

# A STUDY OF SARCOPENIA IN TYPE 2 DM PATIENTS > 10 YEARS IN ASSOCIATION WITH BMD SCAN

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## ABSTRACT

**Introduction:** Diabetes mellitus is a growing global health concern, with an estimated 643 million individuals projected to be affected by 2030. Sarcopenia, once considered a normal part of aging, is now known to be associated with chronic diseases, including type 2 diabetes mellitus (T2DM). Muscle mass typically declines by approximately 8% per decade after age 40, accelerating to 15–25% per decade after age 70.

**Aim:** To determine the prevalence of sarcopenia in patients with T2DM of more than 10 years' duration and evaluate its association with bone mineral density (BMD).

**Methods:** An observational study was conducted at a tertiary care hospital in Salem from January to October 2024. A total of 120 patients with T2DM for over 10 years were included. Data collected included demographics, medical history (fractures, comorbidities, use of insulin, bisphosphonates, or vitamin D supplements), and physical examination findings (weight, height, BMI, and blood pressure). Sarcopenia and BMD were assessed using dual-energy X-ray absorptiometry (DXA).

**Results:** The mean age of participants was  $63.4 \pm 8.7$  years. Most had diabetes for 10–15 years (56.7%), and 32.5% had 16–20 years. The mean BMI was  $25.7 \pm 3.4$  kg/m<sup>2</sup>. Sarcopenia was present in 30.0% of participants. Additionally, 48.3% had osteopenia and 28.3% had osteoporosis.

**Conclusion:** Routine screening for sarcopenia and BMD in older adults with long-standing T2DM is essential for early intervention. Good glycemic control may help mitigate the risk of sarcopenia and related complications.

**Keywords:** Sarcopenia, Type 2 DM patients, BMD scan, Prevalence

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## INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a widespread chronic condition. According to the International Diabetes Federation, approximately 463 million people were living with diabetes in 2019, with T2DM accounting for 90% of these cases. Characterized by chronic hyperglycemia, T2DM is closely linked to a variety of complications that impair quality of life and contribute to increased morbidity and mortality<sup>1</sup>. Among these complications, sarcopenia is a progressive and generalized loss of skeletal muscle mass, strength, and function has gained attention due to its profound impact on patients' health, particularly

in aging populations<sup>2</sup>. Starting in the third decade of life, individuals experience an annual decline in muscle mass of up to 1%. When this muscle loss becomes excessive and progresses rapidly, it results in sarcopenia, characterized by reduced muscle function and capability. Sarcopenia is associated with physical weakness, reduced mobility, and increased risks of falls and fractures. This deterioration in musculoskeletal health not only compromises an individual's independence but also predisposes them to long-term complications, hospitalizations, frailty, and premature death. Alarming, individuals with T2DM are 3 to 16 times more likely to develop sarcopenia compared to those without diabetes, suggesting a strong interplay between the two conditions<sup>3,5</sup>. The pathophysiology linking T2DM and sarcopenia is multifaceted. Chronic hyperglycemia, insulin resistance, systemic inflammation, oxidative stress, and advanced glycation end products (AGEs) contribute to muscle protein degradation and impaired muscle regeneration in diabetic patients. Furthermore, the coexistence of sarcopenia and T2DM creates a vicious cycle, as reduced muscle mass and strength can impair glucose metabolism, exacerbating insulin resistance and worsening glycemic control. This bidirectional relationship underscores the importance of early recognition and targeted interventions to mitigate the burden of these conditions<sup>6</sup>. Sarcopenia in the early stages of chronic kidney disease (CKD) is not well understood, yet it is a complication that warrants attention, particularly when albuminuria is present. Albuminuria can act as a warning sign for both CKD and potential sarcopenia, even in cases where sarcopenia has not been previously suspected<sup>7</sup>. Research suggests that higher levels of lean mass (LM) may offer protection against kidney dysfunction, as individuals with greater LM often exhibit lower levels of albuminuria. Additionally, several pathological mechanisms contribute to the development of sarcopenia in CKD. These include heightened inflammation, protein loss, diminished vitamin D production, metabolic acidosis, and mitochondrial dysfunction. These factors collectively lead to muscle degradation, reduced muscle strength, and loss of muscle mass, ultimately culminating in sarcopenia<sup>8</sup>. The present study aimed to estimate the prevalence of sarcopenia in type 2 DM patients for more than 10 years in association with BMD scans.

#### **OBJECTIVES:**

- To determine the prevalence of sarcopenia in patients with type 2 diabetes mellitus (T2DM) for more than 10 years in association with BMD scan.
- To evaluate the association between sarcopenia and bone mineral density (BMD).
- To identify risk factors contributing to sarcopenia in T2DM patients, including glycemic control, vitamin D levels, and inflammation.

#### **METHODOLOGY:**

An observational study was conducted at a tertiary care hospital, Salem from January to October 2024. A total of 120 patients who had type 2 Diabetes mellitus for more than 10 years were included in the study. A consecutive sampling method was used to select the sample.

#### **Inclusion Criteria:**

- Patients aged  $\geq 50$  years.
- Confirmed diagnosis of T2DM based on American Diabetes Association (ADA) criteria.
- Willingness to undergo BMD and sarcopenia assessments.

#### **Exclusion Criteria:**

- Patients with type 1 diabetes mellitus or gestational diabetes.
- Severe systemic illnesses (e.g., cancer, advanced heart failure).
- Patients with conditions affecting musculoskeletal health independent of diabetes (e.g., rheumatoid arthritis, long-term corticosteroid use).

#### **DATA COLLECTION:**

Written informed consent was obtained from all participants. Patients were recruited from the outpatient and inpatient departments of the tertiary care hospital after screening for eligibility criteria. Detailed demographic data (age, gender, place of residence), medical history (History of fractures, comorbidities, and use of medications such as insulin, bisphosphonates, or vitamin D supplements), and Physical examination including weight, height, BMI, and blood pressure were collected. DXA scans were used for

sarcopenia and BMD assessments. Muscle strength and physical performance tests were conducted in a controlled environment by trained professionals.

#### DATA ASSESSMENT TOOLS:

##### 1. Sarcopenia Assessment:

- Muscle Mass: Measured using dual-energy X-ray absorptiometry (DXA) scans to evaluate appendicular skeletal muscle mass (ASM). ASM was adjusted for height squared ( $ASM/height^2$ ) to determine muscle mass index.
- Muscle Strength: Assessed using a handgrip dynamometer. Grip strength thresholds based on EWGSOP2 guidelines were used to classify sarcopenia.
- Physical Performance: Measured via the Short Physical Performance Battery (SPPB), including gait speed, balance, and chair-stand tests.

##### 2. Bone Mineral Density (BMD):

- BMD measurements at the lumbar spine, femoral neck, and total hip was performed using DXA scans. Values were expressed in  $g/cm^2$  and categorized using T-scores as per WHO criteria (normal, osteopenia, or osteoporosis).

##### 3. Clinical and Laboratory Evaluations:

- Demographic Data: Age, sex, duration of T2DM, and comorbidities.
- Biochemical Markers: Serum creatinine, estimated glomerular filtration rate (eGFR), HbA1c, vitamin D levels, and markers of inflammation (e.g., CRP).
- Urinary Albumin-Creatinine Ratio (UACR): Used to identify albuminuria and assess kidney function.

#### DATA ANALYSIS:

The data was entered in MS EXCEL 2019 and analyzed using SPSS Statistics 16.0. Quantitative variables were expressed in mean standard deviation and qualitative variables were expressed in proportions. The chi-square test was used to evaluate the association between categorical variables and T-tests for continuous variables comparing groups.

#### RESULTS:

In the present study, a total of 120 patients who had type 2 Diabetes mellitus for more than 10 years were included. The majority of the study participants belonged to 61-70 years (48.3%) followed by 51-60 years (32.5%) and 60.0% were male. The mean age of the study participants was  $63.4 \pm 8.7$  years. Most of the study participants had 10-15 years of duration of diabetes (56.7%) and 32.5% had 16-20 years of diabetes. The Mean BMI value ( $kg/m^2$ ) was  $25.7 \pm 3.4$   $kg/m^2$ .

In the current study, Sarcopenia was present in 30.0% of the study participants. A significant proportion of patients had osteopenia (48.3%) and osteoporosis (28.3%), indicating that nearly three-quarters of the population had some degree of bone loss. The mean age of the study participants was 63.4 years, with a higher prevalence of sarcopenia among males (60%).

Sarcopenic patients had significantly higher mean HbA1c levels (8.4%) compared to non-sarcopenic patients (7.6%). Sarcopenic patients had significantly lower serum vitamin D levels (17.8 ng/mL) than their counterparts (23.2 ng/mL). Similarly, there was a correlation between Mean Fasting Plasma Glucose (mg/dL), Muscle Mass Index ( $kg/m^2$ ), Grip Strength (kg), and the presence of sarcopenia ( $p < 0.05$ ). Patients with sarcopenia showed significantly higher rates of osteoporosis (33.3%) compared to non-sarcopenic individuals (19.1%). There was a significant association between the presence of sarcopenia and osteoporosis ( $p < 0.05$ ).

**Table 1: Socio-demographic profile of the study participants (N=120)**

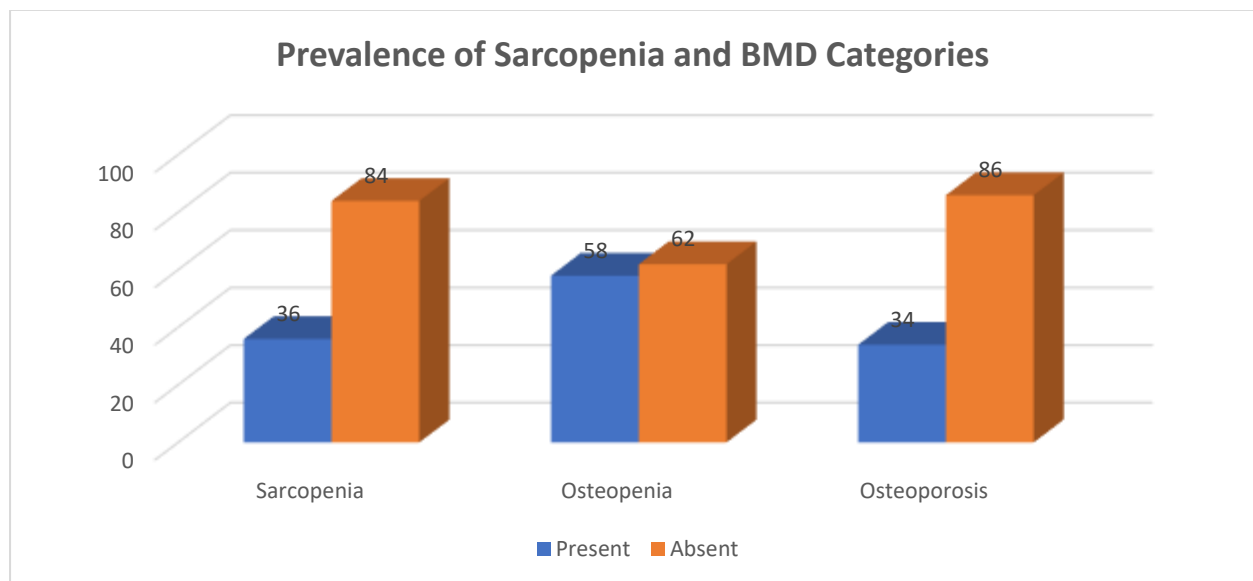
| Variables | Characteristics | Frequency | Percentage |
|-----------|-----------------|-----------|------------|
| Age group | 51-60 years     | 39        | 32.5       |
|           | 61-70 years     | 58        | 48.3       |
|           | >70 years       | 23        | 19.2       |

|                                     |             |                  |      |
|-------------------------------------|-------------|------------------|------|
| Gender                              | Male        | 72               | 60.0 |
|                                     | Female      | 48               | 40.0 |
| Place of residence                  | Urban       | 78               | 65.0 |
|                                     | Rural       | 42               | 35.0 |
| Duration of diabetes                | 10-15 years | 68               | 56.7 |
|                                     | 16-20 years | 39               | 32.5 |
|                                     | >20 years   | 13               | 10.8 |
| Mean duration of diabetes           |             | 12.6 ± 5.3 years |      |
| Mean BMI value (kg/m <sup>2</sup> ) |             | 25.7 ± 3.4       |      |

**Table 2: Prevalence of Sarcopenia and BMD Categories (N=120)**

| Variables    | Characteristics | Frequency | Percentage |
|--------------|-----------------|-----------|------------|
| Sarcopenia   | Present         | 36        | 30.0       |
|              | Absent          | 84        | 70.0       |
| Osteopenia   | Present         | 58        | 48.3       |
|              | Absent          | 62        | 51.7       |
| Osteoporosis | Present         | 34        | 28.3       |
|              | Absent          | 86        | 71.7       |

**Figure 1: Prevalence of Sarcopenia and BMD Categories (N=120)**



**Table 3: Clinical and Laboratory Parameters of the study participants (N=120)**

| Variables                              | Prevalence of Sarcopenia |               | p-value |
|----------------------------------------|--------------------------|---------------|---------|
|                                        | Present (N=36)           | Absent (N=84) |         |
| Mean HbA1c (%)                         | 8.4 ± 1.1                | 7.6 ± 0.8     | <0.001  |
| Mean Fasting Plasma Glucose (mg/dL)    | 146 ± 25                 | 128 ± 21      | <0.05   |
| Serum Vitamin D Levels (ng/mL)         | 17.8 ± 3.5               | 23.2 ± 4.1    | <0.001  |
| Muscle Mass Index (kg/m <sup>2</sup> ) | 6.7 ± 0.4                | 8.2 ± 0.5     | <0.001  |
| Grip Strength (kg)                     | 18.5 ± 2.8               | 26.1 ± 3.4    | <0.001  |

**Table 4: Correlation between BMD and Sarcopenia among the study participants (N=120)**

| Variables | Prevalence of Sarcopenia |               | p-value |
|-----------|--------------------------|---------------|---------|
|           | Present (N=36)           | Absent (N=84) |         |
| Normal    | 4 (11.1%)                | 30 (35.7%)    | <0.001  |

|              |            |            |       |
|--------------|------------|------------|-------|
| Osteopenia   | 20 (55.6%) | 38 (45.2%) | 0.15  |
| Osteoporosis | 12 (33.3%) | 16 (19.1%) | <0.05 |

## DISCUSSION

According to the European Working Group on Sarcopenia in Older People (EWGSOP2) guidelines established in 2018, sarcopenia is suspected when there is a noticeable decline in muscle strength. A confirmed diagnosis requires evidence of reduced muscle mass<sup>9</sup>. The condition is classified as severe sarcopenia when poor physical performance accompanies both low muscle strength and mass. The term "Possible Sarcopenia" refers to individuals with reduced handgrip strength or impaired physical performance, indicating a need for further evaluation. Sarcopenia is confirmed upon detecting low muscle mass alongside these deficits. When all three factors—muscle strength, muscle mass, and physical performance—are compromised, the condition is considered Severe Sarcopenia<sup>10</sup>. In recent years, sarcopenia has drawn significant attention due to its association with increased morbidity. It has been closely linked to type 2 diabetes mellitus (T2DM), with evidence suggesting a bidirectional relationship between the two conditions. However, there remains limited data on the prevalence of sarcopenia among individuals with T2DM, as well as on the factors that may predict its occurrence<sup>11</sup>. The present study aimed to estimate the prevalence of sarcopenia in type 2 DM patients for more than years in association with BMD scans. In the present study, the majority of the study participants belonged to 61-70 years (48.3%) followed by 51-60 years (32.5%) and 60.0% were male. The mean age of the study participants was  $63.4 \pm 8.7$  years. Pechmann LM et al<sup>12</sup> study found that the mean age of the study population was  $65.6 \pm 8.6$  years, 64.4% were male and 35.6% were female. In this study, most of the study participants had 10-15 years of duration of diabetes (56.7%) and 32.5% had 16-20 years of diabetes. The mean duration of diabetes was  $12.6 \pm 5.3$  years and the mean BMI value ( $\text{kg}/\text{m}^2$ ) was  $25.7 \pm 3.4 \text{ kg}/\text{m}^2$ . Similarly, Takahashi et al<sup>13</sup> study reported that the mean duration of diabetes was  $14.1 \pm 10.0$  years and Mori et al<sup>14</sup> study found that the mean diabetes duration of the patients was  $16.6 \pm 11.5$  years. In this study, the prevalence of sarcopenia among the study participants was 30.0%, and the prevalence of osteopenia and osteoporosis were 48.3% and 28.3% respectively. Pechmann LM et al<sup>12</sup> study reported that the prevalence of sarcopenia defined according to the FNIH criteria in the T2DMG was 12.9% and Shahi A et al<sup>15</sup> study found that the prevalence of possible sarcopenia, sarcopenia, and severe sarcopenia was 43%, 18.8%, and 6.1%, respectively. In the present study, Sarcopenia correlated significantly with higher HbA1c, lower vitamin D levels, and reduced physical activity. Sarcopenic patients had significantly higher mean HbA1c levels (8.4%) compared to non-sarcopenic patients (7.6%). This suggests poor glycemic control is a key contributor to muscle degradation in T2DM. Patients with sarcopenia showed significantly higher rates of osteoporosis (33.3%) compared to non-sarcopenic individuals (19.1%). There was a significant association between the presence of sarcopenia and osteoporosis ( $p < 0.05$ ). Pechmann LM et al<sup>12</sup> study observed a positive association between sarcopenia and the presence of osteoporosis in T2DMG ( $p = 0.01$ ). The present results observed that routine assessment of sarcopenia using muscle mass indices and grip strength, alongside BMD scans, is crucial in older T2DM patients and helps in the early identification of at-risk individuals and improves their outcomes. Tight regulation of blood glucose may reduce the risk of sarcopenia.

## CONCLUSION

The study addresses the significant burden of sarcopenia and BMD abnormalities in older T2DM patients. These findings highlight the need for integrated care approaches to address musculoskeletal complications, improve quality of life, and reduce fracture risk. Early interventions targeting glycemic control, nutritional deficiencies, and physical inactivity can mitigate the progression of sarcopenia and its impact on bone health. Structured exercise interventions (resistance training, balance exercises) can enhance muscle strength and slow bone loss.

**Conflict of interest:** None

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