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To determine the proportion of rheumatic musculoskeletal manifestations in type 2 diabetic individuals

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Abstract
Background: Rheumatic Musculoskeletal Disorders (RMSD) are recognized complications of Diabetes Mellitus (DM), particularly in regions with high DM prevalence like India. The impact of DM on musculoskeletal health is exacerbated by lifestyle changes and prolonged hyperglycemia, leading to joint stiffening and increased glycosylation of collagen. There is limited evidence on RMSD complications among individuals with DM in this region.
Method: A cross-sectional study was conducted at Sri Aurobindo Medical College & Postgraduate Institute, Indore, from September 2022 to February 2024. The study included 125 patients with type 2 DM aged 30-70 years, who presented with rheumatic musculoskeletal manifestations. Data were collected through a predesigned proforma, which included detailed patient history and relevant investigations.
Results: The majority of participants were aged 45-59 years (48.9%), with a slightly higher proportion of females (53.4%). Musculoskeletal manifestations varied across age groups, with diffuse idiopathic skeletal hyperostosis (DISH) being the most prevalent, particularly in the 45-59 years age group. HbA1c levels were significantly associated with the prevalence of musculoskeletal conditions, with those having higher HbA1c levels (>7%) showing a broader distribution of conditions like osteoarthritis and frozen shoulder. Additionally, the duration of diabetes was significantly linked to the occurrence of musculoskeletal complications, such as rheumatoid arthritis and positive X-ray findings in knees and shoulders.
Conclusion: The study highlights the significant relationship between diabetes duration, glycemic control, and the prevalence of musculoskeletal complications in patients with type 2 DM. Early diagnosis and targeted interventions based on diabetes duration and HbA1c levels are crucial to mitigating the associated risks and improving patient outcomes.

Keywords: Rheumatic musculoskeletal disorders, diabetes mellitus, type 2 diabetes, hyperglycemia, glycosylation

Introduction
Rheumatic Musculoskeletal Disorders (RMSD) may occur as complications in persons with diabetes mellitus (DM). Unless immediate preventive measures are implemented, the population of individuals with DM in India, which is recognised as the diabetes capital of the world, is projected to reach 69.9 million by 2025 [1]. Kerala, located in the southernmost part of India, has experienced significant urbanisation and industrialization in the last decade. This has resulted in detrimental alterations to lifestyle, negatively impacting metabolic processes. Kerala has the highest recorded prevalence of DM in the country, at 19.5% [2]. In 1999, Trivandrum city recorded a significantly high prevalence rate of 16.3% [3]. The significant increase in the prevalence rates confirms the widespread occurrence of DM in Kerala, consistent with the pandemic pattern. Patients with diabetes mellitus (DM) have a higher prevalence of root mean square deviation (RMSD) compared to individuals without diabetes [4]. The collagen fibril becomes resistant to collagenase as a result of prolonged hyperglycemia, which leads to an increase in glycosylation. The stiffening of joints in DM is attributed to the accumulation of aberrant collagen in the connective tissue surrounding the joints, as well as the enzymatic and non-enzymatic glycosylation of collagen and the improper cross-linking of collagen [5]. Excessive levels of insulin and insulin-like growth factors are believed to promote calcification at the entheseal sites, which are regions under

heightened mechanical stress [6]. While diabetes mellitus (DM) can lead to serious problems affecting both large and small blood vessels, RMSD (presumably referring to a specific medical condition) causes significant morbidity. Early diagnosis of these problems during the course of DM might enhance the quality of life for patients. There is a scarcity of evidence about complications of RMS in individuals with DM from this specific region. Two studies conducted in northern India have documented a greater occurrence of respiratory muscle strength dysfunction (RMSD) in patients with diabetes mellitus (DM) [7, 8]. This study aims to determine the proportion of rheumatic musculoskeletal manifestations in type 2 diabetes individuals.

Materials and Methods

Cross Sectional study in department of General Medicine at Sri Aurobindo Medical College & Postgraduate institute, Indore (MP) from Sept 2022 to Feb. 2024 (24 month) after approval by ethical committee. With aims to determine the proportion of rheumatic musculoskeletal manifestations in type 2 diabetes individuals. Patients diagnosed to have type 2 DM with rheumatic manifestation and aged between 30-70yrs were included while Patients not ready to give consent, with maturity onset diabetes in young, with latent autoimmune diabetes in adult, with history of trauma related musculoskeletal morbidities, Patients with chronic kidney disease or previous cerebrovascular accident were excluded. 125 patients of type 2 DM with rheumatic musculoskeletal manifestation. DM will be proven on the basis of clinical presentation, fasting blood glucose (>126 mg/dI); 2 h post prandial plasma blood sugar (=200 mg/dl) and HBA1C of more than 6.5%. The data will be collected with the help of appropriate predesigned proforma which will include detailed history of patients and the investigations chosen for the study during the period of one and a half year.

Results

A study population comprising 125 individuals was analyzed across various parameters. The majority of participants fell within the age range of 45-59 years (48.9%), followed closely by those aged 60-74 years (35.3%). Gender distribution was relatively balanced, with 46.6% male and 53.4% female participants. In terms of BMI, a significant proportion were categorized as overweight (33.3%) or normal (37.3%). The duration of diabetes varied, with nearly equal proportions across <5 years (35.1%), 5-10 years (34.2%), and >10 years (30.8%). The ethnic distribution was almost evenly split between ethnic (49.2%) and nonethnic (50.8%) groups. HbA1c levels revealed a majority with levels between 7-9% (56.8%). This demographic overview provides a comprehensive snapshot of the study population, facilitating further insights into diabetes management and associated factors within the specified cohort.

Table 1: Characteristics of study population

Parameters	N(%), (N=125)
Age group	
15-29 Years	1 (1.1%)
30-44 Years	17 (13.8%)
45-59 Years	61 (48.9%)
60-74 Years	44 (35.3%)
>75 Years	1 (0.9%)
Gender	
Male	58 (46.6%)
Female	67 (53.4%)
BMI	
Underweight	16 (12.9%)
Normal	47 (37.3%)
Overweight	42 (33.3%)
Obese	21 (16.5%)
Duration of diabetes	
<5 Years	44 (35.1%)
5-10 Years	43 (34.2%)
>10 Years	39 (30.8%)
Ethnic or Nonethnic	
Ethnic	62 (49.2%)
Nonethnic	64 (50.8%)
HbA1c level	
<7%	33 (26.5%)
7-9%	71 (56.8%)
>9%	21 (16.7%)

The distribution of musculoskeletal manifestations across different age groups was investigated, revealing varying prevalence rates. In individuals aged 45-59 years, diffuse idiopathic skeletal hyperostosis (DISH) was notably prominent with 14 cases, followed by osteoarthritis (OA) with 4 cases. In the 60-74 years age group, DISH remained prevalent (8 cases), alongside frozen shoulder and trigger finger each with 4 cases. No instances of musculoskeletal manifestations were reported in the youngest age group (15-29 years), while in the >75 years age group, only 1 case of OA was recorded. The total sample size was 125 individuals, with statistical analysis indicating significant differences in manifestation prevalence across age groups (Chi2 value = 65.116, p<0.001). This analysis offers valuable insights into age-related patterns of musculoskeletal conditions, aiding in targeted intervention and management strategies for these populations.

Table 2: Distribution of types of musculoskeletal manifestations in different age groups

Age Group	DISH	DC	Charcots joint	OA	Frozen shoulder	Trigger finger	Carpal tunnel syndrome	Tennis elbow	Nil	Total	Chi-square value	P
15-29 Yrs	0	0	0	0	0	1	0	0	0	1	65.116	0.00
30-44 Yrs	1	1	1	2	0	1	1	1	11	19		
45-59 Yrs	14	4	2	4	6	2	1	2	24	59		
60-74 Yrs	8	2	2	3	2	4	1	1	22	45		
>75 Yrs	0	0	0	0	0	0	0	0	1	1		
Total	23	7	5	9	8	8	3	4	58	125		

The relationship between glycosylated hemoglobin (HbA1c) levels and various musculoskeletal manifestations among study subjects was explored, revealing distinct patterns. Individuals with HbA1c levels below 7% exhibited a higher prevalence of diffuse idiopathic skeletal hyperostosis (DISH) with 8 cases, followed by trigger finger with 3

cases. In contrast, those with HbA1c levels between 7-9% showed a broader distribution of musculoskeletal issues, including osteoarthritis (OA) with 4 cases and frozen shoulder with 6 cases. Among subjects with HbA1c levels exceeding 9%, osteoarthritis was most prevalent with 4 cases. Statistical analysis indicated significant associations between HbA1c levels and musculoskeletal manifestations (Chi2 value = 37.65, P=0.002). These findings underscore the potential impact of glycemic control on musculoskeletal health outcomes, suggesting the importance of targeted interventions based on HbA1c levels to mitigate associated risks effectively.

Table 3: Glycosylated haemoglobin and various musculoskeletal manifestations among study subjects

HbA1c	Age Group	DISH	DC	Charcots joint	OA	Frozen shoulder	Trigger finger	Carpal tunnel syndrome	Tennis elbow	Nil	Total	Chi-square value
<7%	8	2	0	1	1	3	1	1	16	33	37.65	0.002
7-9%	12	3	4	4	6	3	2	2	35	71		
>9%	3	2	1	4	1	2	0	1	7	21		
Total	23	7	5	9	8	8	3	4	58	125		

The association between the duration of diabetes and various musculoskeletal complications was examined, revealing significant relationships. Among individuals with diabetes duration less than 5 years, rheumatoid arthritis was notably prevalent with 7 cases, while positive findings in knee X-rays were observed in 30 cases. Additionally, positive X-ray results in one shoulder were recorded in 10 cases. In the 5-10 years duration group, 7 cases of rheumatoid arthritis and 7 cases of positive knee X-rays were identified. Conversely, in those with diabetes for over 10 years, 10 cases of rheumatoid arthritis and 9 cases of positive knee X-rays were noted. Significant associations were found between the duration of diabetes and rheumatoid arthritis (p = 0.038), positive knee X-rays (P=0.001), and positive shoulder X-rays (P=0.016). These findings underscore the impact of diabetes duration on the development of musculoskeletal complications, highlighting the need for tailored management strategies based on diabetes duration to mitigate associated risks effectively.

Table 4: Duration of diabetes and different musculoskeletal complications in diabetes mellitus

Duration of diabetes	Rheumatoid arthritis				X-ray in knee					X-ray in shoulder				
	Positive	Negative	Total	P value	Positive in one knee	Positive in both knee	Negative	Total	P value	Positive in one shoulder	Positive in both shoulder	Negative	Total	P value
< 5 Yrs	7	37	44	0.038	1	14	30	45	0.001	1	10	33	44	0.016
5-10Yrs	7	36	43		3	7	33	43		5	6	32	43	
>10 Yrs	10	28	38		5	9	23	37		2	8	28	38	
Total	25	100	125		9	30	86	125		8	24	93	125	

Discussion

Dermatomyositis is linked to a diverse range of musculoskeletal problems. These problems greatly undermine the patient's quality of life. These consequences are often overlooked and inadequately addressed in comparison to other issues such as kidney disease, cardiovascular disease, and skin disease. In recent times, there has been a significant rise in both the occurrence of diabetes and the average lifespan of diabetic patients. As a result, there has been an increase in the prevalence and clinical significance of musculoskeletal symptoms in diabetic patients.

This study examined the occurrence of musculoskeletal (MSK) symptoms in 125 diabetic patients who visited a tertiary teaching hospital. Our study revealed that 52.9% of diabetic individuals residing in this north-eastern state had musculoskeletal symptoms. Nevertheless, a study conducted by Deshmukh DP *et al.* [9] in India revealed that 42% of individuals with diabetes exhibited musculoskeletal (MSK) symptoms. In a study conducted by Majjad *et al.* in 2018 [10], it was discovered that the occurrence rate of musculoskeletal (MSK) issues in patients with diabetes mellitus (DM) is 34.4%.

The predominant musculoskeletal (MSK) consequence seen in this study was diffuse idiopathic skeletal hyperostosis (DISH), with a prevalence of 35%. In their study, Sarkar *et al*. [11] discovered that the prevalence of diffuse idiopathic skeletal hyperostosis (DISH) among diabetes patients was 28%, which aligns with the findings of our current investigation. In their investigation, Mathew *et al.* [12] discovered a prevalence of 14.52% for DISH. The current investigation found that DISH was also commonly observed in diabetic patients between the ages of 45 and 59 years. This phenomenon may occur as a result of the ossification and calcification of soft tissues, such as entheses and joint capsules.

According to our research, OA was the second most frequently observed occurrence, accounting for 13.24% of cases. Patients with inadequate glycemic control had a higher prevalence of OA, and this disparity was statistically significant. Prior research has documented osteoarthritis (OA) as a prevalent musculoskeletal condition in individuals with diabetes. The research conducted by Mathew AJ *et al.* in India discovered that the occurrence of osteoarthritis (OA) is 20.4%. The study found a strong association between OA and glycaemic control. Nevertheless, Sarkar *et al.* discovered no correlation between glycemic control and the occurrence of osteoarthritis in individuals with diabetes.

Several investigations have documented frozen shoulder as an anticipated consequence of diabetes mellitus. Previous literature has revealed that frozen shoulder is prevalent in diabetic patients at a rate ranging from 11% to 30%, while in nondiabetic individuals, the frequency ranges from 2% to 10%.The user's text is a reference to a specific source or citation [13]. Our study revealed that 12.39% of diabetic participants exhibited frozen shoulder, which aligns with the findings of previous investigations.

Our analysis revealed that females had a higher prevalence of DISH, OA, and frozen shoulder, while males were more likely to experience tennis elbow and DC. According to the

previous study, there is a potential connection between women's vulnerability to osteoarthritis (OA) and their hormone levels [14]. Hormone levels undergo periodic variations during menstrual cycles and undergo alterations during the menopausal transition. Elevated hormone levels during specific phases of the menstrual cycle can lead to heightened joint laxity, which is linked to joint instability and the risk of injury [15]. Our investigation also observed cases of trigger finger, with an incidence rate of 11.53%. Prior research has consistently reported a rising prevalence of trigger finger in individuals with diabetes. Various studies have indicated that the prevalence of trigger finger in the general population ranges from 1.7% to 2.6%, however it is higher, between 10% and 20%, in those with diabetes [16]. A prior study suggested a correlation between trigger finger and the occurrence of cardiovascular disease (CVD) in individuals diagnosed with type 2 diabetes [17]. The diagnosis of trigger finger is straightforward and does not require invasive procedures.

The study findings indicate that 20% of the participants were diagnosed with rheumatoid arthritis, and among them, 59% were exclusively females. Lu *et al*. [18] found that the incidence of rheumatoid arthritis (RA) was significantly elevated in female individuals with type 2 diabetes mellitus (T2DM), but not in male participants. Nevertheless, the majority of participants in the aforementioned study were females, accounting for 77.4%, whereas in our study, the female participants constituted 53.4%.

Conclusion

Physicians should regularly inquire about musculoskeletal issues in the medical history of diabetes patients. An early diagnosis will expedite the suitable treatment and so avert additional difficulties.

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