

Musculoskeletal Comorbidities among known Diabetes Patients, their Quality of Life, and Healthcare Costs: A Comparative Study From a Tertiary Care Hospital in Uttarakhand

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Abstract

Introduction: Diabetes is a chronic disorder with long-term sequelae and multisystem manifestation. Burden of diabetes is on the rise. Presence of other morbidities can not only have a detrimental effect on the disease treatment and recovery course, but also on the financial burden and quality of life. Present study aims to investigate how musculoskeletal conditions affect individuals with diabetes compared to those without the condition. **Material and Methods:** A comparative study was conducted among patients attending the outpatient department of a tertiary care hospital in North India to assess the burden of musculoskeletal disorders in people with and without diabetes. A total of 195 diabetes patients and an equal number of individuals without diabetes were sequentially enrolled from the outpatient department (OPD). **Results:** Burden of musculoskeletal comorbidities was significantly higher (46.2%) among people with diabetes than the comparison group (25.1%). The overall odds ratio (OR) for comorbidities of musculoskeletal system was 2.5 times higher in diabetes cases as compared to individuals without diabetes. The OR for rheumatoid arthritis, chronic backache, and osteoarthritis was found to be 3.6, 2.9, and 1.7 respectively. Poor quality of life and higher direct cost of treatment were found among diabetes cases with musculoskeletal comorbidities as against those without these comorbidities. **Conclusion:** Presence of musculoskeletal comorbidity is high among diabetes patients, and it has an impact on the quality of life and treatment cost. Screening for musculoskeletal comorbidities should be included as part of the diabetes complication assessment to allow for early detection and treatment.

Keywords: Comorbidity, diabetes, direct cost, musculoskeletal disorders, Quality Of Life (QOL)

INTRODUCTION

Diabetes is a long-term metabolic condition marked by high blood glucose, which over time can affect multiple organs of the body including heart, blood vessels, eyes, kidneys, and musculoskeletal system. The most prevalent type of diabetes is type 2, which often affects adults, and develops when the body stops producing enough insulin or becomes resistant to it. Type 2 diabetes has been much more common during the past three decades in nations of all income levels.^[1]

According to the International Diabetes Association report (2021), approximately 537 million adults (20–79 years) have diabetes. This figure is expected to increase to 643 million by 2030, and 783 million by 2045. Over three-quarters of diabetic adults live in low- and middle-income countries.^[1] In India, the prevalence of diabetes increased from 7.1% in 2009

to 8.9% in 2019. In this diabetes pandemic, India is only next to China with a caseload of 77 million diabetics.^[2]

Diabetes mellitus (DM) is linked to a spectrum of musculoskeletal conditions. The burden and clinical significance of musculoskeletal abnormalities in diabetic persons have grown in the recent times firstly due to a rise in the number of DM and due to the increased life expectancy

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of diabetic patients.^[3] These musculoskeletal conditions affect joints, soft tissues, nerves, muscles, and tendons. Some of the musculoskeletal abnormalities are exclusive to diabetics, whilst others are common in the general population but more prevalent among diabetics.^[4] The mechanism is not clearly understood but it has been found that in diabetes the connective tissue gets affected, which alters the periarticular and skeletal systems.^[5] High glucose levels in diabetics have been found to disrupt extracellular matrix components, impair cell function, and harm connective tissue.^[6,7]

Along with food and medication, exercise is regarded as one of the three key components of the best diabetes management.^[8] With manifestation of musculoskeletal complications, the physical activity can be hampered among diabetes patients that sets in the vicious cycle of physical inactivity and worsening of diabetes and its complications. This study attempted to explore the burden of musculoskeletal disorders in terms of prevalence, effect on quality of life, and cost of care among diabetes patients compared to nondiabetes patients.

Study objectives:

1. To compare the proportion of musculoskeletal disorders among diabetes patients and nondiabetes patients.
2. To compare quality of life scores between diabetes patients and nondiabetes patients with musculoskeletal comorbidity.
3. To compare the direct costs between diabetes patients and nondiabetes patients with musculoskeletal comorbidity.

METHODOLOGY

The current research was done as part of a Doctorate thesis project. Primary goal of the project was to find out the burden of comorbidities among diabetes patients compared to nondiabetes patients.

Study setting: The study was carried out in a medical college attached tertiary care hospital situated in the Srinagar tehsil of the Pauri district in the Garhwal division of Uttarakhand, India.

Study design: Cross-sectional comparative study.

Study population: Patients attending outpatient department (OPD).

Sampling strategy: Consecutive sampling.

Diabetes cases were chosen from patients over 30 who had been diagnosed with type 2 diabetes mellitus (T2DM) for at least six months or more. An equal number of comparison group with similar age and gender with no history of DM was selected from the same hospital OPDs. A random blood sugar test using a glucometer was also used to ensure the correct selection of the study subjects.

Study duration: The data were collected over the course of a year, from 2017 to 2018.

$$n = \left(\frac{r+1}{r} \right) \frac{(\bar{p})(1-\bar{p}) \left(Z_{\beta} + Z_{\alpha/2} \right)^2}{(p_1 - p_2)}$$

Sample size:

Taking the ratio of comparison group and diabetes cases (r) as 1, the proportion of comorbidity (hypertension) in diabetes cases (p_1) and comparison group (p_2) as 47% and 33.2% respectively, average proportion exposed [$p = (p_1 + p_2/2) = 0.4$, effect size $((p_1 - p_2)^2) = 0.14$, alpha error of 0.05% and power of 80%, the sample size (n) obtained for each group was 192.^[9]

Definitions:

Diabetes Case definition: known type 2 diabetes mellitus (T2DM) patients who were more than or equal to 30 years of age, on treatment and had been diagnosed with T2DM for more than 6 months.

Comparison group: They were individuals who did not have a self-reported history of diabetes, or a physician-diagnosed condition, and this was additionally validated by a random blood sugar level below 126 mg/dL using a glucometer. They were carefully matched pairs according to age (within a two-year range) and gender (male or female) for better comparison.

Musculoskeletal co-morbidity: Musculoskeletal co-morbidity refers to both musculoskeletal conditions or complications lasting for more than 15 days reported by the cases and the comparison group during the interview. These conditions encompass chronic back pain, rheumatoid arthritis, osteoarthritis, fractures, etc.

Study tools

A semi-structured study questionnaire was constructed which included sociodemographic details like name, age, gender, religion, caste, education, occupation, income, number of family members, kind of family, history of addiction, etc., Apart from the background details, data on the comorbid conditions were also collected. Participants were initially asked about the existence of these comorbidities. Socioeconomic status was assessed using Modified Kuppuswami Status scale 2016.^[10]

Cost of treatment

The research study extensively evaluated the direct OPD costs incurred by diabetes patients in the general medicine OPD. This investigation involved the meticulous recording of expenditures on various associated comorbidities over the prior six months, confirmed by cross-referencing prescription slips and receipts. The study primarily focused on determining the average six-month direct cost for diabetic patients with diverse comorbidities, subsequently extrapolated to an annual scale by doubling this figure. The total direct cost was calculated by amalgamating both medical and nonmedical expenses. Medical expenses encompassed fees for physician consultations, emergency department visits, diagnostic tests, prescription

medications, and related medical supplies. Nonmedical costs, on the other hand, included expenses such as transportation for healthcare visits, modifications to diet and lifestyle, and monitoring visits.

Quality of Life (QOL)

The WHO-QOLBREF questionnaire was used to assess the quality of life of patients with and without diabetes in the present study. The WHO questionnaire is a standardized tool and has been validated internationally including India. It is a 26-item specific instrument for measuring the quality of life and it covers four domains of health which are physical, psychological, and social, and environment domain. The four domain ratings represent a person’s subjective assessment of their quality of life in each specific domain. Higher scores signify higher quality of life.^[11-15]

Statistical analysis

Data were entered into a Microsoft Excel spreadsheet, and statistical analyses were performed using IBM SPSS Statistics software, version 23 (IBM Corp., Armonk, NY, USA, 2018). Chi-square test was applied to measure the association of diabetes with comorbidities, while the strength of association was measured by odds ratio (OR). The mean difference for average duration and expenditure that incurred between the two groups was determined using the Student’s *t* test. All tests were performed at 95% CI where *P* ≤ 0.05 was considered statistically significant.

RESULTS

Study participants were comparable between the two groups with respect to the background characteristics. Mean age of the study participants was 56.6 ± 12 years. Around 57.5% participants were males and 43.5% were females. About 84% were married. More than half (53%) of the study participants belonged to upper middle class as per Modified Kuppaswami classification 2016. About 44% of diabetes patients had family history of diabetes compared to only 13% among nondiabetes individuals. Detailed sociodemographic profile of the study participants is available elsewhere.^[16]

Almost half (46.2%) diabetes cases had one or the other musculoskeletal co-morbidity compared to other group where the proportion of musculoskeletal disorders was 25.1% [Figure 1]. The most common comorbidity among diabetic cases was osteoarthritis (24.1%), followed by chronic backache (21.5%), chronic rheumatoid arthritis (4.6%) and then fractures (3.6%) [Table 1]. Of the comorbidities found among diabetics, majority (57.7%) developed after the diagnosis of diabetes [Figure 2].

Comorbidities related to musculoskeletal system such as chronic backache, osteoarthritis, and chronic rheumatoid arthritis were reported in higher frequencies among cases in comparison to controls and the differences were found to be statistically significant (*P* < 0.05). The overall risk of comorbidities of musculoskeletal system was 2.5 times higher

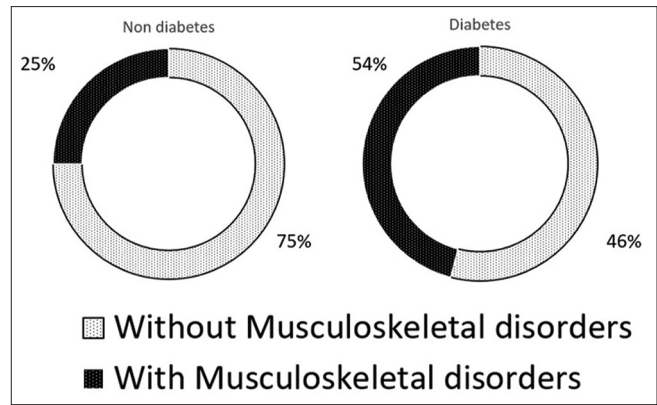


Figure 1: Proportion of musculoskeletal disorders among Nondiabetics and Diabetics; n (%)

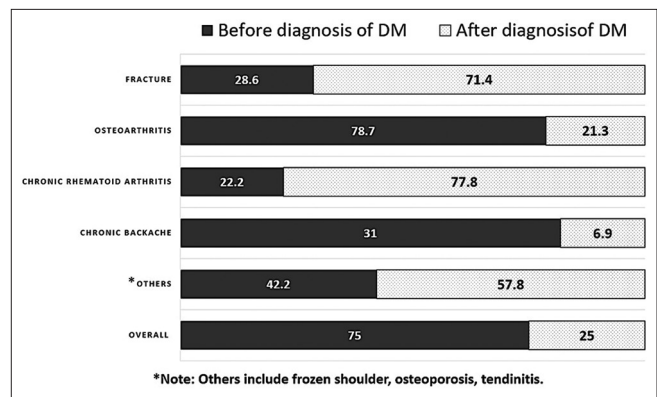


Figure 2: Proportion of musculoskeletal disorders among diabetics that developed after the diagnosis of DM

Table 1: System wise distribution of comorbidities among patients of Diabetes

Characteristic	Diabetic cases with various comorbidities (n=195)
Musculoskeletal	90 (46.2)
Chronic backache	42 (21.5)
Chronic Rheumatoid arthritis	9 (4.6)
Osteoarthritis	47 (24.1)
Fractures	7 (3.6)
Others	4 (2.1)

*Multiple responses

in cases as compared to controls. The OR of rheumatoid arthritis, chronic backache, and osteoarthritis was found to be 3.6, 2.9, and 1.7 respectively [Table 2].

Lower domain-specific and total QOL scores were obtained in diabetic cases with musculoskeletal comorbidities compared to controls with musculoskeletal comorbidities, and these differences were statistically significant [Table 3].

The average half year total expenditure for diabetes cases with musculoskeletal comorbidities was US\$ 51.5 (INR 4105.7 INR), compared to US\$ 18.3 (INR 1460.8) for controls with musculoskeletal comorbidities. This difference

in total expenditure between the two groups was found to be statistically significant. Additionally, it was found that both groups spent most money on purchasing medications, with diabetics spending an average of US\$ 31.7 per month on medications (INR 2531.9). Comorbid diabetes cases were observed to have significantly higher mean direct costs for individual expenses from consultations, prescriptions, diagnostics, and other expenses like commuting costs ($P < 0.05$) [Table 4].

DISCUSSION

The current study aimed to estimate and compare the proportion of musculoskeletal comorbidities among diabetics and nondiabetics. The QOL and treatment costs between the two groups were also investigated in the study.

The present study found that the overall burden of musculoskeletal disorders among diabetics was 46.2% ($n = 90$) and majority of those developed after the diagnosis of diabetes (57.7%; $n = 52$). Edis *et al.* (2021)^[17] in their study on finding out burden of musculoskeletal disorders among diabetics also found similar results with 45.9% of their study subjects who had one or the other musculoskeletal problems.

Many other researchers have also documented that the burden of musculoskeletal comorbidities is higher among diabetics

compared to nondiabetics.^[18-20] The proportion among diabetics ranged from one-third cases to three-fourth of the diabetic cases.^[18,21-23] Such wide range can be attributed to the patient types, severity, and other demographic factors included in different studies.

The present study found that the most common musculoskeletal comorbidity was osteoarthritis which was seen among one-fourth of the diabetics. These results are comparable with evidence from a systematic review, which found out that the pooled prevalence of osteoarthritis among diabetics was around 29.1%.^[24]

Another important musculoskeletal problem among diabetics was back pain which was seen in one-fifth of diabetes subjects, and it was significantly lower (8.7%) among nondiabetics. Previous researches also corroborate this finding that backache is more prevalent (19%–35%) among diabetics compared to nondiabetics.^[25,26] These problems can be attributed to diabetic related changes in blood sugar, insulin, and free radicals, which cause considerably higher risks of back pain.^[27,28]

Rheumatoid arthritis along with other musculoskeletal disorders were also found to be significantly more among cases (10.3%) than controls (3.1%) in the present study. A systematic review by Tian *et al.* (2021)^[29] exploring the relationship between RA (Rheumatoid arthritis) and DM (Diabetes mellitus) found that

Table 2: Proportion and risk of comorbidities of musculoskeletal system among cases and controls

Comorbidities of musculoskeletal System	Cases No. (%)	Controls No. (%)	OR (95% CI)	p-value
Osteoarthritis	47 (24.1)	31 (15.9)	1.7 (1.0-2.8)	0.04
Chronic backache	42 (21.5)	17 (8.7)	2.9 (1.6-5.3)	<0.001
Chronic Rheumatoid arthritis/Others	20 (10.3)	6 (3.1)	3.6 (1.4-9.2)	0.04
Total*	90 (46.2)	49 (25.1)	2.5 (1.7-3.9)	<0.001

*multiple response

Table 3: Comparison of Quality-of-Life scores between cases and controls with musculoskeletal disorders comorbidity

Characteristic	Cases with musculoskeletal comorbidity (90)	Controls with musculoskeletal comorbidity (49)	't' value	p-value
	Mean ± SD	Mean ± SD		
Physical	22.5 ± 5.1	25.1 ± 4.1	3.0	<0.001
Psychological	23.4 ± 5.0	25.7 ± 4.9	3.0	<0.001
Social relationships	11.8 ± 2.4	12.4 ± 2.0	1.4	0.14
Environment	32.2 ± 5.6	35.1 ± 5.0	2.6	0.01
Total Score	90.0 ± 15.9	98.5 ± 14.4	3.0	<0.001

Table 4: Comparison of direct costs between cases and controls with musculoskeletal comorbidity

Characteristic	Cases with musculoskeletal comorbidity (90)	Controls with musculoskeletal comorbidity (12)	't' value	p-value
	Mean ± SD	Mean ± SD		
Consultation	376.2 ± 986.5	131.4 ± 414.4	2.0	0.04
Medications	2531.9 ± 4350.3	904.7 ± 1515.8	3.2	<0.001
Tests	511.3 ± 1051.9	340.8 ± 879.4	0.9	0.34
Any other	686.2 ± 1768.9	83.9 ± 318.7	3.1	<0.001
Total	4105.7 ± 6272.1	1460.8 ± 2475.4	3.5	<0.001

rheumatoid arthritis was associated with a higher risk of DM incidence (pooled relative risk, 1.23; 95% confidence interval, 1.07–1.40). Though our study documented the presence of RA among diabetics and did not attempt to find the causality and directionality of co-occurrence.

Comparing the QOL among diabetics with musculoskeletal disorders and controls with the same disorders, it was found that mean QOL scores were significantly more among controls compared to cases; this significant difference was also observed individually in physical, psychological, and environmental domains of WHO-BREF QOL Scale [Table 3]. This suggests better QOL among controls compared to cases. Patil *et al.* (2020) in their study to assess health-related quality of life among diabetics reported that QOL was worse among those with musculoskeletal and other comorbidities.^[30]

Several studies have shown that QOL is worse among diabetics with comorbidities compared to those without comorbid conditions.^[30,31] Some studies also highlighted that there was a noticeable drop in QOL scores with increase in the number of comorbid conditions, indicating the possibility of a dose-response correlation.^[32-34] Diabetes itself is a debilitating condition that affects the overall QOL when compared to nondiabetics.^[35-38] With added musculoskeletal comorbidities, the QOL is expected to worsen.

The results of the current study revealed that the monthly cost of treatment for diabetics with musculoskeletal comorbidities (4105 INR) was nearly three times higher than that for nondiabetics with musculoskeletal comorbidity (1460 INR), with the highest expenditure reported on the purchase of medications (2531 INR) in comparison to nondiabetics (904 INR).

Despite the lack of historical data comparing diabetics with musculoskeletal comorbidities to their nondiabetic counterparts, there is no disputing the fact that the expense of treating diabetics with difficulties is much higher than it is for diabetics without comorbidities.^[39-45]

Acharya *et al.* (2016) in their study to assess cost for diabetes care in South India found that the total yearly direct cost for diabetics with no complications was around 21000 INR compared to 28000 INR with complications and the cost of illness was 1.4 times higher among the latter group.^[40] Another Indian study by Kumpatla *et al.* (2013) showed that the cost rises even further as the number of comorbidities increases.^[45] Similar trends were reported in other Indian studies.^[39-48]

The study's limitation is that, while it investigates the timeline of diabetes and comorbidity occurrence, the causality relationship cannot be determined because it is a questionnaire-based cross-sectional survey.

CONCLUSION

It can be concluded from the study that musculoskeletal comorbidities are more among diabetics compared to

nondiabetics, and it is associated with poor QOL and high treatment cost that compound the problem.

Recommendations

Regular screening and early detection for musculoskeletal comorbidities among diabetics to reduce the overall impact of the disease especially in terms of QOL and economic burden.

Ethical consideration

The Institutional Ethical Committee (IEC) of the Veer Chandra Singh Garhwali Government Medical Sciences, Uttarakhand institution granted ethics permission for the study (IEC/VCSGGMS and RI/003 dated March 21, 2017). Informed consent was obtained from each participant.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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