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Comparison of Prevalence of Sarcopenia in Elderly Individuals with and without Type 2 Diabetes Mellitus and its Association with Various Risk Factors

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Abstract

Introduction: *Type 2 diabetes mellitus (T2DM) is one of the most common metabolic disorders. Sarcopenia is a degenerative skeletal muscle disorder associated with aging. It has been identified as a novel complication seen in older adults. The aim of our study was to compare the prevalence of sarcopenia in elderly Indian population aged above 60 years with and without type 2 diabetes mellitus.*

Methods: *This was an observational, case-control study, in which elderly population aged more than 60 years were included and categorized into two groups: those with T2DM and those without T2DM. Sarcopenia was diagnosed in presence of low hand grip strength with SARC-F questionnaire score of ≥4.*

Results: *A total of 237 participants were enrolled, consisting of 128 individuals with T2DM and 109 individuals without T2DM. Prevalence of sarcopenia among individuals with T2DM was two times more than individuals without T2DM which was statistically significant (OR=1.35, P=0.029). Mean testosterone was lower in individuals with T2DM than individuals without T2DM. Mean hand grip strength was lower in individuals with T2DM than individuals without T2DM. There was statistically significant association of sarcopenia with age, physical activity and Body Mass Index (BMI).*

Conclusion: *Prevalence of sarcopenia among individuals with type 2 diabetes mellitus is 32.03% while, in individuals without type 2 diabetes mellitus is 13.76%. T2DM is an independent risk factor for development of sarcopenia. Increasing age, sedentary lifestyle, higher BMI and low serum testosterone (in males) are*

independent risk factors for development of sarcopenia.

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Keywords: Sarcopenia, Type 2 Diabetes Mellitus, Hand Grip Strength, Testosterone

Introduction

Type 2 diabetes mellitus (T2DM) is one of the most common metabolic disorders [1]. Over the past thirty years, the prevalence of diabetes has more than doubled globally [2,3]. Type 2 diabetes affected 4.4% of people aged 15–49 years, 15% of people aged 50–69 years, and 22% of people aged 70 years or more. According to a survey conducted by the Indian Council of Medical Research, this amounts to 11.4% of the population [4].

Sarcopenia was first described by Irwin Rosenberg as the age-related loss of skeletal muscle mass [5,6]. It has been believed that sarcopenia is mostly caused by age or secondary to decreased activity, such as bed rest, chronic illne sses, cancer, poor diet, or endocrine disorders. By 2050, it is predicted that 2 billion senior individuals will have been diagnosed with sarcopenia as a result of longer life expectancy [7].

A number of studies have demonstrated that type 2 diabetes mellitus patients aged with a greater decline of muscle mass, strength, and functional ability than people without the diabetes [8]. Asian populations are more likely to have sarcopenia, abdominal obesity, and elevated insulin resistance [9]. Strength, Assistance in walking, Rise from a chair, Climb stairs, and Falls (SARC-F) questionnaire and hand grip strength are bedside diagnostic tool for sarcopenia [10,11]. However, limited studies have investigated the relationship between T2DM and sarcopenia in Indians so far. The aim of the study was to assess the prevalence of sarcopenia in elderly Indian population aged above 60 years with and without type 2 diabetes mellitus. The secondary objective was to determine risk factors associated with sarcopenia.

Materials and Methods

This observational, case-control study was conducted in the Department of Endocrinology of our tertiary care hospital in Central India over a period an 18-month period from 9th May 2023 to 30th November 2024. The study comprised of elderly population aged more than 60 years, categorized into two groups: those with T2DM (case-group) and those without T2DM (control-group). Both groups were matched for age, gender, BMI and lifestyle to control for these potential confounders.

Sample size was determined based on a power analysis. To achieve 95% confidence interval, minimum required sample size was calculated to be 200 (100 per group). During the study period, a total of 237 participants were enrolled, consisting of 128 individuals with T2DM and 109 individuals without T2DM.

Eligible participants included all elderly individuals aged more than 60 years. Exclusion criteria were patients with chronic kidney disease (eGFR <60ml/min), history of cerebro-vascular accidents, history of malignancies, patients with chronic liver disease, very sick patients, patients with chronic illness, patients taking steroids and patients who were not willing to give consent for study.

All the participants were enrolled in the study after applying inclusion and exclusion criteria. All the relevant information pertaining to the study and sociodemographic variables were obtained and documented in proforma. Duration of T2DM, history of comorbidities, lifestyle of participants, duration of exercise per week and type of diet were noted. Sedentary behavior was labelled for individuals who were sitting or lying down for more than 6 hours per day excluding nighttime sleep. Body Mass Index (BMI) was calculated from measured height and weight. Hand grip strength of dominant hand was noted using hand-held dynamometer. Low hand grip strength was labelled as per Asian age-specific cut-offs. SARC-F questionnaire was applied on all participants. Sarcopenia was diagnosed in presence of low hand grip

strength with SARC-F questionnaire score of ≥4. Early morning serum testosterone of male participants was measured. Other available relevant data like blood pressure, hemoglobin and serum creatinine were noted.

Statistical Analysis

Categorical variables were expressed as frequency and proportion whereas continuous data were represented as mean and standard deviation. Statistical analysis was done using Statistical Package of Social Science (SPSS Version 29.0; Chicago Inc., USA). Data comparison was done by applying specific statistical tests (ANOVA test, Chi-square test, Odds ratio) to find out the statistical significance of the comparisons. P-value of less than 0.05 was considered as statistically significant.

Results

A total of 237 participants were enrolled in the study, comprising 128 individuals with T2DM (case-group) and 109 individuals without T2DM (control-group). The baseline characteristics of both groups are shown in Table 1. Both groups were matched for age, gender, BMI and lifestyle to control for these potential confounders.

Table 1: Baseline Ccharacteristics of Sstudy Groups: Data are Represented as Mean±SD.

Parameters	T2DM (Case-group) (n=128)	Non-diabetic (Control-group) (n=109)	P
Age (years)	66.9±6.09	66.7±6.42	0.153
Male Gender – no. (%)	65 (50.8)	55 (50.5)	0.296
Female Gender – no. (%)	63 (49.2)	54 (49.5)	0.296
BMI (kg/m2)	25.2±4.42	24.7±4.74	0.895
Sedentary Lifestyle –%	57.80%	61.50%	0.676
Duration of exercise per week (mins)	144±78	152±69.4	0.526
Systolic Blood Pressure (mmHg)	136±13.6	131±15.1	0.416
Diastolic Blood Pressure (mmHg)	77.6±9.16	78.1±9.15	0.394
Hemoglobin (g/dL)	12.2±1.76	12.4±1.82	0.719
Creatinine (mg/dL)	0.9±0.22	0.87±0.19	0.232
Testosterone (ng/dL) in males	417±210	436±128	0.473
Hand grip strength (kg)	20±7.36	23.3±5.12	0.649

In our study, that the prevalence of sarcopenia among individuals with type 2 diabetes mellitus is 32.03%. The prevalence of sarcopenia in individuals without type 2 diabetes mellitus is 13.76% (Figure 1). We observed that the prevalence of sarcopenia among individuals with T2DM was 2 times more than individuals without T2DM which was statistically significant (OR=1.35, 95% CI: 0.399-4.59, P=0.029).

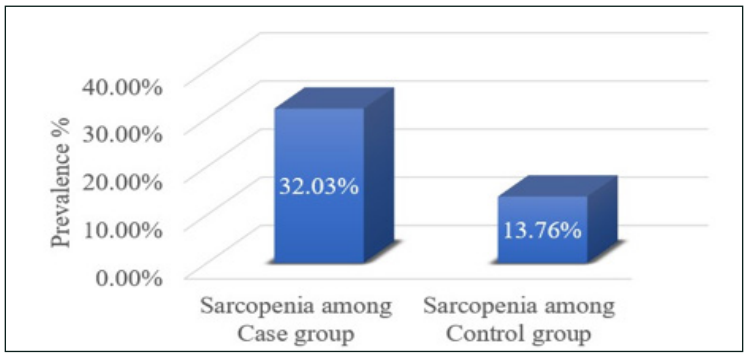

Figure 1: Comparison of sarcopenia among study groups

The mean testosterone levels in male participants declined progressively with age in both study groups (Figure 2). Mean testosterone (ng/dL) was lower in individuals with T2DM than individuals without T2DM (417 vs 436), however it was statistically not significant (P=0.473).The mean hand grip strength progressively declined with age in both study groups (Figure 3). Mean hand grip strength (kg) was lower in individuals with T2DM than individuals without T2DM (20 vs 23.3, P=0.649). The odds ratio came out to be 1.33 (95% CI: 0.387-4.57) which is statistically significant.

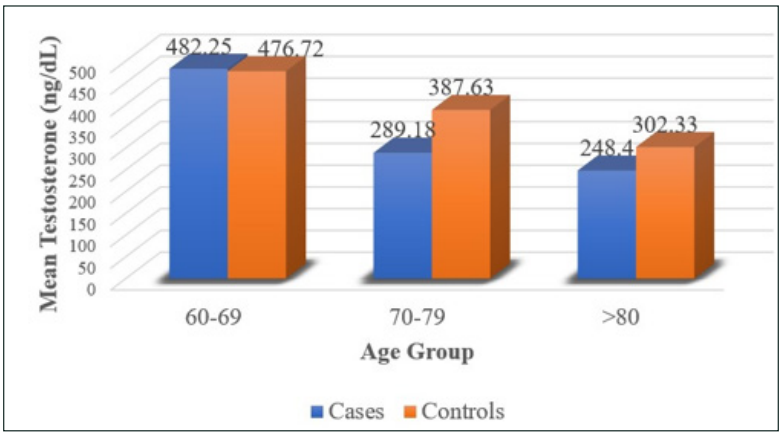

Figure 2: Mean Testosterone in male participants

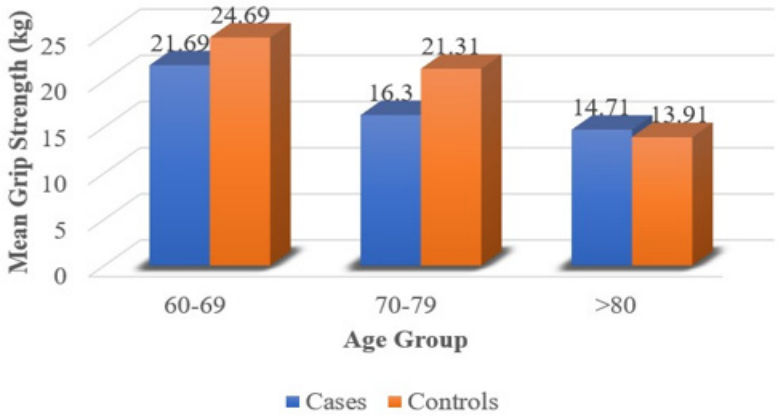

Figure 3: Mean Hand Grip Strength among study participants

The prevalence of sarcopenia progressively increased with age in both study groups (Figure 4). In age group of 60-69 years prevalence was 21.9% and 5.1% among cases and controls respectively. Prevalence rose to 53.5% and 28% among cases and controls respectively who were between 70-79 years of age. In population above 80 years of age, prevalence was 66.6% in both case-group and control group. There was statistically significant increase in the prevalence of sarcopenia with increasing age (P<0.001).

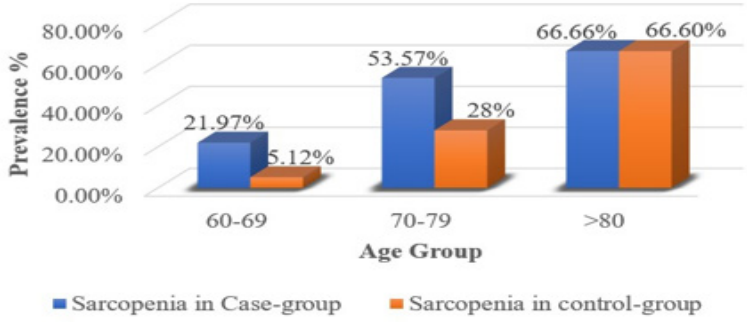

Figure 4: Association of sarcopenia with age

20.7% of males and 33.3% of females in case-group had sarcopenia while 14.5% of males and 17.3% of females in control-group had sarcopenia. There was no statistically significant difference in the prevalence of sarcopenia among males and females (P=0.568). We found that there was statistically significant increase in the prevalence of sarcopenia as the duration of T2DM increases (P<0.001). Prevalence of sarcopenia was more in people with sedentary lifestyle compared to people who were active. 48.6% of people in case-group and 26.1% people in control-group who had sedentary lifestyle developed sarcopenia. 9.25% of participants in case-group and 5.97% of participants in control-group who lead active lifestyle developed sarcopenia. There was statistically significant association between prevalence of sarcopenia and physical activity of study population (P=0.003). There was statistically significant association between sarcopenia and duration of exercise in both study groups (P=0.004). There was no statistically significant difference in prevalence of sarcopenia among vegetarians and non-vegetarians (P=0.957). Prevalence of sarcopenia positively correlated with BMI in both study groups (P=0.018 vs <0.001) which indicates that prevalence of sarcopenia is higher in individuals with higher BMI. Serum testosterone had statistically significant association with sarcopenia in both study groups (P<0.001). Prevalence of sarcopenia was higher in population with low levels of serum testosterone.

There was no statistically significant association of blood pressure with sarcopenia in both study group populations (P=0.877). No correlation was found between sarcopenia and serum creatinine levels in control-group (P=0.433). However, there was correlation between creatinine and sarcopenia in case-group (P=0.026) indicating that individuals who had sarcopenia in case group had lower creatinine compared to individuals without sarcopenia. Hemoglobin showed statistically significant association with sarcopenia in case-group (P<0.001) indicating that participants who had sarcopenia in case-group had lower hemoglobin as compared to individuals without sarcopenia. However, the same was not observed in control-group (P=0.589). We also found statistically significant correlation between serum testosterone levels and duration of T2DM (P<0.001) indicating that serum testosterone levels decreased as the duration of diabetes increased.

Discussion

We observed that the prevalence of sarcopenia among individuals with T2DM was 2 times more than individuals without T2DM. This emphasizes that T2DM is an important independent risk factor for development of sarcopenia. Hence there is a need to screen for sarcopenia in people with T2DM. Our findings align with prevalence rate estimated by most of the studies [9,12-16].

Mean testosterone (ng/dL) was lower in individuals with T2DM than individuals without T2DM, however it was statistically not significant. These findings suggest that age was the most important determining factor for low testosterone levels which is well known fact. Overall mean hand grip strength was lower in individuals with T2DM than individuals without T2DM. Odds ratio came out to be statistically significant. It indicates that people with T2DM are more likely to have low hand grip strength as compared to individuals without T2DM. Our findings were similar with findings in studies done by Kaur P et al. and Cetinus E et al. who established that compared to age-matched control subjects, T2DM patients had reduced hand grip strength [17,18].

We found that there was statistically significant increase in the prevalence of sarcopenia as the duration of T2DM increases. Our study aligns with study done by Santos D et al. where they inferred that those with T2DM for more than ten years had a greater chance of developing sarcopenia. T2DM duration from 5 to 10 years increased the odds of verified sarcopenia, while T2DM ≥ 10 years and T2DM with albuminuria all raised the odds of sarcopenia [19]. Prevalence of sarcopenia was more in people with sedentary lifestyle compared to people who were active. Our study showed concordance with study done by Zhao X et al. where they inferred that sarcopenia is inversely correlated with the volume, frequency, and duration of vigorous-intensity or moderate-intensity physical exercise [20]. Furthermore, Rong Y et al. opined in their study that compared to patients with sarcopenia, participants without sarcopenia engaged in more frequent physical activity [21]. Prevalence of sarcopenia positively correlated with BMI. Our findings aligned with Tey S et al. study which showed that sarcopenia was positively correlated with BMI [22]. However, Han P et al. inferred that the presence of sarcopenia was inversely correlated with BMI [23]. Prevalence of sarcopenia was higher in population

with low levels of serum testosterone. Our findings were similar to the findings of Moctezuma-Velázquez C et al. who observed in their study that patients with sarcopenia had decreased testosterone levels [24]. Furthermore, Italian study by Volpato S et al. found that the chance of developing sarcopenia was independently linked to low bioavailable testosterone [25].

Strengths and Limitations

This study has several strengths, including the inclusion of a well-defined study population and the adjustment for relevant covariates such as age, gender, BMI and lifestyle, enhancing the validity of our findings. This observational case-control study is one of the first of its kind in Central India and may be useful in future for prevention and planning management of sarcopenia in elderly patients. However, the study has some limitations. Our study participants were predominantly composed of older adults belonging to age group of 60-69 years. This demographic limitation may affect the generalizability of the findings to broader age group populations. Possibility of sample bias cannot be ruled out as our study was single-center study. Multi-center studies would enhance the applicability across different healthcare settings. Our study assessed muscle quality only. Muscle quantity and lean body mass was not assessed in our study. Effect of intensity of exercise, glycemic control, quantity of protein intake, medications, smoking or alcohol consumption or drug abuse were not taken into consideration. Future studies with larger, more diverse populations are warranted to confirm and extend these findings.

Conclusion

Prevalence of sarcopenia among individuals with type 2 diabetes mellitus is 32.03%. The prevalence of sarcopenia in individuals without type 2 diabetes mellitus is 13.76%. We conclude that T2DM is an independent risk factor for development of sarcopenia. Also, prevalence of sarcopenia increased with the duration of T2DM.

Increasing age, sedentary lifestyle, higher BMI and low serum testosterone (in males) were independent risk factors for development of sarcopenia. Sarcopenic individuals with T2DM had lower creatinine and lower hemoglobin compared to diabetic individuals without sarcopenia. Mean hand grip strength progressively declined with age. People with T2DM are more likely to have low hand grip strength as compared to individuals without T2DM.

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Author Contributions

Conceptualisation: Dr Sushil Jindal, Dr Jaideep Khare, Dr Sriram M
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Data acquisition and analysis: Dr Sriram M, Dr Nancy
Writing – Original Draft: Dr Sriram M, Dr Maithili M
Supervision: Dr Sushil Jindal, Dr Jaideep Khare

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Conflicts of Interest

There are no conflicts of interest.

Use of Artificial Intelligence

Artificial intelligence was not used for the preparation of manuscript.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethical Considerations

This study was approved by the Institutional Ethics Committee of People's College of Medical Sciences & Research Centre, with approval letter number PCMS/OD/PS/2023/14 dated 08.05.2023. Written informed consent was obtained from all participants. The procedures followed the guidelines laid down in Declaration of Helsinki 1964 and as revised later.We declare that the manuscript has been read and approved by all the authors, that the requirements for authorship as stated earlier in this document have been met, and that each author believes that the manuscript represents honest work.

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