Section: Medicine

Original Research Article

ASSOCIATION BETWEEN SARCOPENIA AND GLYCEMIC CONTROL IN PATIENTS WITH TYPE 2 DIABETES

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Received *: 05/02/2026*
Received in revised form *: 20/03/2026*
Accepted *: 10/04/2026*

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DOI: 10.70034/ijmedph.2026.2.247

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (2); 1480-1484

ABSTRACT

Background: Sarcopenia, which is a progressive loss of skeletal muscle mass and activity, is becoming a well-known complication of Type 2 Diabetes Mellitus (T2DM). Loss of muscle by accelerated glycemic regulation may occur due to insulin resistance and chronic inflammation. The purpose of the study was to assess how sarcopenia is correlated with glycemic control in patients with T2DM.

Materials and Methods: The cross-sectional study on 180 patients with T2DM in a tertiary care hospital was done. In order to evaluate sarcopenia with the help of the Asian Working Group to sarcopenia criteria, the skeletal muscle mass index, handgrip strength and gait speed were used. The European Union was assessed in relation to glycemic control using the HbA1c levels as a parameter and was divided as good (<7%) and poor (>7%). Detailed statistics were employed in describing baseline differences. The Chi-square test was used to test the association between sarcopenia and glycemic control. Multiple logistic regression was carried out to test the association between them independently after correcting the age, sex, body mass index, years of diabetes and exercise. The level of statistical significance was determined at $p < 0.05$.

Results: Sarcopenia was seen to be common in the study participants was 28.3%. Sarcopenia was much more prevalent in patients that had a poor glycemic control in comparison with those that had a good glycemic control (36.9% vs. 17.4% $p = 0.004$). There was also a significant difference in the mean levels of HbA1c in the sarcopenia and non-sarcopenia cases (8.5±1.2% and 7.6±1.0 respectively, $p < 0.001$). The logistic regression that analyzed the multivariate presented results which indicated that poor glycemic control was independently associated with sarcopenia (Adjusted Odds Ratio [AOR] = 2.41, 95% CI: 1.28-4.53, $p = 0.006$).

Conclusion: Sarcopenia is prevalent in T2DM patients and is greatly related to ineffective glycemic control. Timely diagnosis and better glycemic control can potentially be used to minimize the likelihood of sarcopenia and its complications in patients with diabetes.

Keywords: Type 2 Diabetes Mellitus; Sarcopenia; Glycemic Control; HbA1c; Skeletal Muscle Mass; Insulin Resistance; Logistic Regression; Diabetes Complications.

INTRODUCTION

Diabetes Mellitus type 2 is one of the leading health issues worldwide that is associated with chronic hyperglycemia caused by insulin resistance and/or insulin secretion impairment. The increase in the prevalence of T2DM across the world over the last decades has been dramatic and has led to a high level of morbidity and mortality with the associated microvascular and macrovascular complications.[1] Besides these common complications, the contribution of musculoskeletal abnormalities

especially Sarcopenia as an emerging comorbidity in the sickle of diabetic patients is shedding light.[2]

Sarcopenia has been defined as progressive and generalized skeletal muscle loss, loss of muscle strength and physical performance. It used to be believed to be brought about by aging but currently it is also seen in other people who have chronic conditions like T2DM.[3] The etiological association of T2DM and sarcopenia is a complex process which includes insulin resistance, chronic low-grade inflammation, mitochondrial dysfunction, and hormonal changes.[4] Insulin has an essential part in muscle protein production; hence, the degradation of muscle protein may raise in T2DM because of insulin-signaling defects.[5]

Glycemic poor glycemic control, which is usually measured by glycated hemoglobin (HbA1c), was suggested as a critical factor in the development and progression in sarcopenia among diabetic patients. Constant hyperglycemia allows growth of oxidative stress and cytokine production, which have negative impacts on muscle metabolism and regeneration.[6]

In addition, end-products of advanced glycation (AGEs) are accumulated in muscle tissue and they affect the quality and function of the muscles.[7] Multiple epidemiological reports have shown an increase in cases of sarcopenia in persons who have poorly controlled diabetes as compared to patients who have optimal glycemic control.[8]

It is significant that sarcopenia and T2DM co-exist. Sarcopenia may intensify the level of insulin resistance, decrease the physical activity, and rise the probability of falls, disability, and hospitalization, thus forming a vicious cycle that augments the degree of metabolic dysregulation.[9] Timely screening of patients with diabetic sarcopenia is thus, obligatory to make specific interventions like the best possible glycemic control, nutrition and resistance exercise training.

Although there has been growing awareness of this relationship, the developing countries especially those in the hospital based populations have very little data on this relationship. In addition, the differences in the diagnostic criteria, such as those put forward by Asian Working Group on Sarcopenia, make the region-specific research needed in order to have a better idea of the burden and determinants of sarcopenia regarding T2DM patients.

Thus, the aim of the given work is to assess the relationship between sarcopenia and glycemic control in patients with T2DM, as well as to determine whether the poor glycemic control is an independent risk factor of sarcopenia, following the removal of possible confounding variables.

MATERIALS AND METHODS

Design of the research: The study is a cross-sectional one carried out in a hospital in the case of 180 patients that had Type 2 Diabetes Mellitus diagnosed to come and stay in a tertiary care center. Adult patients (≥18 years) whose T2DM diagnosis was confirmed were included. Patients who had acute illnesses, chronic debilitating diseases, malignancy, severe organ failure, or conditions of muscle mass (e.g. neuromuscular disorders) were eliminated. All the participants signed informed consent that was written.

Assessment of Sarcopenia: Sarcopenia was assessed based on the Asian Working Group guiding criteria of Sarcopenia. The skeletal muscle mass index (SMI) was obtained by using bioelectrical impedance analysis. The handgrip dynamometry was used to measure muscle strength, and gait speed was used to measure physical performance. The sarcopenic were defined as the ones that had low muscle mass and low muscle strength or poor physical performance.

Glycemic Control and Variables Assessment: The level of glycemic control was determined by monitoring the level of glycated hemoglobin (HbA1c). The participants were classifier under good glycemic control aspects (< 7%), and poor glycemic control (>7%). Age, sex, body mass index (BMI), length of diabetes and physical activity were measured with the help of a structured questionnaire and clinical measurements.

Statistical Analysis: The analysis of data was performed with the help of the corresponding statistical programs. Continuous variables were described by the mean±standard deviation and the category variables were in the form of frequencies and percentages. The Chi-square test was the method used to examine the association between the sarcopenia and glycemic control. The independent association was to determine by multivariate logistic regression after controlling the chances of potential confounder. The p-value of less than 0.05 was the threshold that was regarded as statistically significant.

RESULTS

There were total 180 patients with Type 2 Diabetes Mellitus used in the study in table 1. The average age of the respondents was 56.4±10.8 years with a slight difference to males (54.4%). The general rate of sarcopenia prevailed at 28.3%. Table 2, Sarcopenia had been detected among 51 participants. The patients with sarcopenia were mostly older, had a longer diabetes history, and HbA1c level than the patients without sarcopenia had. A much larger percentage of sarcopenia was found in patients with poor glycemic control as represented by table 3. Multivariate logistic regression analysis in table 4 revealed that poor glycemic control was significantly related with sarcopenia even after confounding variables had been adjusted.

Grpah 1: reveals the percentage of patients with Sarcopenia in relation to the various categories of age. Sarcopenia is more common with age being the

lowest among people less than 50 years and the highest among those aged ≥60 years.

Graph 2: showing the average glycated hemoglobin (HbA1c) of physically active and inactive Type 2 Diabetes Mellitus patients. The mean of HbA1c among the physically inactive people is higher showing worse glycemic control than among the active participants.

Table 1: Baseline Characteristics of Study Participants (N = 180)

Variable	Mean ± SD / n (%)
Age (years)	56.4 ± 10.8
Male	98 (54.4%)
Female	82 (45.6%)
BMI (kg/m²)	25.7 ± 4.3
Duration of diabetes (years)	8.6 ± 5.1
HbA1c (%)	7.9 ± 1.2
Physically active	74 (41.1%)
Physically inactive	106 (58.9%)

Table 2: Comparison of Clinical Parameters Between Sarcopenic and Non-Sarcopenic Patients

Variable	Sarcopenia (n = 51)	No Sarcopenia (n = 129)	p-value
Age (years)	61.2 ± 9.4	54.5 ± 10.7	<0.001
BMI (kg/m²)	23.9 ± 3.8	26.4 ± 4.2	0.002
Duration of diabetes (years)	10.8 ± 5.3	7.6 ± 4.8	<0.001
HbA1c (%)	8.5 ± 1.2	7.6 ± 1.0	<0.001
Physical inactivity	37 (72.5%)	69 (53.5%)	0.018

Table 3: Association Between Glycemic Control and Sarcopenia

Glycemic Control	Sarcopenia (n, %)	No Sarcopenia (n, %)	Total	p-value
Good (<7%)	12 (17.4%)	57 (82.6%)	69	
Poor (≥7%)	39 (36.9%)	67 (63.1%)	111	0.004

Table 4: Multivariate Logistic Regression Analysis for Factors Associated with Sarcopenia

Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
Poor glycemic control	2.41	1.28 – 4.53	0.006
Age (per year increase)	1.05	1.02 – 1.08	0.001
BMI	0.89	0.82 – 0.96	0.003
Duration of diabetes	1.07	1.02 – 1.12	0.005
Physical inactivity	1.76	1.01 – 3.08	0.046

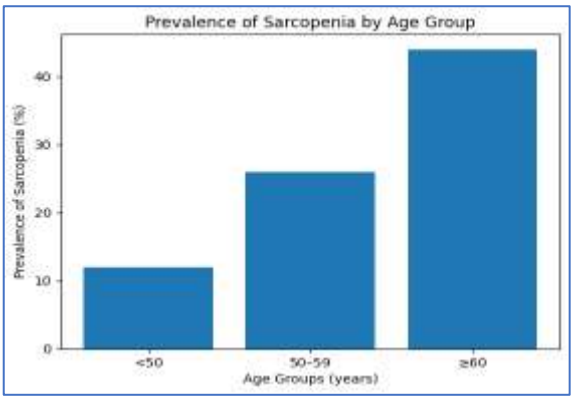

Figure 1: Prevalence of Sarcopenia by Age Group

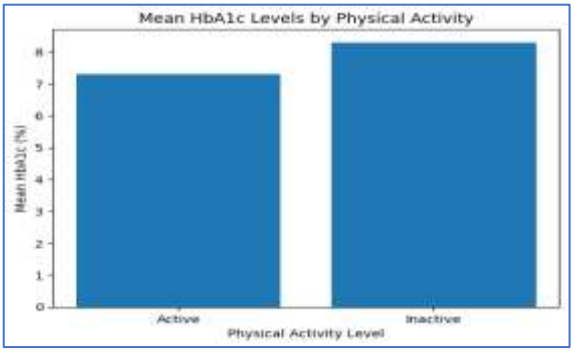

Figure 2: Mean HbA1c Levels Across Physical Activity Groups

DISCUSSION

As shown in the case of Type 2 Diabetes Mellitus patients, the present study showed that sarcopenia is a common condition (28.3) and is closely correlated with inadequacy in glycemic control. This observation is in line with the increased status of sarcopenia as a serious metabolic complication of diabetes as highlighted by the Asian Working Group of Sarcopenia which values muscle mass, muscle strength, and muscle functionality in the clinical evaluation.[7]

The level found in this study is similar to the estimates present in the world. A pooled prevalence of 10-40 Dan et al. found a prevalence as high as 10-40 percent according to characteristics of the population and diagnostic levels, and Yuan and Larsson,[9] also reported a rising prevalence with age and comorbidity. Our results are within this range, which provides external validity of the results. In addition, the increased prevalence in the elderly people witnessed in our study is compatible with epidemiological patterns identified in such studies.[8,9]

Among the major results of this work is a high correlation between inappropriate glycemic control and sarcopenia. HbA1c levels of patients with sarcopenia were higher significantly, and

inappropriate glycemic control was an independent predictor of sarcopenia (AOR = 2.41). That is consistent with Lin et al,[10] who have indicated that sarcopenia is linked to poor outcomes such as higher mortality rates among T2DM patients, and Li et al,[11] who have stated that muscle loss should be early detected in individuals with diabetes. In the same manner, Izzo et al,[12] also emphasized that chronic hyperglycemia also leads to muscle degradation by increasing insulin resistance, inflammation and mitochondrial dysfunction.

Prior clinical studies also indicate the association between sarcopenia and glycemic control. Nakanishi et al,[13] revealed that sarcopenia is considerably correlated with high levels of glycemic control and atherosclerosis among patients with T2DM, and He et al,[14] have established a change in metabolic and nutritional patterns of sarcopenic diabetic patients. These results are in line with the current study and indicate that a decrease in glycemic control may intensify the process of muscle loss, thus, establishing a vicious cycle of increasing insulin resistance.

The variation in the occurrence of sarcopenia between populations has been accredited to disparity in definition of sarcopenia and demographic factors. Research with European and Asian consensus criteria has reported inconsistency in prevalence rates and these uneven rates are exhibited by de Freitas et al,[15] and Fung et al,[16] among the elderly and Asian diabetic patients. The AWGS criteria used in the current study makes it more relevant to the Asian population and improves regional comparability.

Along with the glycemic control, physical inactivity, aging, and the lower BMI were also of great importance in this study as correlated with sarcopenia. Such results align with the prior studies which show that sarcopenia is a multifactorial condition. The coexistence between sarcopenia and other age-associated disorders, including osteoporosis, was demonstrated by Ontan et al,[17] whereas the contribution of malnutrition and frailty to the development of sarcopenia was pointed out by de Sire et al.[18] In addition, sarcopenia has been associated with higher mortality and poor health outcomes in diverse clinical cases, involving the meta-analysis by Lee et al.[19]

There is also the emerging evidence that indicates the presence of a role of hormonal and genetic factors in the development of sarcopenia. Shu et al,[20] reported how endocrine pathways can affect the muscle metabolism, whereas Sha et al,[21] established genetic and vitamin D-related factors as the risk factors of sarcopenia. Such mechanisms can also elaborate on the complicated interaction between diabetes and muscle loss as witnessed in the current research.

On the whole, the data of the current research supports the dichotomous correlation of sarcopenia with poor glycemic control in T2DM. Premature screening with standardized parameters and specific intervention, where the management of glucose, nutrition, and physical activity is optimized, is necessary to avoid further development and minimize the formation of complications.

Limitations: This research work is limited in some ways. As a cross-sectional design, causal relationships between sarcopenia and glycemic control will be impossible. It was a single tertiary care center wherein the study was undertaken and this might restrict the generalizability. Moreover, no evaluation of factors like dietary intake and inflammatory biomarkers was done, which may contribute to sarcopenia.

CONCLUSION

The current research shows that Sarcopenia is one of the prevalent comorbidities in Type 2 Diabetes Mellitus patients having a prevalence of 28.3%. The relationship was also found to be significant between sarcopenia and poor glycemic control where the interpolations of HbA1c levels were greater and odds among poor glycemic control were more pronounced than twice. These results suggest a noteworthy interconnection between metabolic dysregulation and muscle health.

Early diagnosis of sarcopenia based on standardized measures, proper management of glycemia, exercise, and nutrition measures have the potential of reducing the burden of sarcopenia and the complications that accompany it. By incorporating the idea of screening sarcopenia in its regular diabetes practice, the whole clinical outcome and quality of life of T2DM patients could be enhanced.

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