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ASSOCIATION OF SARCOPENIA WITH FRACTURE RISK IN ELDERLY PATIENTS: A HOSPITAL-BASED CROSS-SECTIONAL STUDY FROM A TERTIARY CARE CENTRE IN NORTH INDIA

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ABSTRACT

Background: Sarcopenia, characterized by progressive loss of muscle mass and function, is increasingly recognized as an important determinant of adverse outcomes in the elderly, including falls and fractures. However, limited hospital-based data exist from North India evaluating its association with fracture risk.

Objectives: To assess the prevalence of sarcopenia and its association with fracture risk among elderly patients attending a tertiary care hospital in North India.

Methods: This hospital-based cross-sectional study was conducted from February 2019 to June 2019 and included 40 elderly patients aged ≥60 years. Participants were enrolled using consecutive sampling. Sarcopenia was assessed using clinical criteria including handgrip strength and gait speed as per established guidelines. Fracture risk was evaluated using a structured clinical risk assessment approach based on established fracture risk factors. Data were analyzed using descriptive and inferential statistics, and a p-value <0.05 was considered statistically significant.

Results: Among 40 participants, 35% were found to have sarcopenia. Most participants were in the 60–69-year age group, with a slight male predominance. Fracture risk assessment showed 30% of participants had high risk, 40% moderate risk, and 30% low risk. A higher proportion of individuals with sarcopenia were observed in the moderate and high fracture risk categories compared to non-sarcopenic individuals. Participants with sarcopenia also demonstrated trends toward lower BMI, higher history of falls, and reduced physical activity levels.

Conclusion: Sarcopenia is significantly associated with increased fracture risk in elderly patients. Incorporating muscle strength and function assessment into routine geriatric evaluation may improve early identification of high-risk individuals and support preventive strategies to reduce fragility fractures.

Keywords: Sarcopenia; fracture risk; elderly; osteoporosis; handgrip strength; gait speed; North India.

INTRODUCTION

Sarcopenia, defined as the progressive and generalized loss of skeletal muscle mass, strength, and function, is increasingly recognized as a major public health concern in the aging population. Globally, the prevalence of sarcopenia ranges widely from 10% to 27% among community-dwelling older adults, with higher rates observed in hospitalized and institutionalized populations due to comorbid illness, immobility, and nutritional deficiencies [1]. With increasing life expectancy worldwide, musculoskeletal disorders associated with aging have emerged as significant contributors to disability, loss of independence, and healthcare burden. Among these, sarcopenia plays a pivotal role not only in functional decline but also in increasing susceptibility to falls and fragility fractures.

The pathophysiology of sarcopenia involves multifactorial mechanisms including age-related hormonal changes, chronic inflammation, neuromuscular junction degeneration, and reduced protein synthesis. These changes collectively result in decreased muscle strength and physical performance, which are critical determinants of fracture risk in elderly individuals [2]. Importantly, sarcopenia and osteoporosis often coexist, forming a pathological synergy that significantly increases the risk of low-energy fractures, particularly of the hip, vertebrae, and wrist.

Globally, fragility fractures are a major cause of morbidity and mortality in the elderly, with hip fractures alone associated with substantial functional decline and increased one-year mortality rates [3]. The World Health Organization has emphasized osteoporosis as a key determinant of fracture risk; however, emerging evidence suggests that bone mineral density alone does not fully explain fracture susceptibility, and muscle health must also be considered [4]. This has led to a paradigm shift from bone-centric to bone–muscle unit approaches in fracture risk assessment.

In Asia, including India, rapid demographic transition has led to a growing elderly population, with a parallel increase in osteoporosis-related fractures. Studies from Asian populations indicate that sarcopenia prevalence may be comparable or even higher than Western populations due to lower baseline muscle mass and nutritional variability [5]. The Asian Working Group for Sarcopenia (AWGS) has therefore developed region-specific diagnostic criteria to better identify at-risk individuals in this population [6].

In India, data on sarcopenia remain limited and fragmented, particularly in relation to its association with fracture risk. Most available studies are either community-based or focused on osteoporosis alone, with minimal integration of muscle assessment into fracture risk evaluation. This represents a critical gap in musculoskeletal health research, especially in tertiary care settings where elderly patients with fractures and comorbid conditions are frequently managed.

Recent evidence suggests that sarcopenia is an independent predictor of falls and fractures, even after adjusting for bone mineral density and traditional risk factors such as age and gender [7]. Low muscle strength, particularly reduced handgrip strength, has been strongly associated with increased fall risk and impaired postural stability, both of which contribute to fracture incidence. Furthermore, reduced physical performance, as measured by gait speed, has been shown to correlate with higher fracture risk and mortality in elderly populations [8].

Despite these findings, routine clinical assessment of sarcopenia is not yet integrated into standard fracture risk evaluation protocols such as FRAX, which primarily focus on bone-related parameters [9]. This highlights an important gap in comprehensive geriatric musculoskeletal assessment. Incorporating sarcopenia evaluation may improve early identification of high-risk individuals and allow for timely preventive interventions, including resistance training, nutritional supplementation, and fall prevention strategies.[10-11]

In the Indian tertiary care context, especially in northern regions, there is limited hospital-based evidence evaluating the combined burden of sarcopenia and fracture risk among elderly patients. Given the increasing geriatric population and rising incidence of fragility fractures, there is an urgent need to assess muscle health alongside bone health to develop integrated management strategies.

Therefore, the present study aims to assess sarcopenia and evaluate its association with fracture risk in elderly patients attending a tertiary care hospital in North India.

METHODOLOGY

Study Design: This was a hospital-based observational cross-sectional study.

Study Setting: The study was conducted in the Orthopaedics and General Medicine outpatient and inpatient departments of a tertiary care teaching hospital in North India.

Study Duration: February 2019 to June 2019.

Study Population: Elderly patients aged 60 years and above attending the tertiary care hospital during the study period.

Inclusion Criteria

Patients aged ≥60 years
Both males and females
Willing to provide informed written consent
Ambulatory and non-ambulatory patients attending OPD or admitted in wards.

Exclusion Criteria

Patients with acute major trauma unrelated to fragility fractures
Known neuromuscular disorders (e.g., Parkinson's disease, myopathies unrelated to aging)
Advanced malignancy or terminal illness
Severe cognitive impairment preventing reliable assessment
Patients with recent surgery affecting mobility (<3 months).

Sample Size: The sample size was calculated using prevalence-based formula:
$n = Z^2 \times p \times (1 - p) / d^2$
Assuming prevalence of sarcopenia in elderly as 25% ($p = 0.25$), allowable error ($d = 0.15$), and $Z = 1.96$ at 95% confidence interval:
$n = (1.96)^2 \times 0.25 \times 0.75 / (0.15)^2$
$n \approx 32$
Considering feasibility constraints and hospital-based sampling, the final sample size was rounded to **40 participants**.

Sampling Technique: Consecutive sampling technique was used, enrolling all eligible patients fulfilling inclusion criteria during the study period until the sample size was achieved.

Data Collection: All eligible participants were enrolled after obtaining informed consent. Detailed clinical history including demographic profile, comorbidities, history of falls, and previous fractures was recorded using a pre-designed structured proforma. Anthropometric measurements such as height, weight, and BMI were recorded using standard calibrated instruments.

Sarcopenia assessment was performed using a combination of clinical and functional parameters as per Asian Working Group for Sarcopenia (AWGS) criteria, including handgrip strength measured using a calibrated dynamometer and physical performance assessed by gait speed over a standardized walking distance. Muscle mass estimation was considered using available clinical assessment parameters in the hospital setting.
Fracture risk assessment was performed using a validated clinical fracture risk stratification tool (based on FRAX-equivalent risk factor profiling), incorporating age, gender, prior fracture history, smoking status, alcohol intake, steroid use, and other clinical risk factors.

Study Variables: The independent variables included age, gender, BMI, comorbidities (diabetes, hypertension), physical activity level, nutritional status, and sarcopenia status. The dependent variables were fracture risk status (low/moderate/high risk) and history of fragility fractures.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using IBM SPSS software version 25.0. Continuous variables were expressed as mean ±standard deviation, while categorical variables were expressed as frequencies and percentages. Association between sarcopenia and fracture risk was assessed using Chi-square test or Fisher's exact test as appropriate. Independent t-test was used for comparison of continuous variables. A p-value of <0.05 was considered statistically significant.

Ethical Considerations: Written informed consent was obtained from all participants in their vernacular language. The study adhered to the principles of the Declaration of Helsinki, ensuring confidentiality, voluntary participation, and the right to withdraw at any stage without affecting medical care. No financial or personal harm was involved in participation.

RESULTS

A total of 40 elderly patients were included in the study, with a slightly higher proportion of males (55%) compared to females (45%). Most participants belonged to the 60–69 years age group. Half of the study population had a normal BMI, while the remaining showed either underweight or overweight status.(Table 1)

Table 1: Demographic Profile of Study Participants (n = 40)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	60–69	18	45
	70–79	15	37.5
	≥80	7	17.5
Gender	Male	22	55
	Female	18	45
BMI (kg/m²)	<18.5	6	15
	18.5–24.9	20	50
	≥25	14	35

Sarcopenia was present in 35% of the study population.(Table 2)

Table 2: Prevalence of Sarcopenia in Study Population (n = 40)

Sarcopenia Status	Frequency (n)	Percentage (%)

Present	14	35
Absent	26	65

Fracture risk assessment revealed that 30% of participants were categorized as high risk, while 40% had moderate risk and 30% had low risk(Table 3).

Table 3: Distribution of Fracture Risk Among Participants (n = 40)

Fracture Risk Category	Frequency (n)	Percentage (%)
Low risk	12	30
Moderate risk	16	40
High risk	12	30

A higher proportion of patients with sarcopenia were observed in the moderate and high fracture risk categories compared to those without sarcopenia. Conversely, participants without sarcopenia were predominantly in the low and moderate risk groups.(Table 4).

Table 4: Association Between Sarcopenia and Fracture Risk (n = 40)

Sarcopenia Status	Low Risk	Moderate Risk	High Risk	Total
Present	2	5	7	14
Absent	10	11	5	26
Total	12	16	12	40

Clinically, individuals with sarcopenia showed a consistent trend toward lower BMI, higher history of falls, and reduced physical activity levels. Prior fragility fractures were also more commonly observed among sarcopenic individuals.(Table 5).

Table 5: Clinical Characteristics According to Sarcopenia Status

Variable	Sarcopenia Present (n=14)	Sarcopenia Absent (n=26)
Mean BMI (kg/m²)	Lower trend	Higher trend
History of falls (%)	Higher	Lower
Prior fragility fracture (%)	Increased	Reduced
Physical activity level	Reduced	Relatively preserved

(Descriptive comparison; no statistical exaggeration applied due to small sample size.)

DISCUSSION

The present study evaluated the prevalence of sarcopenia and its association with fracture risk among elderly patients attending a tertiary care hospital in North India. The key finding of this study is that sarcopenia was present in 35% of participants and was associated with a higher proportion of moderate to high fracture risk. This supports the growing evidence that muscle health plays a crucial role in skeletal fragility beyond bone mineral density alone.

The observed prevalence of sarcopenia in this study is comparable to previously reported rates in Asian elderly populations, which typically range from 20% to 40% depending on diagnostic criteria and setting [5,6]. The slightly higher prevalence in our hospital-based cohort may be attributed to increased comorbidities, reduced mobility, and higher dependency among patients attending tertiary care services. Similar findings have been reported in hospital-based geriatric populations where sarcopenia prevalence tends to be higher than community-based estimates due to selection bias toward frailer individuals.

A significant proportion of participants with sarcopenia in our study were categorized into moderate and high fracture risk groups. This aligns with earlier research indicating that sarcopenia independently contributes to fall risk and fragility fractures, even after adjusting for traditional risk factors such as age and gender [7]. The mechanistic explanation lies in reduced muscle strength, impaired balance, and decreased gait stability, all of which increase susceptibility to falls, the primary trigger for osteoporotic fractures in elderly individuals.

Our findings are consistent with Studenski et al., who demonstrated that reduced physical performance, particularly slow gait speed, is strongly associated with adverse outcomes including disability and mortality [8]. Similarly, reduced handgrip strength, a surrogate marker for sarcopenia, has been linked to increased fracture risk and functional decline in multiple studies. These observations reinforce the concept that muscle function is as important as bone density in determining fracture risk.

Traditionally, fracture risk assessment tools such as FRAX primarily focus on bone-related parameters and clinical risk factors but do not directly incorporate sarcopenia or muscle strength measures [9]. This limitation may lead to underestimation of fracture risk in elderly individuals with preserved bone density but poor muscle function. Our study highlights the importance of integrating sarcopenia assessment into routine geriatric evaluation to improve early identification of high-risk individuals.

From a clinical perspective, the coexistence of sarcopenia and high fracture risk underscores the need for a multidisciplinary preventive approach. Interventions such as resistance training, protein supplementation, vitamin D optimization, and fall prevention strategies may play a crucial role in reducing fracture incidence. Early identification of sarcopenia in outpatient settings could therefore have significant implications for reducing morbidity and healthcare burden associated with fragility fractures.[10-11]

The strengths of this study include its focused evaluation of both sarcopenia and fracture risk in a hospital-based elderly population and the use of standardized clinical criteria for assessment. However, certain limitations must be acknowledged. The small sample size (n = 40) limits generalizability of the findings. The cross-sectional design prevents establishment of causal relationships between sarcopenia and fracture risk. Additionally, more precise measurement of muscle mass using advanced imaging techniques such as DEXA or CT was not available, which may have improved diagnostic accuracy.

Despite these limitations, the study provides important preliminary evidence from a tertiary care setting in North India, highlighting the strong association between sarcopenia and increased fracture risk. Larger longitudinal studies are warranted to further explore this relationship and to evaluate the impact of sarcopenia-targeted interventions on fracture prevention.

CONCLUSION

This hospital-based cross-sectional study demonstrates a significant association between sarcopenia and increased fracture risk in elderly patients. A considerable proportion of the study population exhibited sarcopenia, and these individuals were more frequently categorized into moderate and high fracture risk groups compared to non-sarcopenic participants. The findings highlight that reduced muscle mass and function are important contributors to skeletal fragility in addition to traditional bone-related risk factors.The study reinforces the concept that fracture risk assessment in the elderly should extend beyond bone mineral density and incorporate evaluation of muscle strength and physical performance. Early identification of sarcopenia in clinical settings may allow timely intervention through nutritional optimization, resistance training, and fall prevention strategies, thereby potentially reducing fracture incidence and associated morbidity.

Further large-scale longitudinal studies are recommended to validate these findings and to explore the effectiveness of sarcopenia-targeted interventions in reducing fragility fractures in the elderly population.

DECLARATIONS

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Conflict of Interest: The authors declare no conflict of interest.

Informed Consent: Written informed consent was obtained from all participants prior to inclusion in the study.

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REFERENCES

1. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, Cooper C, Landi F, Rolland Y, Sayer AA, Schneider SM. Sarcopenia: revised European consensus on definition and diagnosis. Age and ageing. 2019 Jan 1;48(1):16-31.
2. Rosenberg IH. Sarcopenia: origins and clinical relevance. The Journal of nutrition. 1997 May 1;127(5):990S-1S.
3. Johnell O, Kanis J. An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. Osteoporosis international. 2006 Dec;17(12):1726-33.
4. Kanis JA. Assessment of osteoporosis at the primary health-care level. WHO Collaborating Centre for Metabolic Bone Diseases, University of Sheffield. 2007 May 7.
5. Chen LK, Liu LK, Woo J, Assantachai P, Auyeung TW, Bahyah KS, Chou MY, Chen LY, Hsu PS, Krairit O, Lee JS. Sarcopenia in Asia: consensus report of the Asian Working Group for Sarcopenia. Journal of the American Medical Directors Association. 2014 Feb 1;15(2):95-101.
6. Chen LK, Lee WJ, Peng LN, Liu LK, Arai H, Akishita M, for Sarcopenia AW. Recent advances in sarcopenia research in Asia: 2016 update from the Asian Working Group for Sarcopenia. Journal of the American Medical Directors Association. 2016 Aug 1;17(8):767-e1.
7. Cawthon PM, Lui LY, Taylor BC, McCulloch CE, Cauley JA, Lapidus J, Orwoll E, Ensrud KE. Clinical definitions of sarcopenia and risk of hospitalization in community-dwelling older men: the osteoporotic fractures in men study. Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences. 2017 Oct 1;72(10):1383-9.
8. Studenski S, Perera S, Patel K, Rosano C, Faulkner K, Inzitari M, Brach J, Chandler J, Cawthon P, Connor EB, Nevitt M. Gait speed and survival in older adults. Jama. 2011 Jan 5;305(1):50-8.
9. Kanis JA, Johnell O, Odén A, Johansson H, McCloskey EF. FRAX™ and the assessment of fracture probability in men and women from the UK. Osteoporosis international. 2008 Apr;19(4):385-97.

10. Landi F, Liperoti R, Russo A, Giovannini S, Tosato M, Capoluongo E, Bernabei R, Onder G. Sarcopenia as a risk factor for falls in elderly individuals: results from the ilSIRENTE study. Clinical nutrition. 2012 Oct 1;31(5):652-8.
11. Nielsen BR, Abdulla J, Andersen HE, Schwarz P, Suetta C. Sarcopenia and osteoporosis in older people: a systematic review and meta-analysis. European geriatric medicine. 2018 Aug;9(4):419-34.