

## Investigation of Blood Glucose Levels in Patients with Complaint of Shoulder Pain: A Cross-Sectional Study

### Abstract

**Background:** Several studies have reported a potential association between Diabetes Mellitus (DM) and Musculoskeletal (MSK) problems. Moreover, we had a similar observation in our shoulder disorder clinic: many patients presenting to our clinic with shoulder pain were affected with diabetes or had their blood glucose levels in the prediabetic range. Therefore, we aimed to investigate the blood glucose levels of the patients with complaints of shoulder pain to determine the prevalence of diabetes and prediabetes in these patients.

**Methods:** The present cross-sectional study included the patients presenting to a shoulder disorder clinic with shoulder pain from April 2016 to August 2016 (4 months). The patients with shoulder pain due to acute trauma and previous history of fracture or surgery on the affected limb were excluded. All the patients gave informed consent before enrollment. The patients' data, including the demographic and clinical data, were collected in a researcher-made checklist. Data analysis was performed using the SPSS version 24.

**Results:** According to our findings, of a total of 564 patients who met the eligibility criteria and were enrolled in the present study, 18.8% had DM, 25.9% were affected with prediabetes, and 55.3% had a Fasting Blood Sugar (FBS) in the normal range. Moreover, the male participants were more likely to have abnormal FBS levels compared to female participants (54% vs. 33.9%). Also, there was no significant relationship between blood glucose levels and any specific underlying pathology for shoulder pain ( $P=0.191$ ).

**Conclusion:** According to the present study results, it was concluded that the prevalence of DM was higher in the patients with shoulder pain compared to the general population, which necessitates performing further studies in this regard. Moreover, identification of DM risk factors should be emphasized, especially in societies without routine DM screening.

**Keywords:** Diabetes Mellitus, Shoulder Pain, Blood glucose, Correlation study, shoulder

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### Introduction

Several studies have reported a potential association between DM and musculoskeletal complaints<sup>(1-3)</sup>. According to previous studies, the prevalence of shoulder disorders is higher in patients with DM compared to the general population<sup>(3,4)</sup>. Shah et al. reported a higher prevalence (63%) of upper extremity impairments in patients with diabetes<sup>(5)</sup>. Shoulder disorders are particularly prominent among all DM-related musculoskeletal complaints. For example, 11%-30% of the patients with type 2 DM are affected with adhesive capsulitis<sup>(1)</sup>. However, this specific complication of diabetes has received less attention compared to its other complications.

There are several studies investigating musculoskeletal complaints in patients with DM. However, the studies evaluating the glucose levels in the patients presenting with musculoskeletal problems as their first presentation of diabetes are limited<sup>(6,7)</sup>. Therefore, the present cross-sectional study aimed to investigate the blood glucose levels of the patients presenting to our shoulder disorder clinic with complaints of shoulder pain to determine the prevalence of diabetes and prediabetes in these patients. We hope that the present study results help the clinicians in earlier diagnosis and treatment of diabetes in the patients with shoulder pain as their first DM presentation, especially in societies without routine screening for DM.

## Methods

The present cross-sectional study included the patients presenting to a shoulder disorder clinic with shoulder pain from April 2016 to August 2016 (4 months). At first, the underlying pathology of the patients' shoulder pain was diagnosed with comprehensive history taking and physical examination, as well as imaging investigations, such as plain radiography and/or MRI.

ROM of the affected shoulder was measured in Forward Flexion (FF), Internal Rotation (IR), and External Rotation (ER) using a goniometer by a single assessor who was blinded to the study objectives and other data, such as the glucose levels of the patients at the time of presentation. Afterward, the patients were classified into 4 groups based on the ROM. A passive FF of more than 160 °, ER of more than 30 °, and IR of higher than L1 level were considered normal ROM, while the ROM that did not meet these criteria was considered restricted ROM. In addition, the patients were classified into 3 groups based on the FBS levels: the diabetic (FBS>126 mg/dL), prediabetic (100 mg/dL<FBS<125 mg/dL), and normal (FBS<100 mg/dL) groups.

The patients with shoulder pain due to acute trauma and previous history of fracture or surgery on the affected limb were excluded from the study. Moreover, all the patients gave informed consent before enrollment. Data collection was performed using a researcher-made checklist, including the data regarding age, gender, Body Mass Index (BMI), side of affected shoulder (right or left), the related diagnosis, history of DM, Fasting Blood Sugar (FBS) levels, and Range of Motion (ROM) of the affected shoulder.

The present study was approved by the Ethics Committee of the X University of Medical Sciences with the ethics code of X. Also, data analysis was performed using the SPSS version 24. Eventually, comparisons were performed using the statistical tests of one-way Analysis of Variance (ANOVA), cross-tabulation, chi-squared test, and Spearman's correlation.

## Results

According to our findings, a total of 564 patients met the eligibility criteria and were enrolled in the present study. The participants' mean age was 51.24±11.12 years, while most participants were in the age range of 40-60. In addition, 59.6% of the patients were women. Also, male patients were older than female patients. 28.9% of the male patients were older than 60, while only 16.1% of the female patients were older than 60.

Most participants were overweight (25 kg/m<sup>2</sup> < BMI < 30 kg/m<sup>2</sup>, Table 1), and the participants' mean FBS was 108.28 mg/dL, with the range of 69-285 mg/dL. In addition, 18.8% of the patients had DM, 25.9% were affected with prediabetes, and 55.3% had an FBS in the normal range. Also, the male participants were more likely to have abnormal FBS levels compared to female participants (54% vs. 33.9%).

According to our investigations, the prevalence of impaired FBS was increased in older ages. For example, 46% and 30.7% of the patients older than 55 were affected with prediabetes and diabetes, respectively. However, the prevalence of prediabetes and diabetes was 16.9% and 13.5% in those younger than 55, respectively. In addition, 43% of the patients with diabetes (8.8% of the total patients) were newly diagnosed with DM. Also, an overall rate of 73.7% of all the patients with abnormal blood glucose levels (diabetes and prediabetes) were newly diagnosed.

Table 1. Distribution of patients according to body mass index(BMI)

BMI group	Frequency	Percent
<= 19.00	18	3.2%
19.01 – 25.00	144	25.5%
25.01 – 30.00	306	54.3%
> 30.01	96	17%

According to our results, there was no significant relationship between blood

glucose levels and any specific underlying pathology for shoulder pain, including rotator cuff tear, rotator cuff tendinitis, frozen shoulder, glenohumeral joint osteoarthritis, and non-specified shoulder pain ( $P = 0.191$ ). The distribution of the participants based on the related diagnosis is presented in Table 2. Using the Pearson's chi-squared test, we found no significant relationship between the side of the affected shoulder (right or left) and the blood glucose levels of the patients ( $P = 0.092$ ). However, using Spearman's correlation, we found that the patients with normal FBS and abnormal FBS were significantly different in the mean FF ( $P = 0.022$ ) and IR ( $P = 0.038$ ), while there was no significant difference in the ER ( $P = 0.121$ ). In addition, 62% of the patients with adhesive capsulitis had impaired blood glucose, while the prevalence was 66% for the patients with restricted ROM and a diagnosis rather than adhesive capsulitis (Table 3).

Table 2. Distribution of patients with different FBS group according to the diagnosis

		Diagnosis				
		Rotator Cuff Tear	Frozen Shoulder	Rotator Cuff Tendinitis	Glenohumeral DJD	Non-specific
FBS	$\leq 99$	132	18	48	6	48
	100 – 125	102	6	12	0	12
	$>125$	48	24	6	0	12
Total		282	48	66	6	72

Table 3. Prevalence of diabetes and pre diabetes among patients with diagnosis other than adhesive capsulitis according to ROM.

BS status	Normal ROM	Restricted ROM
Normal	198	48
Pre diabetes	54	66
Diabetes	42	30

## Discussion

There are several studies investigating musculoskeletal complaints, such as shoulder pain, in patients with DM. However, to the best of our knowledge, the studies evaluating the prevalence of diabetes in patients presenting with shoulder complaints are limited. Therefore, the present study aimed to investigate the blood glucose levels of patients with complaints of shoulder pain. However, diabetes mellitus is a dynamic topic, with new information being generated frequently<sup>(8)</sup>. Regarding the lack of enough evidence, published guidelines recommend that the decision for FBS assessment should be made regarding the clinical judgment and patient preference<sup>(9)</sup>. In addition, some guidelines recommend routine DM screening for all individuals older than 40<sup>(10)</sup>, while others suggest screening only for patients with DM risk factors<sup>(11)</sup>.

According to previous studies, the prevalence of diabetes and prediabetes in Iran is 5.1%-7.7% and 2.5%-16.8%<sup>(12, 13)</sup>. Also, several studies have reported a higher prevalence of impaired blood glucose (14.4%) in the Iranian population older than 60<sup>(14)</sup>. Therefore, we compared the prevalence of diabetes and prediabetes in the patients with shoulder pain with that of the general population of Iran, indicating a significant difference that grew higher with increased age (Table 4), showing the importance of blood glucose level assessments in the elderly. However, this conclusion cannot be confirmed by the present study results because we had less than 40 of the affected patients in our study. In addition, several studies have proved the association of idiopathic frozen shoulder with diabetes, recommending DM screening for these patients. However, a recently published study did not support this recommendation<sup>(15)</sup>.

Given the present study findings in the patients with shoulder pain, which includes the patients with frozen shoulder and other shoulder pathologies, we agree with the recommendations for DM screening in these patients. Moreover, the high prevalence of impaired glucose metabolism in these

patients necessitates considering shoulder pain as a risk factor for DM. It is especially important for societies without routine screening for DM. As previously mentioned, 73.7% of our participants with abnormal blood glucose levels had not been diagnosed before, while other studies have reported that about one-third of these diabetic patients had not been diagnosed before<sup>(16)</sup>.

According to the previous studies in Iran, about 50% of the patients with diabetes are undiagnosed<sup>(12-14)</sup>. Other studies in different areas of the world have also reported similar rates<sup>(18,19)</sup>. Moreover, these studies recommend DM screening for men with a BMI>25 or hypertension and women with abdominal obesity, as well as all individuals with a family history of DM. Also, some studies have reported a relationship between BMI, shoulder problems, and diabetes<sup>(17)</sup>. Considering all these studies, many risk score models have been developed to increase the coverage of DM diagnosis, including the Finnish Diabetes Risk Score (FINDRISC) and the Colombian Diabetes Risk Score (CoDRISC). Also, the rate of the patients with undiagnosed DM in our study was almost 2

times higher than the previous studies. Therefore, we recommend including shoulder problems in these risk score models as well. While the relationship between diabetes and frozen shoulder is well established, we found a significant relationship between restricted ROM and impaired glucose levels. According to our findings, impaired glucose levels were significantly correlated with restricted FF and IR, while this variable had an insignificant relationship with the restricted ER. However, these findings have some limitations because we assessed the passive ROM in all the patients, regardless of their diagnosis. Moreover, the assessment was subjective, and we used no standard examination protocol to separate the ROM of the glenohumeral joint from the scapulothoracic movements [20]. These findings may help the clinicians dealing with shoulder problems, showing that the patients with DM are more susceptible to shoulder stiffness and restricted ROM due to any shoulder pathology. However, the cross-sectional nature of the present study and the presence of some confounding variables limit the generalization of our results..

Table 4. Comparison of diabetes and pre diabetes in patients with shoulder pain and normal population.

	Study Population	Normal Population
Prevalence of Diabetes	Male :26.3 Female:10.7 Total:18.8%	Male:7.1% Female:8.3% Total:7.7%
Prevalence of Prediabetes	Male:23.7 Female:23.2 Total:25.9%	Male:17.4% Female:16.3% Total:16.8%
Prevalence of diabetes according to the age group		
26-35	0%	3%
36-45	5.8%	6.8%
46-55	19.4%	12.9%
56-65	27.7%	16.8%
Prevalence of pre diabetes according to the age group		
26-35	0%	11.9%
36-45	11.7%	17.3%
46-55	19.4%	21.4%
56-65	44%	24.3%

In general, it is not clear whether the early diagnosis of DM can improve the patients' outcome and future quality of life, while it is highly probable that it can help in better treatment planning. According to our results, shoulder pain can be a potential risk factor for DM. However, further studies with larger sample sizes and control of the confounding variables are needed to confirm our findings

## Conclusion

According to the present study results, it was concluded that the prevalence of DM was higher in the patients with shoulder pain compared to the general population, which necessitates performing further studies in this regard to define shoulder pain as a risk factor for DM, especially in the societies without routine DM screening.

## Declarations

## Ethical Considerations and Participation Consent

The present study was approved by the Research Ethics Committee of the Tehran University of Medical Sciences, and informed consent was obtained from all the participants.

## Consent for Publication

Not applicable

## Availability of Data and Materials

The datasets generated and/or analyzed in the present study are available from the corresponding author on request.

## Competing Interests

The authors declare no competing interests.

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