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Prevalence and Determinants of Sarcopenia Among Patients with Type 2 Diabetes Mellitus in Northeast India: A Cross-Sectional Study

Dr Anupravo Bhaumik[1], Dr Pradip Bhaumik[2], Dr Kanak Choudhury[3]

[1]Senior Resident, Department of General Medicine, Agartala Government Medical College & GBP Hospital, Agartala
[2]Professor & HOD, Department of General Medicine, Agartala Government Medical College & GBP Hospital, Agartala
[3]Assistant Professor, Department of General Medicine, Agartala Government Medical College & GBP Hospital, Agartala

Corresponding Author:

Dr Kanak Choudhury
Assistant Professor, Department of General Medicine, Agartala Government Medical College & GBP Hospital, Agartala

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ABSTRACT

Background: Sarcopenia, defined as the progressive loss of muscle mass and function, is increasingly recognised as a comorbidity in Type 2 Diabetes Mellitus (T2DM). However, there is a paucity of data regarding its prevalence and characteristics in Northeast India.
Objective: To estimate the prevalence of sarcopenia among hospitalised patients with T2DM and identify associated demographic and clinical factors.
Methods: A total of 270 patients with T2DM were randomly selected for evaluation. Sarcopenia was diagnosed using CT-based skeletal muscle area (SMA) and skeletal muscle index (SMI) at the L3–L4 level, applying sex specific cutoffs. Sociodemographic, clinical, and laboratory data were systematically collected and analysed.
Methods: A total of 270 patients with T2DM were randomly selected for evaluation. Sarcopenia was diagnosed using CT-based SMA and SMI at the L3–L4 level, applying sex specific cutoffs. Sociodemographic, clinical, and laboratory data were systematically collected and analysed.
Results: Sarcopenia was identified in 72 participants (26.7%). Individuals with sarcopenia were older (mean age 64.9 versus 61.4 years, $p = 0.007$) and had a longer duration of diabetes (mean 9.4 versus 8.2 years, $p = 0.039$). There was no significant difference in sex distribution ($p = 0.398$). The SMI was significantly lower in participants with sarcopenia (36.6 versus 42.1, $p < 0.001$), whereas SMA did not differ significantly between groups.

Keywords: *Sarcopenia, Type 2 Diabetes Mellitus, skeletal muscle area, skeletal muscle index, prevalence, Northeast India.*

INTRODUCTION

Sarcopenia, originally defined by Rosenberg in 1988 as the age-dependent reduction in skeletal muscle mass, has been recognised as a pressing public health challenge due to its association with frailty, disability, and increased mortality in older adults.[1] The definition has grown over time to include not just muscle mass, but also muscle strength and physical performance, showing that it is influenced by many factors.[2] Type 2 Diabetes Mellitus (T2DM), a long-term metabolic disorder marked by insulin resistance and high blood sugar, has been more often connected to sarcopenia. This connection has led to the idea of 'diabetic sarcopenia".[3] This intersection represents a critical yet underrecognized comorbidity that significantly impacts patient outcomes.

Epidemiological evidence constantly indicates the higher prevalence of sarcopenia among patients with T2DM compared to non-diabetic populations. A cross-sectional study demonstrated that in Asia, sarcopenia prevalence in T2DM patients ranges from 10% to 30%, depending on diagnostic criteria and population characteristics.[4] Meta-analyses further confirm that the prevalence of sarcopenia among individuals with diabetes is notably high. Several factors—including advancing age, elevated body mass index (BMI), poor glycemic control reflected by HbA1c, longer duration of diabetes, increased levels of high-sensitivity C-reactive protein (hs-CRP), presence of diabetic nephropathy, and greater visceral fat accumulation—have all been identified as contributors to the heightened risk of sarcopenia in this population.[5]

The processes that cause sarcopenia in people with T2DM are complex and involve several factors. Insulin resistance reduces protein synthesis and accelerates muscle breakdown. High blood sugar causes oxidative stress and mitochondrial dysfunction, which also leads to muscle loss.[6] In addition, complications from diabetes, ongoing inflammation, and hormone imbalances make muscle loss worse.[7] These factors show that T2DM and sarcopenia affect each other: diabetes speeds up muscle decline, and sarcopenia makes it harder to control metabolism.

Sarcopenia in patients with diabetes is associated with an increased risk of falls, hospitalisation, cardiovascular events, and mortality.[8] These findings highlight the critical need to estimate and monitor the prevalence of sarcopenia in T2DM cohorts, especially in resource-limited settings where the burden of diabetes is increasing rapidly.

Clinically, spotting sarcopenia early in people with T2DM is important for starting prevention and treatment. Lifestyle modifications, such as resistance exercise and adequate protein intake, have been shown to reduce muscle loss.[9] In addition, researchers are investigating pharmacological agents that enhance insulin sensitivity and promote muscle growth.[10] Accurate estimation of sarcopenia prevalence is critical for evaluating the effectiveness of these interventions and for guiding healthcare planning and resource allocation.

Knowing how common sarcopenia is among people with T2DM is important for clinical decisions, public health planning, and future research. However, few studies have looked at this association in North-East populations, leaving a major gap in our understanding. This paucity of data has prompted us to conduct the present study to estimate the proportion of patients with Sarcopenia among those with Type 2 Diabetes Mellitus.

MATERIALS AND METHODS

Study Design and Setting: This research employed a cross-sectional, descriptive design within the Department of Medicine at Agartala Government Medical College and Govinda Ballabh Pant Hospital (AGMC), Agartala, Tripura, India.

Study duration: 2 years (January 2023 to December 2024).

Study population: Patients with T2DM admitted to the Medicine Department, AGMC.

Inclusion criteria:

1. Patients diagnosed with T2DM.
2. Patients admitted under the Department of Medicine at AGMC
3. Patients who provided informed written consent to participate in the study.

Exclusion criteria:

1. Pregnant and lactating women.
2. Patients with chronic kidney disease in the end-stage renal disease (CKD-ESRD) undergoing hemodialysis.
3. Critically ill patients on life support.
4. Patients suffering from chronic obstructive pulmonary disease (COPD).
5. Patients diagnosed with liver cirrhosis, malignancy, or HIV infection.
6. Patients with any other diseases predisposing to sarcopenia.
7. Patients who declined to provide consent for participation.

Sample size calculation: The sample size was calculated based on Cochran's formula for sample size collection:
$N = Z_{1-\alpha/2}^2 \text{ X } [p \text{ X } (1-p)] / d^2$

Where Z is the critical value at an α level of significance, p is the expected proportion of outcome (sarcopenia in diabetic nephropathy), and d is the allowable error. Considering p as 28.5% as per the study by Sazlina et al., the calculated sample size at the 95% confidence level and 5% allowable error was 269.9, which was rounded off to 270.[11]

Patients with T2DM who met the eligibility criteria and gave informed consent were selected using simple random sampling. Every Monday, a list of admitted patients was made, and seven people were chosen by lottery without replacement. This process was repeated each week until the sample size was reached. Patients who had already been selected in earlier weeks were not included in later lists.

Operational Definitions:

Sarcopenia: Subjects having depleted muscle mass were labeled as sarcopenic. It was diagnosed using a non-contrast CT scan on a Siemens 128-slice CT scanner in a quantitative manner by directing the sonic beam through the axial plane between the inter-somatic disc spaces of the L3-L4 region. Skeletal muscle mass was separated according to differential density thresholds. A density value of +35 HU was used to separate fat from muscle tissue and +150 HU to separate muscle from bone tissue. The L3 Skeletal Muscle Index (SMI) was expressed as cross-sectional mass / (height)².

a. For male subjects: An SMA (Skeletal Muscle Area) of <144.3 cm^2 and/or an SMI (Skeletal Muscle Index) of <45.4 4cm^2/m^2 was considered as sarcopenia.

b. For female subjects: An SMA of <92.2 cm^2 and/or an SMI (Skeletal Muscle Index) of <34.4 $4cm^2/m^2$ was considered as Sarcopenia.

Study tool: A pretested, structured case record form was employed to document the socio-demographic, clinical, and laboratory findings of the study participants.

Method of data collection: The study collected data systematically to ensure the results were valid and reliable. The research focused on patients with T2DM who were admitted to the Department of Medicine at AGMC. Researchers first identified participants who fit the inclusion and exclusion criteria. When patients were admitted to the hospital, those who met the criteria were invited to join the study.

Eligible patients received detailed information about the study's purpose, procedures, and potential risks and benefits. Written consent was obtained from each participant before enrollment. Participants who consented were included, while those who declined were excluded without affecting their medical care.

After enrolment, participants underwent a multi-stage assessment. In the first stage, we collected detailed medical histories, including sociodemographic data, diabetes duration, management methods, and comorbidities. A pretested, structured case record form ensured consistent data collection.

A systematic clinical examination was conducted to assess participants' general and systemic health, with a focus on parameters related to sarcopenia and diabetic complications. Height and weight were measured to calculate BMI.

Radiological exams were performed to assess muscle mass and evaluate for sarcopenia. We performed a non-contrast CT scan with a Siemens 128-slice scanner. Axial images at the L3-L4 level were used to measure skeletal muscle mass. We used different density thresholds to distinguish muscle from fat and bone. We then calculated SMA and SMI, using set cutoffs to diagnose sarcopenia in men and women.

All collected data, including patient history, clinical findings, radiology results, and laboratory values, were systematically recorded in the case record pro forma. This consistent strategy ensured reliable data collection for analysis while maintaining participant confidentiality and adherence to ethical guidelines.

Data management: We compiled case record proformas into a spreadsheet to create a master chart for analysis. We used SPSS for Windows version 25.0 for data analysis. Categorical variables are shown as proportions, and continuous variables as means and standard deviations. We used the chi-square test to compare proportions and the Student t-test to compare two means. Conditional logistic regression was used to predict key outcomes, including variables that showed significant effects in univariate analysis. We considered results statistically significant if the p-value was <0.05.

Ethical issues: Each participant gave written informed consent. We kept all data confidential and used it only for research. We requested permission from the Medical Superintendent of AGMC to provide free CT scans to study subjects who are not covered under ABPMJAY. All patients received the best possible care in the study setting, regardless of whether they participated. The Institutional Ethics Committee of AGMC reviewed and approved the study protocol.

RESULTS

Of the 270 individuals assessed, sarcopenia was present in 72 (26.7%) participants, whereas it was absent in the remaining 198 (73.3%) participants. The distribution of participants by sarcopenia status is shown in Figure 1.

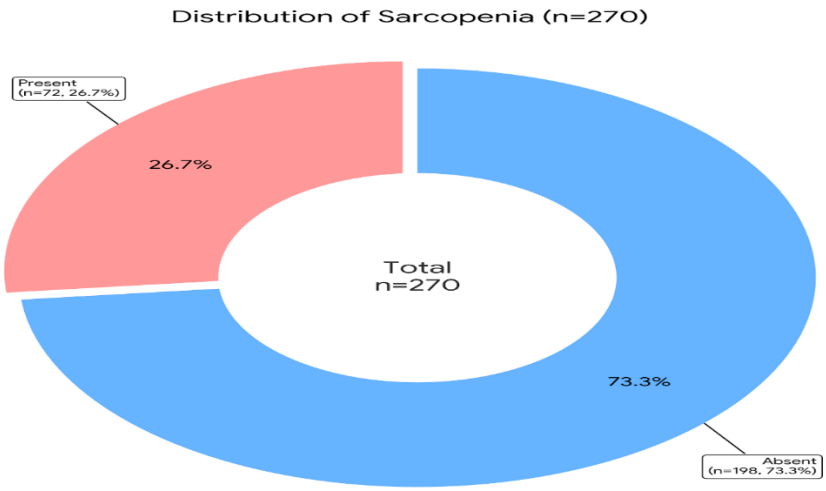

Figure 1: Distribution of sarcopenia among the study population

The mean age of individuals with sarcopenia was 64.9 years (SD = 9.9), which was higher compared to those without sarcopenia, whose mean age was 61.4 years (SD = 8.8). When considering the overall study population, the mean age was 64.1 years (SD = 9.6). The difference in mean age between participants with and without sarcopenia was statistically significant (p = 0.007), indicating that sarcopenia was more frequent among older individuals in this cohort. The distribution of sarcopenia in relation to age is shown in Figure 2.

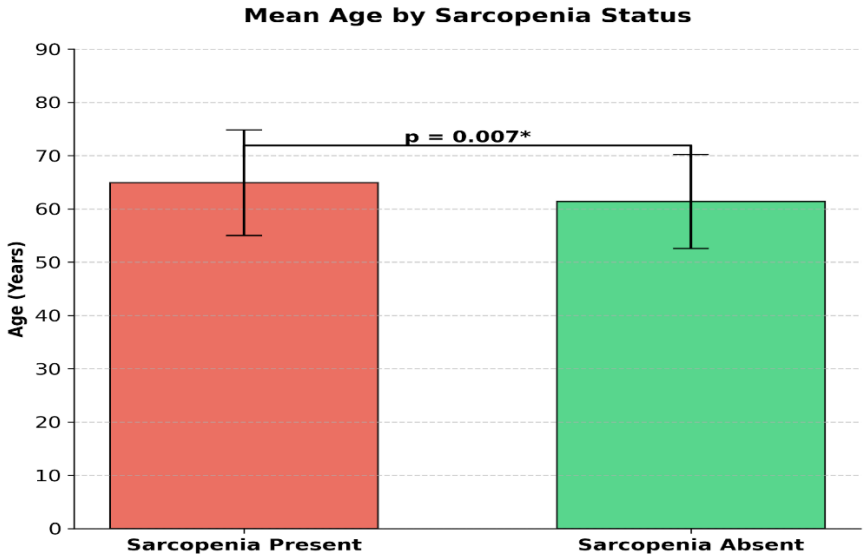

Figure 2: Distribution of age by sarcopenia status

Of the 131 women in the study, sarcopenia was present in 38 (52.8%) participants and absent in 93 (47%). Of the 139 men, sarcopenia was present in 34 (47.2%) participants and absent in 105 (53%). In total, 61 participants had sarcopenia and 209 did not. The p-value for the difference between men and women was 0.398, showing no significant difference in sarcopenia rates between the sexes. Figure 3 illustrates the distribution of sarcopenia according to sex.

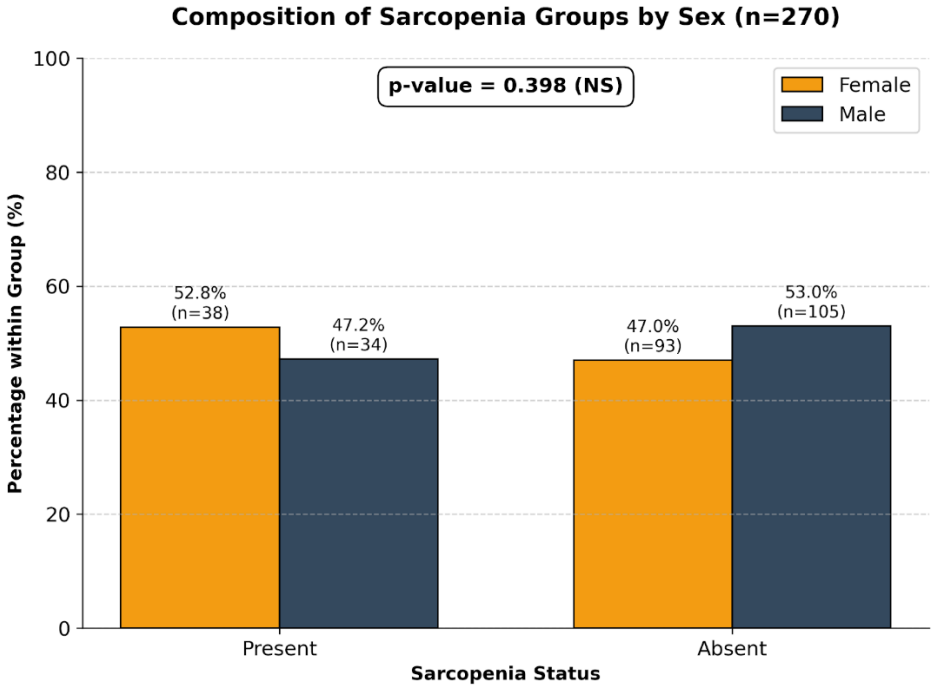

Figure 3: Distribution of sex across sarcopenia categories

The mean duration of diabetes in individuals with sarcopenia was 9.4 years (SD = 4.1), longer than in those without sarcopenia, whose mean duration was 8.2 years (SD = 4.8). When considering the entire study population, the average duration of diabetes was 8.5 years (SD = 4.7). The difference between the two groups was statistically significant (p = 0.039), suggesting that a longer duration of diabetes is associated with a higher likelihood of sarcopenia in this cohort. Figure 4 presents the relationship between sarcopenia and diabetes duration.

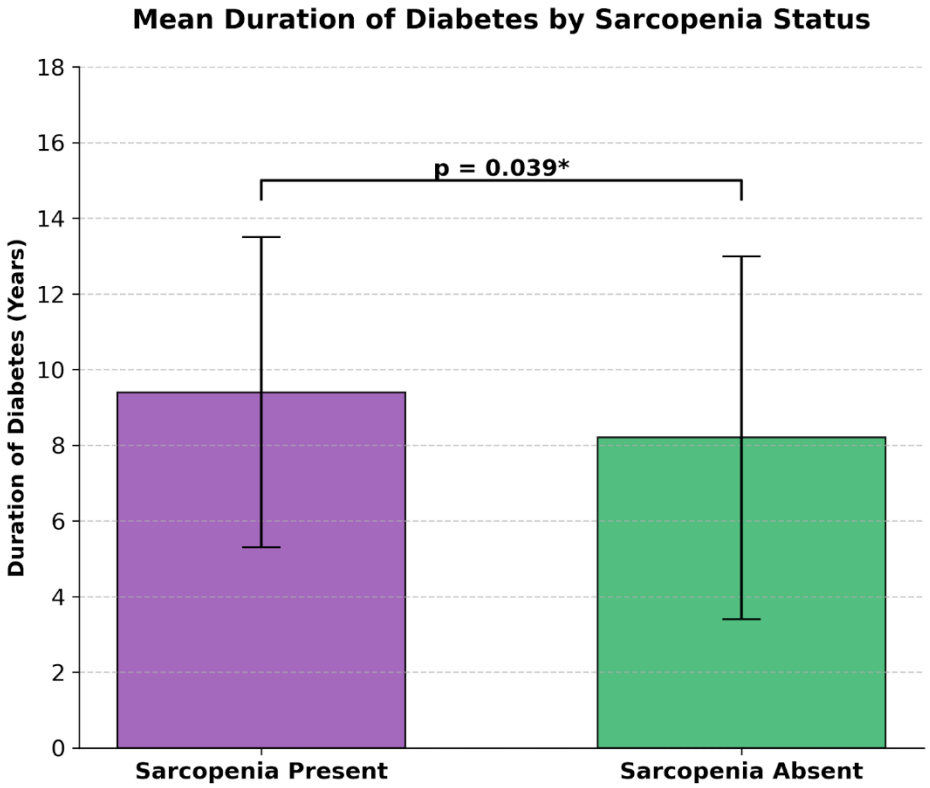

Figure 4: Relationship between the duration of diabetes and the presence of sarcopenia

The mean SMA in individuals with sarcopenia was 116.2 cm² (SD = 25.8), which was slightly lower than that of those without sarcopenia (121.4 cm², SD = 25.8). However, the difference in this comparison was not statistically significant (p = 0.145). In contrast, the SMI showed a marked difference: participants with sarcopenia had a mean index of 36.6 (SD = 5.2) compared to 42.1 (SD = 5.8) in those without sarcopenia. This difference was highly significant (p<0.001), highlighting that reduced SMI is strongly associated with sarcopenia, whereas SMA alone did not differ significantly between groups. Figure 5 illustrates the association between sarcopenia and skeletal muscle measurements.

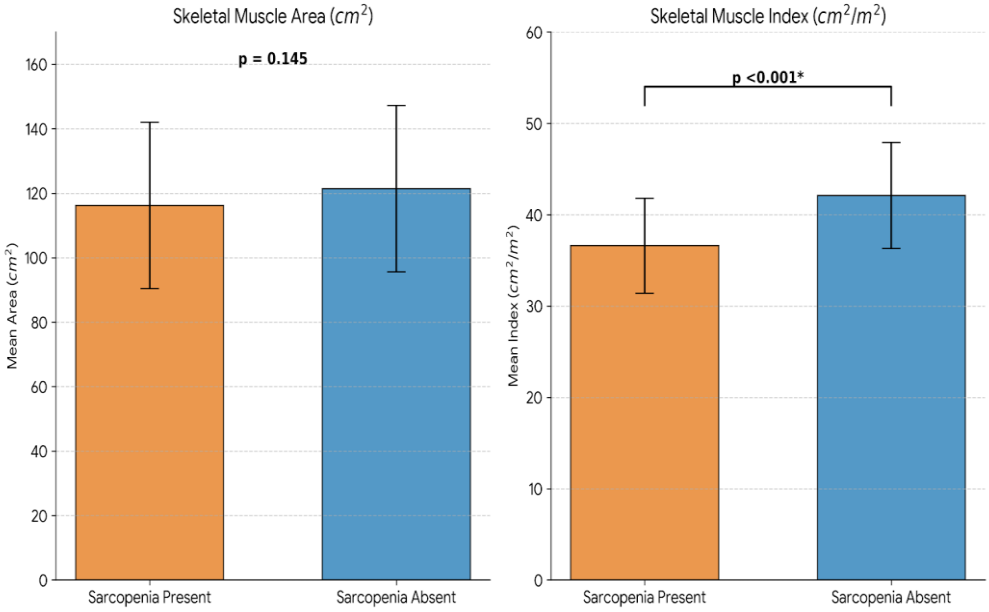

Figure 5: Distribution of skeletal muscle measurements across the study groups

DISCUSSION

This study identified sarcopenia in 26.7% of participants, with age and diabetes duration emerging as significant correlates, while sex differences were not statistically significant. These findings contribute to the growing evidence that sarcopenia is a multifactorial condition, particularly relevant in populations with T2DM.

Age and Sarcopenia
In this group, older age was strongly linked to sarcopenia. This finding is similar with earlier studies, which have often found that ageing is the main factor behind muscle decline. Bhat et al. found that sarcopenia became much more common in middle-aged and older Indian adults, showing that age is key to muscle health.[12] In the same way, Nguyen et al. found that older age was independently linked to sarcopenia in people with T2DM.[13] These findings reinforce the need for early screening and preventive strategies in ageing populations.

Sex Differences
Although women showed a slightly higher prevalence of sarcopenia, the difference was not statistically significant. This contrasts with Yoshimura et al., who found significantly higher sarcopenia rates among post-stroke women compared to men.[14] Other hospital-based studies by Menzies et al have found sex-specific differences, with women often showing greater vulnerability because of hormonal changes and lower baseline muscle mass.[15] However, in this study, there were no significant sex differences, which may be due to similar comorbidity profiles or lifestyle factors among participants. These results indicate that sex might not be a universal factor in all populations.

Diabetes Duration
Participants with sarcopenia had a longer mean duration of diabetes, supporting the hypothesis that chronic hyperglycemia and metabolic dysregulation accelerate muscle loss. A recent Indian cross-sectional study reported similar findings, where longer diabetes duration was significantly associated with sarcopenia and sarcopenic obesity.[16] Another study from Nguyen et al. confirmed that prolonged diabetes exposure increased sarcopenia risk, independent of BMI and waist circumference.[13] Mechanistically, insulin resistance, mitochondrial dysfunction, and chronic inflammation have been implicated in this relationship.[3] Our findings strengthen the evidence that diabetes duration is a key risk factor for sarcopenia.

Skeletal Muscle Measurements
People with sarcopenia had a much lower SMI, but their SMA was not significantly different. This result shows that SMI is a better diagnostic tool because it considers body size and more accurately detects muscle loss. Liu et al. emphasised that predicted SMI is a scalable and reliable marker for sarcopenia risk and mortality in older adults.[17] A review by Liu et al. also concluded that indices incorporating body composition adjustments outperform absolute muscle area in clinical utility.[18] Our findings corroborate these observations, suggesting that SMI should be prioritised in both research and clinical practice.

Clinical Implications
When diabetes and sarcopenia occur together, a condition known as “diabetic sarcopenia,” it creates serious clinical challenges. Ortez Toro found that this combination greatly lowers functional ability and quality of life in older adults.[3] Research shows that resistance training, enough protein in the diet, and good blood sugar control can help slow the progression of sarcopenia.[19] These results highlight why it is important to include muscle health checks in regular diabetes care, especially for older people with long disease duration.

Limitations and Future Directions
Because this study used a cross-sectional design, it is not possible to evaluate the cause and effect. We also did not measure functional outcomes like grip strength or gait speed. Future studies that follow participants over time should examine how muscle decline progresses in people with diabetes and assess the impact of specific interventions. Furthermore, analysis of larger groups stratified by sex may identify differences that were not observed in the present sample.

CONCLUSION
Sarcopenia is a prevalent comorbidity among patients with T2DM, affecting more than one quarter of the studied population. Older age and longer duration of diabetes were identified as significant contributing factors, whereas sex differences were not statistically significant. Importantly, the SMI proved more sensitive than the SMA, underscoring its clinical utility for assessing muscle health.

These findings show that it is important to regularly screen people with diabetes for sarcopenia, especially in places where resources are limited and diabetes rates are rising quickly. Detecting sarcopenia early and using targeted interventions such as resistance exercise, adequate protein intake, and good blood sugar control may help slow muscle loss and improve patient health. More long-term studies that include functional assessments are needed to understand cause-and-effect relationships and to see how well prevention strategies work.

REFERENCES

1. Rosenberg IH. Sarcopenia: origins and clinical relevance. Clin Geriatr Med. 2011;27(3):337-339.
2. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, et al. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing. 2019;48(1):16-31.
3. Ortez Toro JJ. Diabetes and sarcopenia: unraveling the metabolic crossroads of muscle loss and glycemic dysregulation. Endocrines. 2025;6(3):47

4. Nguyen TN, Nguyen TN, Nguyen AT, Nguyen TX, Nguyen HTT, Nguyen TTH, et al. Prevalence of sarcopenia and its associated factors in patients attending geriatric clinics in Vietnam: a cross-sectional study. BMJ Open. 2020;10(9):e037630.
5. Feng L, Gao Q, Hu K, Wu M, Wang Z, Chen F, et al. Prevalence and risk factors of sarcopenia in patients with diabetes: a meta-analysis. J Clin Endocrinol Metab. 2022;107(5):1470-1483
6. Park SW, Goodpaster BH, Lee JS, Kuller LH, Boudreau R, de Rekeneire N, Harris TB, Kritchevsky S, Tylavsky FA, Nevitt M, Cho YW, Newman AB; Health, Aging, and Body Composition Study. Excessive loss of skeletal muscle mass in older adults with type 2 diabetes. Diabetes Care. 2009;32(11):1993-1997.
7. Kalyani RR, Corriere M, Ferrucci L. Age-related and disease-related muscle loss: the effect of diabetes, obesity, and other diseases. Lancet Diabetes Endocrinol. 2014;2(10):819-829.
8. García-Tercero E, Villalon Rubio D, Belenguer-Varea Á, Cunha-Pérez C, Viña J, Tarazona-Santabalbina FJ. Impact of Sarcopenic Diabetes on Outcomes and Mortality in Older Adults Hospitalized for Hip Fracture: A Nested Case-Control Study Within a Real-World Evidence Cohort. Nutrients. 2025;17(16):2616.
9. Peterson MD, Gordon PM. Resistance exercise for the aging adult: clinical implications and prescription guidelines. Am J Med. 2011;124(3):194-198.
10. Morley JE. Pharmacologic Options for the Treatment of Sarcopenia. Calcif Tissue Int. 2016;98(4):319-333.
11. Sazlina SG, Lee PY, Chan YM, Hamid AMS, Tan NC. The prevalence and factors associated with sarcopenia among community-living elderly with type 2 diabetes mellitus in primary care clinics in Malaysia. PLoS One. 2020;15(5):e0233299.
12. Bhat G, Ireland A, Shah N, Gondhalekar K, Mandlik R, Kajale N, et al. Prevalence and factors associated with sarcopenia among urban and rural Indian adults in middle age: A cross-sectional study from Western India. PLOS Glob Public Health. 2024;4(10):e0003553.
13. Nguyen HT, Truong NT, Phan PD, Le HM, Nguyen DT, Nguyen NH, et al. Prevalence of sarcopenia and associated factors among patients with type 2 diabetes: A cross-sectional study. Arch Balk Med Union. 2025;60(2):201-210.
14. Yoshimura Y, Wakabayashi H, Nagano F, Matsumoto A, Shimazu S, Shiraishi A, et al. Sex differences in sarcopenia prevalence and muscle-related outcomes among post-stroke inpatients. Eur Geriatr Med. 2025;16(3):1071-1079.
15. Menzies C, Bowtell R, Shur N, Brook MS. Menopause, Female Sex Hormones, Skeletal Muscle Mass and Muscle Protein Turnover in Humans. J Cachexia Sarcopenia Muscle. 2026;17(1):e70232.
16. M Y, Patel MG, Makwana HH, Kalariya H. Unraveling the enigma of sarcopenia and sarcopenic obesity in Indian adults with type 2 diabetes - a comparative cross-sectional study. Clin Diabetes Endocrinol. 2024;10(1):22.
17. Liu Y, Qi Y, Wang H, Zhao X, Zhang M, Ma L, et al. Predicted skeletal muscle index as a scalable marker for sarcopenia risk and mortality in older Chinese adults. Front Med (Lausanne). 2025;12:1640410.
18. Liu G, Jiang S, Xie W, Liu X, Yang G, Lu W, et al. Biomarkers for sarcopenia, muscle mass, muscle strength, and physical performance: an umbrella review. J Transl Med. 2025;23(1):650.
19. Sui Y, Ma Y, Zhou K, Liang R, Liu X. A narrative review on the correlation between diabetic foot and sarcopenia. Front. Endocrinol. 2026;17:1711060.