

## Original Research Article

# Musculoskeletal disorders in patients with diabetes mellitus: a neglected manifestation

Debashish B. Bala<sup>1\*</sup>, Niharika H. Gill<sup>2</sup>

<sup>1</sup>Department of Medicine, K.J. Somaiya Medical College and Hospital, Mumbai, Maharashtra, India

<sup>2</sup>Department of Medicine, Rheumatology Services, K.J. Somaiya Medical College and Hospital, Mumbai, Maharashtra, India

**Received:** 19 March 2026

**Accepted:** 16 April 2026

### \*Correspondence:

Dr. Debashish B. Bala,

E-mail: [baladebashish@gmail.com](mailto:baladebashish@gmail.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### ABSTRACT

**Background:** A variety of musculoskeletal manifestations are commonly related with diabetes mellitus. This study is aimed at evaluating the prevalence and clinical spectrum of musculoskeletal manifestations in patients with diabetes mellitus in KJ Somaiya Hospital, Mumbai.

**Methods:** A tertiary care centre based cross-sectional study was conducted with 82 patients from November 2018 to October 2020 to evaluate the pattern of musculoskeletal (MSK) manifestations in adult diabetic patients and to correlate them with duration and control of diabetes. A detailed history and clinical examination were noted in each patient with particular importance given on musculoskeletal examination and relevant investigations.

**Results:** Most of the patients (35.6%) were aged between 51 and 60 years. Female patients accounted for 63.4% of the study population. 69 (84.2%) patients had HbA1c  $\geq 7$  (poor glycaemic control). The most common musculoskeletal manifestation was Frozen shoulder (18.3%) followed by Osteoarthritis (17.1%).

**Conclusions:** Musculoskeletal manifestations are quite prevalent in patients with diabetes mellitus, and there is significant correlation between development of these manifestations and glycaemic control, age and duration of diabetes of patients.

**Keywords:** Musculoskeletal disorders, Diabetes mellitus, Diabetes complications, Frozen shoulder, Osteoporosis, Osteoarthritis

### INTRODUCTION

A study on global prevalence of diabetes estimated the prevalence of diabetes to be 2.8% in 2000 and 4.4% in 2030 all over the world.<sup>1</sup> Another study by international diabetes federation estimated that 592 million, i.e. 1 in 10 adults, worldwide will have diabetes by 2035.<sup>2</sup> Type 2 diabetes mellitus has contributed disproportionately greater to the increasing prevalence of diabetes globally compared to type 1 diabetes mellitus. In India, there were 74.9 million diabetic patients in 2021, within the age group of 20–79 years, which was projected to increase to 124.9 million by 2045. In 2021, India stood second, only to

China (140.9 millions) in the world with the highest number of people with diabetes mellitus with the United States (17.7 million) in second and third place respectively.<sup>4</sup>

Musculoskeletal (MSK) complications of diabetes mellitus (DM) are the most common endocrine arthropathies. These include adhesive capsulitis (frozen shoulder), carpal tunnel syndrome, Dupuytren's contracture, diabetic cheiroarthropathy, flexor tenosynovitis, osteoporosis and osteoarthritis. Although less valued than the vascular complications, musculoskeletal complications significantly reduce the

patients' quality of life.<sup>5</sup> These manifestations, which are some of the causes of chronic disability in diabetes, have been associated with disease duration, degree of metabolic control, and the presence of end organ damage.

The musculoskeletal disorders in diabetic patients are associated with advanced glycation end products (AGEs).<sup>6</sup> AGEs are heterogeneous molecules derived from non-enzymatic products of the reaction of glucose or other sugar derivatives with proteins or lipids.<sup>6</sup> AGEs accumulate in various neuromusculoskeletal tissues, such as bone, cartilage, muscles, tendons, ligaments, and nerves, and damages the tissue.<sup>6</sup> Early detection of these musculoskeletal complications, and their management helps to significantly reduce pain and morbidity from these complications.

## METHODS

A hospital based cross-sectional study was conducted in the Department of General Medicine, KJ Somaiya Hospital and Research Centre, Sion, Mumbai from November 2018 to October 2020, after due permission from the Institutional Ethics Committee and Review Board and after Written Informed Consent from the patients.

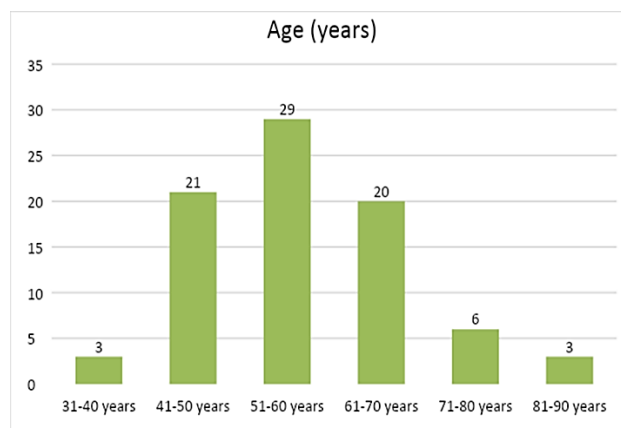
Total 82 serially recorded patients from diabetic outpatient / In-patient department were taken for our study using American Diabetes Association criteria.<sup>6</sup> Sample size was calculated using the formula -  $n = Z^2PQ/E^2$ , where; P - prevalence of musculoskeletal complications in type 2 DM (taken as 30% as per study of Cagliero E7), Q = 1-P, Z- Alpha error (at 95% confidence Interval; Z-1.96), E- Absolute error (taken as 10%). Exclusion criteria included congenital musculoskeletal manifestations, musculoskeletal manifestations due to burns, accidents and trauma and autoinflammatory/ auto-immune conditions such as rheumatoid arthritis, systemic lupus erythematosus and spondyloarthropathy.

A detailed history and clinical examination were noted in each patient with emphasis on musculoskeletal examination and underwent some necessary investigations fasting blood glucose, post prandial blood glucose, glycosylated hemoglobin, serum creatinine, anti-streptolysin O titter, erythrocyte sedimentation rate, C-reactive protein, anti-nuclear antibodies, anti-ds DNA antibodies, X-ray of multiple joint /bones, electrocardiogram and fundus examination. Data were recorded in a pre-designed proforma.

## RESULTS

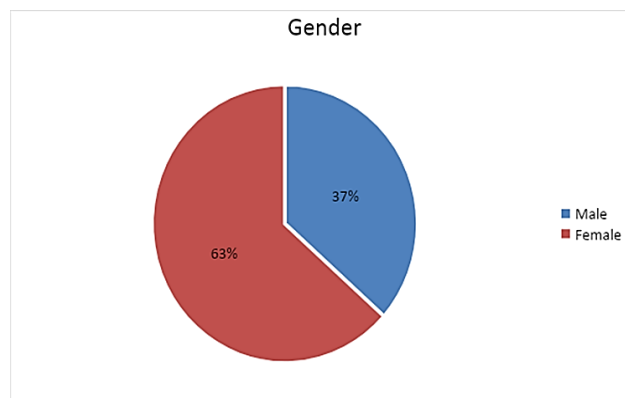
A hospital based cross-sectional study was conducted with 82 patients to evaluate the pattern of musculoskeletal (MSK) manifestations in adult diabetic patients and to correlate them with duration and control of diabetes. The following observations were noted:

Majority of the patients (35.6%) were from the age group of 51-60 years followed by 25.6% from the age group of 41-50 years, 24.4% from the age group of 61-70 years, 7.2% from the age group of 71-80 years and 3.6% from the age groups of 31-40 years and 81-90 years. The mean age of patients was  $58.17 \pm 10.61$  years (Figure 1).



**Figure 1: Distribution of patients according to age.**

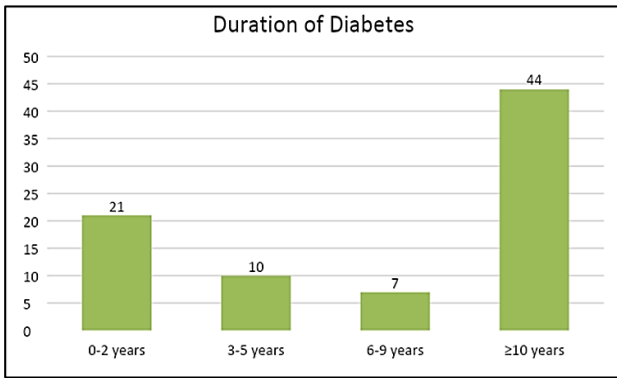
There were 30 (36.6%) male patients while female patients constituted 63.4% of the study population (Figure 2). (25.7%) patients had diabetes for 0-2 years while 10 (12.2%) and 7 (8.5%) patients had diabetes for 3-5 years and 6-9 years respectively. 44 (53.6%) patients had diabetes for  $\geq 10$  years. The mean duration of diabetes was  $8.75 \pm 6.82$  years (Figure 3).



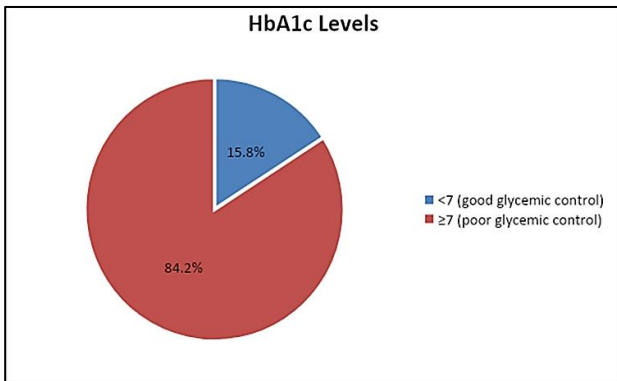
**Figure 2: Distribution of patients according to gender.**

Majority of the patients were on oral hypoglycemic agents (OHA) (92.7%) patients while 10 (12.2%) patients were on insulin. 4 (4.9%) patients were not on any treatment for diabetes. 8 (9.7%) patients had non-proliferative diabetic retinopathy (NPDR), 7 (8.5%) patients had ischemic heart disease, 5 (6.1%) patients had chronic kidney disease and 2 (2.4%) patients had cerebrovascular accident (CVA). The mean fasting blood sugar (FBS) of patients was  $165.65 \pm 50.02$  mg/dl while the mean postprandial blood sugar (PPBS) of patients was  $246.51 \pm 76.62$  mg/dl. 13 (15.8%) patients had HbA1c  $< 7$  (good glycemic control) while 69 (84.2%) patients had HbA1c  $\geq 7$  (poor glycemic

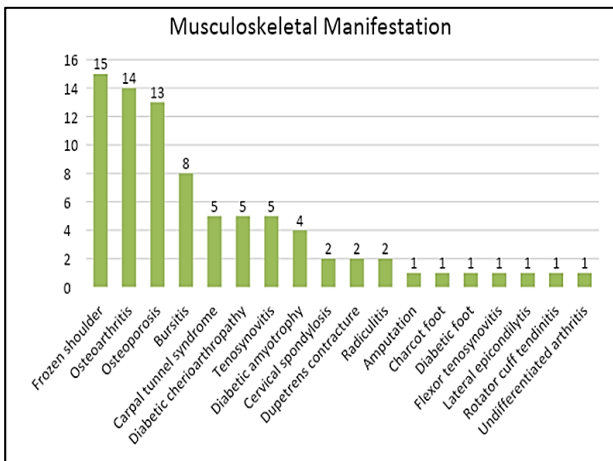
control). The mean HbA1c level of patients was  $9.05 \pm 1.46\%$  (Figure 4).



**Figure 3: Distribution of patients according to duration of diabetes.**



**Figure 4: Mean HbA1c levels of patients.**



**Figure 5: Distribution of patients according to musculoskeletal manifestation.**

The most common musculoskeletal manifestation was frozen shoulder (18.3%) followed by osteoarthritis (17.1%), osteoporosis (15.8%), bursitis (9.7%), carpal tunnel syndrome (6.1%), diabetic Cheri arthropathy (6.1%), tenosynovitis (6.1%), diabetic amyotrophy (4.8%), cervical spondylosis (2.4%), Dupuytren's

contracture (2.4%), radiculitis (2.4%), amputation (1.2%), Charcot foot (1.2%), diabetic foot (1.2%), flexor tenosynovitis (1.2%), lateral epicondylitis (1.2%), rotator cuff tendinitis (1.2%) and undifferentiated arthritis (1.2%) (Figure 5).

Majority of patients with duration of diabetes between 0-2 years had frozen shoulder (7.3%) while majority of the patients with duration of diabetes between 3-5 years and 6-9 years had tenosynovitis (3.6%) and osteoporosis (3.6%) respectively. Majority of patients with duration of diabetes  $\geq 10$  years had osteoporosis (10.9%). There was no significant association of musculoskeletal manifestations and duration of diabetes of patients as per Chi-Square test ( $p > 0.05$ ).

Majority of patients with good glycemic control (8.5%) had bursitis while majority of the patients with poor glycemic control had frozen shoulder. There was no significant association of musculoskeletal manifestations and control of diabetes in patients as per Chi-Square test ( $p > 0.05$ ).

## DISCUSSION

A hospital based cross-sectional study was conducted with eighty-two patients to evaluate the pattern of musculoskeletal (MSK) manifestations in adult diabetic patients and to correlate them with duration and control of diabetes. Diabetes mellitus is associated with a great variety of musculoskeletal manifestations, many of which are subclinical and correlated with disease duration and its inadequate control.<sup>8</sup> These complications significantly compromise patient's quality of life. These complications are generally neglected and poorly managed as compared to other complications such as neuropathy, retinopathy and nephropathy.<sup>8</sup>

One of the postulated hypotheses for the aetiology of musculoskeletal disorders in diabetes mellitus patients is the accumulation of advanced glycation end products in the connective tissues. Advanced glycation end products (AGEs) are modifications of proteins or lipids that become glycated nonenzymatically and oxidized after reacting with aldose sugars.<sup>9</sup> AGEs attribute to the modification of the extracellular matrix (ECM); modify the action of cytokines, hormones, and free radicals via engagement of cell surface receptors; and affect the function of intracellular proteins. This contributes to both microvascular and macrovascular complications of diabetes mellitus.<sup>9</sup> AGEs are also associated with aging related sarcopenia, by accumulating in musculoskeletal tissues.<sup>10</sup> Thus, musculoskeletal disorders in DM have been associated with disease duration, degree of metabolic control, and the presence of end organ damage.<sup>8</sup>

In the present study, majority of the patients (35.6%) were from the age group of 51-60 years followed by 25.6% from the age group of 41-50 years, 24.4% from the age group of 61-70 years, 7.2% from the age group of 71-80 years and 3.6% from the age groups of 31-40 years and 81-90 years.

The mean age of patients was 58.17±10.61 years. There were 30 (36.6%) male patients while female patients constituted 63.4% of the study population. This is similar to the studies of Jobin et al and Majjad et al.<sup>11,12</sup>

Jobin et al cross-sectional study evaluating the prevalence of musculoskeletal manifestations in patients with diabetes found 14.8 % (n=74) belonged to the age group less than 40 years, 30% (n=150) between 41-50 years. 36.4% (n=182) of the patients belonged to the age group between 51-60 year, 15.8% (n=79) and 3% (n=15) belonged to the age group above 71 years.<sup>11</sup> 60.2 % (301) of the patients were male and 39.8% (199 patients) were female patients.

It was observed in the present study that 21 (25.7%) patients had diabetes for 0-2 years while 10 (12.2%) and 7 (8.5%) patients had diabetes for 3-5 years and 6-9 years respectively. 44 (53.6%) patients had diabetes for ≥10 years. The mean duration of diabetes was 8.75±6.82 years. This is concordant to the studies of Jobin et al, Majjad et al and Edis et al.<sup>11-13</sup> Majjad et al cross-sectional study assessing the prevalence of musculoskeletal disorders observed mean of duration of diabetes mellitus was 10 years, with range from 1 to 33 years.<sup>12</sup> Edis et al cross-sectional study observed 284 (40.5 %) patients were having duration of diabetes up to five years. 183 (26.1%) patients were having duration of six to ten years.<sup>11</sup> 235 (33.5%) patients were having duration of diabetes more than ten years. It was observed in our study that majority of the patients were on oral hypoglycemic agents (OHA) (92.7%) patients while 10 (12.2%) patients were on insulin. Four (4.9%) patients were not on any treatment for diabetes. 27 (32.9%) patients had hypertension while eight (9.7%) and seven (8.5%) patients had non-proliferative diabetic retinopathy (NPDR) and ischemic heart disease respectively. five (6.1%) patients had chronic kidney disease, while two (2.4%) patients had cerebrovascular accident (CVA).

Majjad et al cross-sectional study found 34% of the patients had hypertension, 11% had dry mouth, also 11% had dry eye, and few patients had other extra musculoskeletal manifestations as heart failure, liver failure, skin ulcer, asthma, pulmonary edema, and skin pigmentations.<sup>11</sup> In the present study, the mean fasting blood sugar (FBS) of patients was 165.65±50.02 mg/dl while the mean Postprandial Blood Sugar (PPBS) of patients was 246.51±76.62 mg/dl. 13 (15.8%) patients had HbA1c <7 (good glycemic control) while 69 (84.2%) patients had HbA1c ≥7 (poor glycemic control). The mean HbA1c level of patients was 9.05±1.46%. This is in concordance to the study of Jobin et al.<sup>11</sup>

Edis et al cross-sectional study observed 268 patients were having HbA1c level of less than or equal to seven. 424 patients were having HbA1c of more than seven. HbA1c levels were higher in patients with musculoskeletal disorders, and there was a statistically significant difference in Dupuytren's contracture (p <0.001), adhesive capsulitis (p=0.048), and carpal tunnel syndrome (p=0.045).<sup>11</sup>

The most common musculoskeletal manifestation in our study was frozen shoulder (18.3%) followed by osteoarthritis (17.1%), osteoporosis (15.8%), bursitis (9.7%), carpal tunnel syndrome (6.1%), diabetic chorioarthropathy (6.1%), tenosynovitis (6.1%), diabetic amyotrophy (4.8%), cervical spondylosis (2.4%), dupuytren's contracture (2.4%), radiculitis (2.4%), amputation (1.2%), charcot foot (1.2%), diabetic foot (1.2%), flexor tenosynovitis (1.2%), lateral epicondylitis (1.2%), rotator cuff tendinitis (1.2%) and undifferentiated arthritis (1.2%). These findings were consistent with the studies of Jobin et al, Majjad et al and Ramchurn et al.<sup>11,12,14</sup> Ramchurn et al conducted a study on 96 diabetic patients to look for the prevalence of locomotor disease of the upper extremities.<sup>14</sup> The study revealed prevalence was significantly higher in diabetic patients than that seen in the controls (53%) (p=0.02). Most common disorders were shoulder adhesive capsulitis (25%), carpal tunnel syndrome (20%), tenosynovitis (29%), limited joint mobility (28%) and Dupuytren's contracture (13%).

In our study, majority of patients with duration of diabetes between 0-2 years had frozen shoulder (7.3%) while majority of the patients with duration of diabetes between 3-5 years and 6-9 years had tenosynovitis (3.6%) and osteoporosis (3.6%) respectively. Majority of patients with duration of diabetes ≥10 years had osteoporosis (10.9%). There was no significant association of musculoskeletal manifestations and duration of diabetes of patients as per Chi-Square test (p>0.05).

## CONCLUSION

Musculoskeletal manifestations are frequent in patients with DM, and incidence of these manifestations is associated with blood glucose level, age and duration of diabetes of patients. The musculoskeletal system should be examined as a made a part of physical examination in diabetic patients and lifestyle modification and physiotherapy for various joint issues should be part of diabetic management.

Diabetes mellitus is a multi-system disease and the musculoskeletal disorders associated with it should be evaluated and managed in a holistic approach involving the rheumatologist, diabetologist as well as the orthopaedist for optimal treatment. Early rehabilitative measures should be taken to reduce the disease burden in diabetes mellitus patients.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

1. Wild S, Roglic G, Green A. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care*. 2004;27:1047-53.

2. International Diabetes Federation. *IDF Diabetes Atlas*. 6th ed. Brussels: International Diabetes Federation. 2013.
3. Maiti S, Akhtar S, Upadhyay AK, Mohanty SK. Socioeconomic inequality in awareness, treatment and control of diabetes among adults in India: Evidence from National Family Health Survey of India (NFHS), 2019–2021. *Sci Rep.* 2023;13:2971.
4. International Diabetes Federation. *IDF Diabetes Atlas*. 10th ed. Brussels: International Diabetes Federation. 2021.
5. Silva MBG, Skare TL. Manifestações musculoesqueléticas em diabetes mellitus. *Rev Bras Reumatol.* 2012;52(4):601-9.
6. Suzuki A, Yabu A, Nakamura H. Advanced glycation end products in musculoskeletal system and disorders. *Methods.* 2022;203:179-86.
7. American Diabetes Association. *Diabetes Care.* 2018;40(1):S13-27.
8. Sarkar S, Goswami B, Sengupta B, Sengupta S, Bhattacharjee B. Musculoskeletal manifestations in type-2 diabetic patients attending a tertiary care hospital in a North-Eastern city of India-A cross-sectional observational study. *J Family Med Prim Care.* 2023;12(3):472-7.
9. Goldin A, Beckman JA, Schmidt AM, Creager MA. Advanced Glycation End Products Sparking the Development of Diabetic Vascular Injury. *Circulation.* 2006;114:597-605.
10. Olson LC, Redden JT, Schwartz Z, Cohen DJ, McClure MJ. Advanced Glycation End-Products in Skeletal Muscle Aging. *Bioengineering (Basel).* 2021;8(11):168.
11. Jobin P, Dhurvey P, Nair A. Prevalence of musculoskeletal manifestations in patients with type 2 Diabetes mellitus in a tertiary care hospital. *Indian J res.* 2018;7(8):38-41.
12. Majjad A, Errahali Y, Toufik H. Musculoskeletal Disorders in Patients with Diabetes Mellitus: A Cross-Sectional Study. *Int J Rheumatol.* 2018;2018:3839872.
13. Edis P, Özdemir N, Hekimsoy Z. The musculoskeletal disorders in diabetic patients and the evaluation of their relationship with metabolic parameters and microvascular complications. *Acta Endocrinol (Buc).* 2024;20(2):136-42.
14. Ramchurn N, Mashamba C, Leitch E, Arutchelvam V, Narayanan K, Appleyard M. Upper limb musculoskeletal abnormalities and poor metabolic control in diabetes. *Eur J Intern Med.* 2009;20:123-30.

**Cite this article as:** Bala DB, Gill NH. Musculoskeletal disorders in patients with diabetes mellitus: a neglected manifestation. *Int J Adv Med* 2026;13:124-8.