higher order scales of the SF-36 (PCS and MCS). Age had a significant effect at the 5%

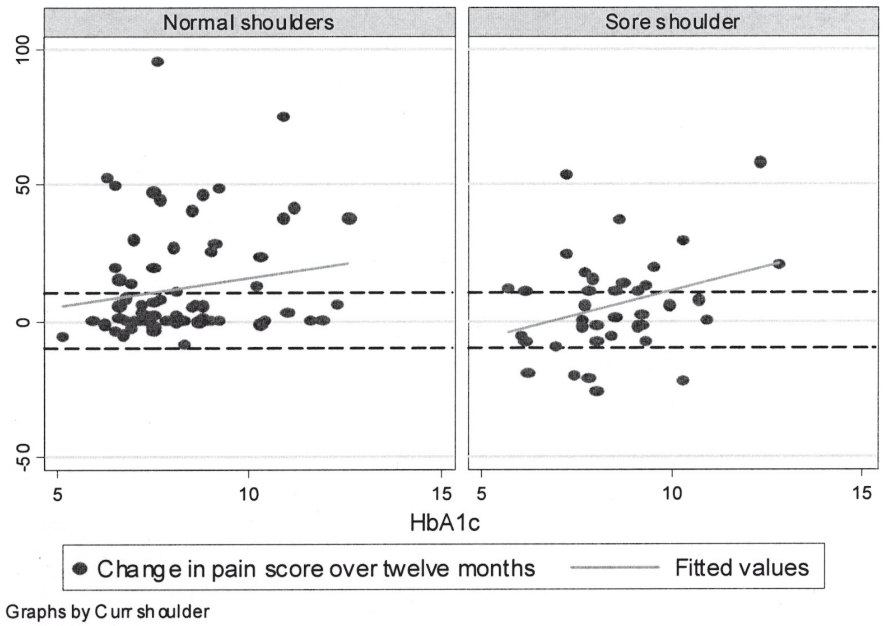

Fig. 1. Change in pain score over twelve months by HbA1c*.
*Dashed line indicates minimum clinically significant change (± 10).

level on both PCS and MCS. Therefore, age was used as a covariate to adjust the means prior to testing the diabetes, current shoulder and time effects. Patients with current shoulder symptoms fared significantly worse (approximately half a standard deviation) on both PCS and MCS. The age-adjusted means and standard errors are listed in Table V. There was a significant interaction over time between the diabetes status and PCS, with diabetic patients worsening over time [with means and standard errors of 41.10 (1.16), 37.77 (1.24) and 36.25 (1.24) between baseline, 6 and 12 months] and control patients remaining the same [43.16 (1.31), 42.67 (1.68), 42.46 (1.39)]. Therefore the main effects cannot be considered separately. No other interaction terms were significant; shoulder symptoms in patients had an independent negative effect on their mental and physical quality of life, while diabetic patients experienced significant worsening of physical functioning over the 12 months of follow-up compared to the controls, whose physical functioning was still below the population mean of 50, but remained stable over 12 months of follow-up.

Methods used to treat shoulder dysfunction

The majority of patients (78% of diabetic patients and 76% of control patients) with current shoulder symptoms had tried at least one treatment. The most common were analgesics (37% and 18%), physiotherapy (36% and 47%), and corticosteroid injections (18% and 24%). Seven percent and 12% had undergone surgery. Of those patients who had ever had sore shoulders, 85% of diabetics and 83% of controls had tried at least one treatment. There were no significant differences in the treatments used to relieve current or past shoulder symptoms between diabetic and control patients.

Discussion

This is the first published Australian study to investigate shoulder dysfunction over time in patients with diabetes versus control patients. Our data shows that shoulder symptoms are very common in the hospital outpatient setting in both diabetic and non-diabetic patients. Therefore shoulder symptoms are common in an aging population and particularly in those with other illnesses.

The prevalence of shoulder pain or disability in our cohort of diabetic patients (35%) is higher than the reported prevalence of 14% in the general population (26) and 16% in a general practice sample (27). Our estimate of the prevalence of frozen shoulder (7%) is at the conservative end of Bridgman's report in diabetic outpatients of approximately 10% (10). It is possible that there was a left censorship bias in our study, in that patients with shoulder pain may have been more likely to be captured and thus artificially inflate the prevalence of shoulder pain. Based on the differences between diabetic patients who did and did not consent to undergo a shoulder examination, our figures may underestimate shoulder pathologies in patients with a longer duration of diabetes who are not experiencing as much shoulder pain (as in the case of patients with adhesive capsulitis who have moved into the less painful resolution stage), since the patients who agreed to a shoulder examination had a shorter disease duration and higher baseline pain scores.

The large burden of degenerative disease is confirmed by previous studies reporting rotator cuff lesions to be the most common of shoulder pathologies (28, 29), with an estimated incidence of 8.1 per thousand in a survey conducted in a primary care setting in the UK (29). While the significant impact of degenerative disease of the shoulder in our diabetic cohort is not surprising given its high prevalence in the general population, the presence of degenerative disease is likely to pose a greater burden in patients with diabetes. Surgery to repair rotator cuffs has been reported to be less successful and to have higher complication rates in diabetic patients (19), which is consistent with the poorer outcome in other surgical interventions for shoulder symptoms in patients with diabetes (30, 31).

There appears to be no consensus in the literature as to what constitutes an appropriate control group with which to compare diabetic patients in order to investigate differences in the prevalence of shoulder symptoms. Previous studies have recruited controls from a wide range of sources including other outpatient departments (10), inpatients (12), hospital staff and persons accompanying diabetic patients to appointments (11), and patients from primary care (5). We used a control group of ambulatory outpatients in a hospital procedure clinic, as we felt these were as similar as possible to the diabetic

outpatients without having diabetes. Some of the control groups used in other studies may have under- or over-estimated the prevalence of shoulder symptoms, shoulder pain and disability, and quality of life due to their being compared with low prevalence (5) or high prevalence groups (12). Some of the control groups were age-and/or gender-matched (10, 12) while some were not (5, 32). We chose not to match for age or gender in order to allow us to investigate the effect of age on shoulder pain and disability or quality of life. The large difference in age between diabetic and control patients was unexpected; retrospective matching by age and/or gender would have reduced the size of the sample and perhaps would have increased the time taken to recruit an adequate number of participants. It would have been almost impossible to match on BMI given the large proportion of diabetic subjects in the obese and morbidly obese categories compared to the control group (26% and 18% compared to 11% and 5%).

We did not find any difference in the prevalence of current shoulder symptoms between the two main types of diabetes. This could be due to the differing epidemiological patterns of shoulder symptoms in patients with type 1 and type 2 diabetes, such as the higher prevalence of frozen shoulder in patients with type 2 diabetes.

Our results shows that shoulder pain and disability as measured by the SPADI was worse in diabetics compared to controls. In diabetic patients reporting shoulder symptoms compared to those not reporting shoulder symptoms, the pain score worsened over the entire 12 months and disability worsened over the first 6 months, but stabilised over 6-12 months. There is evidence that among patients with shoulder symptoms, diabetics report more pain and diabetics become more disabled with age. The worsening of the pain and disability scores from baseline to 6 months may reflect a real decline over time, the slowness of which may be due to long-standing symptoms or degenerative conditions.

After adjustment for age, patients with current shoulder symptoms have worse physical and mental QoL as measured by the SF-36v2. Physical QoL worsened over the year of follow-up in patients with diabetes but remained stable in control patients. There was no corresponding relationship between diabetes and time in the mental quality of life. Therefore it can be concluded that diabetics do experience a worsening of physical QoL over time compared to controls and this is independent of whether patients currently have shoulder problems or not. This finding is even more important as diabetics already have a physical and mental quality of life that is below population norms (1). Shoulder symptoms may form part of greater overall physical limitations measured by physical QoL, in which physical deconditioning may also play a part.

Both diabetic and control patients accessed a wide variety of treatments for shoulder symptoms, of which the most common were physiotherapy, simple analgesics and corticosteroid injections. Few patients sought more invasive interventions. This is consistent with the relatively modest pain and disability scores of 35 to 40/100 in patients with current shoulder symptoms compared to 50 to 65/100 in studies of unselected patients with shoulder pain seeking treatment (23, 33). Despite the numerous treatments attempted, for most of our patients shoulder pain and disability either showed no change or worsened over 12 months.

Due to the low literacy and arithmetic capabilities of these patients (especially the diabetics), more patients than expected required additional assistance with the SPADI questionnaire. We used the original VAS with visual anchors (22), but would recommend administering the SPADI with integer scales (23) and a more visual format, such as placing the numbers 0-10 on a ten-step staircase.

We also suspect that analgesic use among diabetics may be under-reported (and unrelated to recall), as we discovered during recruitment that patients who claimed not to have had any treatment for shoulder symptoms would report that they had taken analgesics if they were specifically asked about the use of particular drugs such as paracetamol.

We did not collect information on exercise habits or occupation. Some information on exercise tolerance is included in the SF-36, but otherwise if the amounts or types of exercise (or indeed, any other diabetes-related behaviour) was different between diabetic patients and controls, and if this factor was associated with the prevalence of shoulder symptoms, we would probably not have detected these effects. A large proportion of the diabetic population was either retired or living on disability pensions and therefore questions relating to occupation would not have been useful. Furthermore, given the retrospective nature of the questioning and the inability to verify any facts objectively by other means, the likelihood is increased of recall bias by the differential recall of occupational exposure that may have predisposed individuals to work-related shoulder injuries between patients with and without current shoulder symptoms. We also cannot discount the effect of other factors not included in the analysis on shoulder pain, shoulder disability and quality of life in this population.

Shoulder symptoms are very common, affecting 1 in every 3 diabetic patients and 1 in every 6 control patients interviewed in our sample. Shoulder pain and difficulty are worse in patients reporting current shoulder symptoms and in patients with diabetes, and worsens over time. Diabetes, shoulder symptoms, and elapsing time contribute to shoulder pain and disability as measured by the SPADI. Following adjustment for age, the physical quality of life worsened over time in patients with diabetes and was worse in patients with current shoulder symptoms regardless of whether they had diabetes or not. Mental quality of life was worse only in patients with current shoulder symptoms.

In conclusion, shoulder symptoms are associated with poor physical and mental quality of life in addition to shoulder pain and disability, even in patients with relatively moderate shoulder pain and disability who already have poorer quality of life than the general population.

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