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## Original Article

# Prevalence and Risk Factors of Five Most Common Upper Extremity Disorders in Diabetics

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## ABSTRACT

**Background:** In addition to macrovascular and along with other microvascular complications, diabetic patients suffer from some common musculoskeletal complications. The aim of this study was to assess the prevalence of five musculoskeletal disorders of upper extremity including shoulder capsulitis (SC), limited joint mobility (LJM), Dupuytren's contracture (DC), carpal tunnel syndrome (CTS), and trigger finger (TF) as well as identify their related risk factors in diabetic patients.

**Methods:** We recruited 432 types 1 or 2 diabetic patients and evaluated them for the presence of musculoskeletal disorders and their-related risk factors in 2012-13. The patients were examined by an endocrinologist and then suspected subjects evaluated by a rheumatologist for defining final diagnosis.

**Results:** The most prevalent musculoskeletal disorder of upper extremity was SC (8.79%), followed by CTS (8.56%), LJM (6.94%), DC (7.4%), and TF (6.71%). Advanced age, female sex, smoking, and duration of diabetes were associated with the appearance of SC; female sex and duration of diabetes with CTS; advanced age and smoking with LJM; advanced age, duration of diabetes and history of foot ulcer with DC; and history of laser photocoagulation was associated with TF.

**Conclusions:** The results show lower prevalence of upper musculoskeletal disorders and different associated risk factors in our diabetic population in comparison with previous studies on other populations.

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## Introduction

Diabetes mellitus is one of the most common metabolic disorders in both developing and developed countries. In addition to macrovascular and along with other microvascular complications, diabetic patients might be involved with some musculoskeletal complications. Damage to vessels and nerves, protein glycosylation, and increased collagen in the skin and musculoskeletal connective tissues are some factors thought to contribute in the development of musculoskeletal disorders in diabetics<sup>1</sup>.

Shoulder capsulitis (SC), limited joint mobility (LJM), Dupuytren's contracture (DC), carpal tunnel syndrome (CTS), and trigger finger (TF) are the most prevalent musculoskeletal disorders of upper extremity leading pain, discomfort, limited motion, and poor quality of life in diabetic patients<sup>2</sup>.

The prevalence of these disorders in diabetics is different compared with general population. For example 8-50% for LJM among diabetics, while only 4-20% among individuals

without diabetes<sup>3</sup> or 5-36% for TF in patients with diabetes as compared with 2% in the general population<sup>4</sup>. In addition the prevalence of these disorders is different from each other and in different populations. These complications have generally been under recognized and poorly treated, compared to the other microvascular complications of diabetes and lead to considerable morbidity<sup>3</sup>.

Since prevention and treatment of the complications of chronic diseases depends on understanding with their prevalence and risk factors, this study aimed to assess the prevalence of these five musculoskeletal disorders and their related risk factors in a population of diabetic patients in Hamadan Province, West of Iran.

## Methods

### Study population

This was a cross sectional study conducted at the Hamadan Diabetes Center, Hamadan, Iran. This center covers the

majority of the diabetic population in Hamadan Province with different socioeconomic status. From September 2012 to February 2013, by convenience sampling method, 432 patients were recruited with the diagnosis of type 1 or 2 diabetes mellitus according to the American Diabetes Association (ADA) criteria for diabetes. The patients were given self-administered questionnaires about their medical history including general characteristics, general risk factors: current smoking history (patients regularly smoke a tobacco product/products one or more times per day or have smoked in the 30 days prior to admission)<sup>5</sup>, hypertension (systolic blood pressure  $\geq 140$  mmHg and/or diastolic  $\geq 90$  mmHg and/or on antihypertensive treatment)<sup>6</sup>, diabetes mellitus, duration of diabetes, type of medication, and history of foot ulcer and laser photocoagulation. Height, weight, body mass index (measured by the weight in kg divided by the square of the height in meters), and both systolic and diastolic blood pressures were recorded thereafter. At the beginning of assessment, five upper musculoskeletal disorders were evaluated by an endocrinologist, and then suspected cases were examined by a rheumatologist for definite final diagnosis.

The study was approved by the Ethical Committee of Hamadan University of Medical Sciences and all participants completed informed consent.

### Criteria for diagnosis

The criteria for diagnosing the target musculoskeletal disorders were as follows: SC (shoulder pain for no less than one month with difficulty in laying on the affected shoulder and limited active and passive shoulder joint movements in at least three planes)<sup>7</sup>; CTS (pain or paresthesia in the thumb, index, middle, and lateral half of the ring fingers, typically provoked at night and positive Tinel's sign and Palen's test)<sup>2,8</sup>; LJM (limited joint mobility: Inability to extend one or more interphalangeal or metacarpophalangeal joints to 0° on each hand (prayer's sign))<sup>9</sup>; DC (one or more of the following four features on examination: a palmar or digital nodule, tethering of the palmar or digital skin, a pretendinous band and a digital flexion contracture)<sup>10</sup>; and TF (palpating a nodule or thickened flexor tendon with locking happening in extension and flexion of any fingers)<sup>11</sup>.

### Statistical analysis

We used *t*-test for analyzing the data to comparing the quantitative variables, while qualitative variables were compared with chi-square test or Fisher's exact test if required. Multivariate logistic regression analysis was used to identify risk factors associated with upper musculoskeletal disorders with the presence of baseline variables as probable confounders. In Forward stepwise method, the significance of variables was evaluated by Wald test. Exit and entrance of the variables to the model were in the level of  $\alpha=0.05$ .  $P<0.05$  was considered statistically significant. All statistical analyses were performed using SPSS version 16.0 for Windows.

## Results

General characteristics and clinical data of the study population are presented in Table 1. A total of 432 patients (298 females and 134 males) were included into the study. Sixty three patients (14.6%) suffered from type 1 and 369 patients (85.4%) from type 2 of diabetes mellitus, respectively. The

most prevalent musculoskeletal disorder of upper extremity was SC (8.79%), followed by CTS (8.56%), LJM (6.94%), DC (7.4%), and TF (6.71%). Fifty five patients (12.7%) had two and more of these complications. The most frequent combination was the combination of SC and CTS (12 patients) and then LJM and DC (seven patients).

**Table1:** General characteristics of the study population

Characteristics	Female (n=298)	Male (n=134)	P value
Age (yr), mean $\pm$ SD	54.0 $\pm$ 13.2	51.6 $\pm$ 16.5	0.064
Duration of diabetes(yr), mean $\pm$ SD	9.1 $\pm$ 7.5	9.5 $\pm$ 7.1	0.569
Body mass index (kg/m <sup>2</sup> ), mean $\pm$ SD	28.6 $\pm$ 4.5	25.9 $\pm$ 4.2	0.001
Type 2 diabetes (%)	261 (88.2)	108 (80.6)	0.037
Positive history of smoking (%)	6 (2.1)	21 (15.9)	0.005
Positive history of hypertension (%)	129 (43.6)	46 (34.3)	0.070
Positive history of insulin therapy (%)	139 (32.3)	54 (40.3)	0.050
Laser photocoagulation (%)	37 (12.5)	17 (12.7)	0.950
Positive history of foot ulcer (%)	30 (10.1)	24 (17.9)	0.024

Comparing the distribution of the risk factors between diabetics with and without five musculoskeletal disorders (Table 2) showed that some risk variables such as advanced age, longer duration of diabetes, and positive history of hypertension were more prevalent in the patients suffered from these musculoskeletal disorders compared to those without these phenomena.

According to the multivariable logistic regression analysis (Table 3), advanced age, female sex, smoking, and duration of diabetes were associated with the appearance of SC; female sex and duration of diabetes with CTS; advanced age and smoking with LJM; advanced age, duration of diabetes and history of foot ulcer with DC; and history of laser photocoagulation was associated with TF.

## Discussion

Overall prevalence of each upper musculoskeletal disorder in our diabetic population was less than 10% and associated risk factors for each disorder were identified to be different from each other.

Prevalence of these five disorders was reported very different in the previous studies.

In India a study reported the prevalence as follows: LJM: 29%, SC: 18%, TF: 7%, CTS: 5%<sup>12</sup>. Prevalence of SC in our study estimated as 8.79% that was lower than other studies ranged as 10.8-31.8%<sup>7, 13-16</sup>. In Turkey on 297 type two diabetic patients SC was detected in 29% of the patients associated with the age of patients and the duration of diabetes<sup>13</sup>. Another study reported a prevalence of 18% on 100 Indian diabetic patients<sup>12</sup>. But a recent study in Saudi Arabia reported a prevalence of 6.7% for this complication<sup>17</sup>. In our study, we did not include improved cases of SC that could be result of lower prevalence of SC in our study in comparison with some other observations. In current study, there was significant association between SC and some risk profile such as smoking, female gender, duration of diabetes and age. Association of SC with age and duration of diabetes has been also shown in some studies<sup>13, 18</sup>. Strong association between SC and female gender might be due to higher prevalence of home-based manual works in women. This association is more pronounced in CTS with odds ratio of 5.48 for women compared with men that is concordant with some other surveys<sup>19</sup>.

**Table 2:** Distribution of associated factors in positive and negative cases of five upper musculoskeletal disorders

Characteristics	Shoulder Capsulitis			Carpal Tunnel Syndrome			Trigger Finger			Limited Joint Mobility			Dupuytren's Contracture		
	Pos (38)	Neg (394)	P value	Pos (37)	Neg (395)	P value	Pos (29)	Neg (403)	P value	Pos (30)	Neg (402)	P value	Pos (32)	Neg (400)	P value
Age $\pm$ SD	59.6 $\pm$ 6.9	52.5 $\pm$ 15.3	0.005	58.1 $\pm$ 9.4	52.6 $\pm$ 15.2	0.032	57.1 $\pm$ 11	52.3 $\pm$ 15.1	0.130	60.6 $\pm$ 12	52.5 $\pm$ 14.9	0.004	64.1 $\pm$ 10.1	52.2 $\pm$ 14.8	0.001
Female sex (%)	33 (86.8)	265 (67.2)	0.013	34 (91.8)	262 (66.3)	0.002	22 (75.8)	274 (67.9)	0.408	18 (60.0)	278 (69.1)	0.269	19 (59.3)	277 (69.2)	0.335
Type 2 diabetes (%)	38 (100)	332 (84.2)	0.009	36 (97.2)	332 (84)	0.036	27 (93.1)	341 (84.6)	0.406	28 (93.3)	340 (84.5)	0.013	32 (100)	337 (84.2)	0.013
Duration of diabetes $\pm$ SD	12.7 $\pm$ 6.9	9.0 $\pm$ 7.4	0.003	12.5 $\pm$ 8.0	9 $\pm$ 7.3	0.007	12.5 $\pm$ 8.2	9.1 $\pm$ 7.3	0.021	9.1 $\pm$ 7.4	12.2 $\pm$ 7.3	0.031	15.4 $\pm$ 8.3	8.8 $\pm$ 7.1	0.001
Body mass index $\pm$ SD	28.5 $\pm$ 3.6	27.6 $\pm$ 4.6	0.235	30.7 $\pm$ 3.4	27.4 $\pm$ 4.5	0.001	28.5 $\pm$ 4.2	27.6 $\pm$ 4.5	0.321	27.6 $\pm$ 4.8	27.7 $\pm$ 4.5	0.899	26.1 $\pm$ 4.2	27.8 $\pm$ 4.5	0.039
History of smoking (%)	4 (10.5)	23 (5.8)	0.281	1 (2.7)	26 (6.5)	0.718	1 (3.4)	26 (6.4)	0.999	4 (13.3)	23 (5.7)	0.108	0 (0.0)	27 (6.7)	0.246
History of hypertension (%)	25 (65.7)	153 (38.8)	0.001	22 (59.4)	154 (38.9)	0.015	18 (62)	158 (39.2)	0.016	17 (56.6)	159 (39.5)	0.066	21 (65.6)	155 (38.7)	0.003
Insulin therapy (%)	22 (57.8)	189 (47.9)	0.437	25 (67.5)	184 (46.5)	0.007	19 (65.5)	190 (47.1)	0.003	17 (56.6)	192 (47.7)	0.247	18 (56.2)	191 (47.7)	0.334
History of Laser (%)	6 (15.7)	50 (10.6)	0.452	6 (16.2)	48 (12.1)	0.440	9 (31.0)	45 (11.1)	0.005	3 (10.0)	51 (12.6)	0.999	11 (34.3)	43 (10.7)	0.001
History of foot ulcer (%)	8 (21.0)	50 (10.6)	0.124	7 (18.9)	48 (12.1)	0.297	8 (27.5)	47 (11.6)	0.021	5 (16.6)	50 (12.4)	0.567	10 (31.2)	45 (11.2)	0.003

Data are presented as mean  $\pm$ SD or number (%)

**Table 3:** Multivariable logistic regression analysis of associated risk factors with five upper musculoskeletal disorders

Characteristics	Shoulder Capsulitis OR (95% CI)	Carpal Tunnel Syndrome OR (95% CI)	Limited Joint Mobility OR (95% CI)	Dupuytren's Contracture OR (95% CI)	Trigger Finger OR (95% CI)
Age (yr)	1.03 (1.00, 1.06)	-	1.04 (1.01, 1.08)	1.07 (1.03, 1.10)	-
Female gender	4.44 (1.53, 12.85)	5.63 (1.68, 18.80)	-	-	-
Smoking	4.72 (1.29, 17.24)	-	3.14(0.98, 10-15)	-	-
Duration of diabetes	1.04 (1.00, 1.09)	1.05 (1.01, 1.09)	-	1.06 (1.02, 1.12)	-
Laser photocoagulation	-	-	-	-	3.74 (1.59, 8.75)
History of foot ulcer	-	-	-	2.68 (1.07, 6.72)	-
<b>Hosmer &amp; Lemeshow test</b>					
$\chi^2$ (df)	15.028 (8)	6.297(8)	6.162 (8)	7.756 (8)	0.1 (8)
P value	0.059	0.614	0.629	0.458	<0.001
Correct classification	91.1%	91.4%	93.0%	92.8%	93.2%

Prevalence of CTS has been reported 11-21% in diabetic patients<sup>19-23</sup> that was higher than in our study. A UK study estimated this prevalence as 20% in 96 diabetic patients<sup>24</sup>. But some recent studies reported a lower prevalence<sup>12,17</sup>. For example in the Saudi Arabia authors reported a prevalence of 6.7% for CTS in their population<sup>17</sup>.

The prevalence of LJM in our study was 6.94% while in other studies reported as 8-50%<sup>2</sup>. In some studies, the relationship between LJM and age and duration of diabetes has been also shown<sup>25</sup>.

The prevalence of DD in the literatures has been reported as 4-63%<sup>2,18,21,25,26</sup> and similar to our study has been associated with high age and duration of diabetes.

Prevalence of TF in our study was lower (6.71%) in comparison with other studies reported around 20%<sup>20,21,25,27</sup>.

In overall, while age and duration of diabetes were more associated with these disorders, other factors were different among them and implicated different pathogenic mechanisms in each disorder.

The commonest abnormality in our study was SC while TF had the lowest prevalence. In the case of the diversity of

the prevalence in different studies differences in diagnostic criteria must be taken into consideration. Lower prevalence of musculoskeletal disorders in our study and some recent studies in comparison with previous old studies can be explained by better glycemic control and patients care and decreased manual works in women in developing countries over time.

Our study had some limitations. The first was the lack of data regarding the glycemic control of the patients that could be very helpful in evaluation of the effect of chronic hyperglycemia on development of these disorders. The second limitation was the lack of data about other chronic complications of diabetes such as nephropathy and neuropathy, and the third was that it would be better if the positive cases for CTS evaluated with electrodiagnostic study. Thus, we recommend performing further studies with the focused on other patients' variables such as occupational status, glycemic control, as well as evaluating other chronic complications.

## Conclusions

This study shows lower prevalence of upper musculoskeletal disorders in our diabetic population in comparison with

previous studies and different associated risk factors for each disorder.

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## Conflict of interest statement

Authors had no financial interests related to the material in the manuscript.

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