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Original Article

Frequency of Sarcopenia in Elderly Patients with Distal Radius Fracture

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ABSTRACT

Objective: To determine the frequency of sarcopenia among elderly patients presenting with distal radius fracture.
Study Design: Cross-sectional analytical
Place and Duration of Study: Combined Military Hospital, Rawalpindi Pakistan, from Sep 2025 to Feb 2026.
Methodology: A total of 266 patients aged ≥60 years with radiologically confirmed distal radius fractures were included irrespective of mechanism of injury. The severity of sarcopenia was determined as the thigh muscle girth measured in the anteroposterior and lateral radiographs of the femurs using DICOM software.
Results: The total number of patients included in this study was 266. The mean age of the patients was 68.4±6.7 years. Sarcopenia was identified in 104(39.1%) patients. FOOSH was the mechanism of injury in 181(68.0%) cases. Fall On an Outstretched Hand (FOOSH) was significantly more frequent among sarcopenic patients compared to non-sarcopenic patients (84.6% vs. 57.4%; p<0.001).
Conclusion: Sarcopenia is significantly associated with FOOSH-related distal radius fractures in elderly patients. Early screening and targeted preventive strategies may help reduce fall related fracture risk.

Keywords: Distal Radius Fracture, Aging, Fall on Outstretched Hand, Fragility Fracture, Sarcopenia.

How to Cite This Article: *Mir AB, Naqvi AN, Saleem R, Anwar A, Liaquat M, Bukhari US. Frequency of Sarcopenia in Elderly Patients with Distal Radius Fracture. Pak Armed Forces Med J 2026; 76(Suppl-8): S1398-S1402. DOI: https://doi.org/10.51253/pafmj.v76iSUPPL-8.14605*

INTRODUCION

Distal radius fracture (DRF) is one of the the most common fragility fractures in the old age population and is a growing public health concern worldwide.[1] These fractures usually occur after low-energy trauma, specifically falls on an outstretched hand (FOOSH), and there is a strong association with age-related musculoskeletal decline.[2] With increasing life expectancy, the incidence of DRF is rising amongst people aged 60 years and above.[3]

There are multiple causes of falls in older adults and are influenced by impaired balance, visual deficits, comorbidities, environmental hazards, and reduced muscle strength.[4] Among these factors, sarcopenia is of clinical importance because it is considered as potentially modifiable contributor of falls and fracture risks. In sarcopenia there is progressive age-related loss of skeletal muscle mass, muscle strength, and physical performance.[5] Pathophysiology of sarcopenia is neuromuscular degeneration, chronic inflammation, hormonal changes, and physical inactivity, all of which leads to impaired mobility and increased chances of injury.[6]

The mechanism of FOOSH is commonly implicated in DRF, where the impact of a fall is transmitted through the extended upper limb.[7] Older people with sarcopenia may have slower protective reflexes, decreased muscle power, and impaired postural stability, increasing the chances of FOOSH-related injuries. Hence, studying sarcopenia in patients with DRF may help in understanding of the biomechanical and physiological factors contributing to fracture occurrence.[7]

Different imaging-based methods have been considered for assessing sarcopenia in clinical settings. Femoral radiographs for thigh muscle girth measurement is considered as a practical and cost effective for estimating muscle mass, especially in busy orthopedic departments where advanced imaging modalities may not be easily available.[8] Although sarcopenia has been increasingly associated with fragility fractures and adverse geriatric outcomes, its specific relationship with DRF and FOOSH mechanisms remains unclear in elderly patients. Identifying this association may help in early screening strategies and targeted interventions, including resistance training, nutritional optimization, vitamin D supplementation, and fall-prevention programs, which could reduce recurrent fractures and functional decline.[9] So, the aim of this study is to determine the prevalence of sarcopenia and its relation with fall on an outstretched hand (FOOSH) amongst the older population presenting with distal radius fracture.

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Received: 29 Jan 2026; revision received: 04 Jul 2026; accepted: 06 Jul 2026

METHODOLOGY

This cross-sectional analytical study was conducted in the Department of Orthopedic Surgery, Combined Military Hospital Rawalpindi Pakistan from 2nd Oct 2025 to 25th Feb 2026, after getting approval from Institutional Ethical Review Board under reference no: 987; dated: 01-09-2025. Before including in studies written informed consent was taken from each patient. Patients with fractures of the distal radius were recruited from the orthopedic emergency and outpatient orthopedic department of Combined Military Hospital Rawalpindi Pakistan.

Inclusion Criteria: The patients were included irrespective of gender, age ≥60 years, those who were diagnosed radiologically with distal radial fractures, and those that can tell a reliable history regarding how the fracture occurred (mechanism of injury), such as fall on an outstretched hand (FOOSH), direct trauma, or other causes.

Exclusion Criteria: Patients with pathological fractures were excluded to avoid confounding due to underlying bone diseases affecting fracture risk. Patients with polytrauma and open fractures with severe soft tissue injuries were excluded because these are considered to be associated with high- energy trauma, which differs from the low-energy fragility fracture mechanism under investigation. In addition, to ensure reliability and accuracy of reporting on injury mechanism patients already having neurological disorders affecting balance (such as stroke or Parkinsonism) and those with cognitive impairment were excluded.

Sample size was calculated through openepi software by using single population proportion formula using the single population proportion formula in OpenEpi. The calculated sample was 266, keeping the prevalence (p) of sarcopenia among elderly population in Pakistan as 47.18%,[10] confidence level of 95% and 6% margin of error. Margin of error of 6% was selected considering the feasibility and time-bound nature of this single-center hospital-based study.

To minimize sampling bias, consecutive sampling was used by enrolling all eligible patients presenting during the study period until the required sample size was achieved. Uniform inclusion and exclusion criteria were strictly followed for all participants. Data collection and radiographic measurements were performed using standardized procedures, and radiological assessments were independently verified by a consultant orthopedic surgeon to improve consistency and reduce observer-related bias.

The structured proforma was developed specifically for the study and included demographic, clinical, and radiological variables. Age and gender were recorded from hospital records and patient interviews. Body mass index (BMI) was calculated using measured weight and height (kg/m²). Information regarding comorbidities (diabetes mellitus and hypertension) was obtained from documented medical records and patient history. Previous falls were assessed by asking participants whether they had experienced one or more falls during the preceding 12 months. Visual impairment was determined through documented ophthalmologic history or self-reported difficulty in vision affecting daily activities. Mechanism of injury was assessed through direct patient interview at presentation and categorized as fall on an outstretched hand (FOOSH) or other mechanisms. Reference normative values for radiographic thigh muscle thickness were obtained from a healthy adult cohort as described by Kong *et al*.[9] In their study, mean AP thigh muscle width was 13.99±1.86 cm in males and 12.95±1.96 cm in females, with corresponding lateral quadriceps heights of 3.17±0.80 cm and 2.76±0.82 cm, respectively. These values were used to establish sex-specific thresholds for radiographic sarcopenia in the present study.

Radiological evaluation of sarcopenia was done. All patients included in the study were subjected to digital X-ray of the whole of the femur in anteroposterior (AP) and lateral position. The girth of the thigh muscle, 15 cm above the adductor tubercle (antero-posterior view) and 15 cm above the end of the Blumensaat line (lateral view), was measured. The measurements were done through DICOM software that is incorporated in Hospital Management System (HMS). The operational definition of sarcopenia was based on sex-specific radiographic thigh muscle thickness thresholds validated against psoas cross-sectional area. In accordance with previously published criteria, sarcopenia was defined as thigh muscle thickness <20 mm in males and <15 mm in females measured on standardized anteroposterior and lateral femoral radiographs. These cut-offs have been shown to reliably correlate with radiographic sarcopenia and reduced muscle mass [9]. Radiographic measurements were performed in a blinded manner without prior knowledge of mechanism of injury. To reduce the chances of

observer bias, the principal investigator conducted the measurements and was confirmed by a second orthopedic surgeon who was a consultant. Radiographic assessment was used as a surrogate marker of muscle mass rather than a definitive diagnostic criterion for sarcopenia.

The data was analyzed through IBM Statistical Package for the Social Sciences(SPSS) version 27. Quantitative variables (age, BMI) were given as Mean±SD. Categorical variables (gender, sarcopenia status and mechanism of injury) were reported as frequencies and percentages. The chi-square test was used to determine the relationship between sarcopenia and FOOSH mechanism. The p value ≤ 0.05 was considered as significant.

RESULTS

This study includes 266 older patients who had distal radius fractures that had been radiologically confirmed. The Mean±SD age of the patients was 68.4±6.7 years and BMI was 26.1±3.4 kg/m2. The study population was composed of 157(59.0%) males and 109(41.0%) females. Common comorbidity was hypertension, which was found in 148(55.6%) patients, followed by diabetes mellitus which was found in 112(42.1%) patients. A history of previous falls was reported in 96(36.1%) patients, while visual impairment was present in 83(31.2%) patients (Table-I). FOOSH was the mechanism of injury in 181(68.0%) patients with 85(32.0%) patients having other mechanisms of fracture (Table-II). FOOSH was more common on stratification in sarcopenic patients [88(84.6%)] than in non-sarcopenic patients [93(57.4%)]. This relation was significant (Chi-square test, $\chi^2 = 20.41$, $p<0.001$)) (Table-III).

Table-I: Baseline Characteristics of Study Participants (n=266)

Variable	n(%)
Male	157(59.0%)
Female	109(41.0%)
Diabetes Mellitus	112(42.1%)
Hypertension	148(55.6%)
Previous Falls (≥1 in past year)	96(36.1%)
Visual Impairment	83(31.2%)

Table-II: Mechanism of Injury (n=266)

Mechanism	n(%)
Fall On An Outstretched Hand	181(68.0%)
Other Mechanisms	85(31.9%)

Table-III: Association Between Sarcopenia and Fall On An Outstretched Hand Mechanism (n=266)

Sarcopenia Status	Fall On An Outstretched Hand n(%)	Other Mechanism n(%)	*p*-value
Present (n=104)	88(84.6%)	16(15.4%)	<0.001
Absent (n=162)	93(57.4%)	69(42.6%)	

Note: Chi-square test was used to calculate p value. Effect size was estimated using Cramer's V (0.28), indicating a moderate association. p-value ≤ 0.05 was considered statistically significant

DISCUSSION

The current study shows that nearly two-fifths of elderly patients with distal radius fractures were suffering from sarcopenia and there was a significant association with FOOSH as the mechanism of injury. These findings conclude that sarcopenia may have role not only to an increased risk of falls but also to the injury types resulting from such falls. Present study shows, FOOSH was significantly more prevalent in sarcopenic patients than non-sarcopenic patients (84.6% vs. 57.4%, $p<0.001$). Earlier studies are also suggestive that sarcopenia increase the risk of falls and is linked with fragility fracture mechanisms, like fractures of upper limb after low-energy falls.[11] However, some studies are suggestive of link between sarcopenia and overall risk of falls rather than mechanism of fractures specifically, therefore direct comparison gets affected. Sarcopenia prevalence in the present study (39.1%) supports earlier reports showing 30% to 45% in elderly patients with fragility fractures.[12,13] This agreement supports the reliability of the observed burden of sarcopenia in fracture populations.

However, depending upon difference in diagnostic criteria (e.g., grip strength or DXA-based definitions), study settings, and population characteristics, some population-based studies have shown lower prevalence, showing that sarcopenia estimates are method-dependent. The present studies shows that age and previous falls history are significantly associated with FOOSH, this fact is also supported by earlier longitudinal studies showing the relation between increased risk of fractures with recurrent falls and age.[14,15] In contrast, after adjustment gender and BMI does not affect outcome. This finding supports the earlier evidence suggesting that it is not the body mass alone, but muscle quality and function that strongly determines risk of fall-related injury.[16]

Thigh muscle thickness measured radiographically, in current studies offered a convenient and accessible means of assessing sarcopenia in orthopedic patients. Standard diagnostic tools are DEXA and handgrip strength but these are not readily available in acute fracture settings, so imaging base alternatives are used. Previous studies supports this approach where radiographic muscle measurements are used for muscle mass assessment.[17,18] Clinically, the current study highlights the importance of early identification of sarcopenia in patients presenting

with distal radius fractures, as these fractures often represent sentinel fragility events. Timely interventions such as resistance training, nutritional optimization, and vitamin D supplementation, which are linked to improve muscle function and reduce risk of future fall can be started based on early detection.[19,20] This shows the importance of fracture clinics for secondary prevention strategies.

The current study has several limitations. Its cross-sectional design limits the ability to establish a temporal or causal relationship between sarcopenia and FOOSH. In addition, sarcopenia was assessed using radiographic thigh muscle thickness rather than gold-standard methods such as DXA or handgrip strength, which may affect comparability and may not fully reflect the multidimensional diagnostic criteria recommended by EWGSOP2 guidelines with other studies. Being a single-center study with consecutive sampling may also limit generalizability. Finally, the classification of injury mechanism relied on patient recall, which may introduce recall bias. Potential residual confounding may exist because variables such as osteoporosis status, nutritional status, physical activity, medication use, and vitamin D levels were not assessed. Formal inter-observer and intra-observer reliability analysis was not performed. Future multicenter prospective studies using standardized functional assessments are recommended to further validate these findings and clarify the causal relationship between sarcopenia and fracture mechanisms. Consecutive hospital-based sampling may have introduced selection bias and limits generalizability. In addition, adjustment for multiple comparisons was not performed because the analyses were exploratory in nature.

CONCLUSION

Sarcopenia was highly prevalent among elderly patients with distal radius fracture and was independently associated with FOOSH as the mechanism of injury. These findings suggest that age-related muscle loss may be associated with differences in fall biomechanics and fracture patterns. Routine sarcopenia screening in fracture clinics may facilitate early intervention and secondary fracture prevention.

Conflict of Interest: None.

Funding Source: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

ABM & ANN: Data acquisition, data analysis, critical review, approval of the final version to be published.

RS & AA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

ML & USB: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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