

## Original Research Article

# Association of bone mineral density with sarcopenia indicators in the elderly population

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### ABSTRACT

**Background:** Osteoporosis and sarcopenia are age-related conditions that contribute to frailty, falls, and disability. The coexistence of osteopenia and sarcopenia, known as osteosarcopenia, is a growing concern. This study investigated the association between bone mineral density (BMD) and sarcopenia in elderly patients with osteoporosis.

**Methods:** A hospital-based cross-sectional study was conducted at Cumilla Medical College Hospital, Bangladesh, from January 2020 to January 2021. A total of 100 elderly patients ( $\geq 60$  years) with osteoporosis were enrolled. BMD was assessed using dual-energy X-ray absorptiometry. Sarcopenia was evaluated using the EWGSOP2 criteria, hand grip strength, appendicular skeletal muscle mass index (ASMMI), and the Timed Up and Go test (TUG). Data were analyzed using SPSS version 20.

**Results:** The mean age was  $66 \pm 7$  years, and 88% of the patients were female. Sarcopenia was present in 61% of patients and was more prevalent in patients with severe osteoporosis (72.4%). The mean lumbar spine and femoral neck T-scores were  $-3.29 \pm 1.04$  and  $-3.09 \pm 1.56$ , respectively. The functional parameters included grip strength of  $17.76 \pm 5.94$  kg (right hand), walking speed of  $0.65 \pm 0.12$  m/s, and TUG of  $13.5 \pm 3.2$  seconds. Significant positive correlations were observed between ASMMI and BMD at the lumbar spine ( $r=0.264$ ) and femoral neck ( $r=0.356$ ) ( $p=0.008$ ).

**Conclusions:** Reduced BMD was significantly associated with impaired sarcopenia indicators in elderly patients. Early identification and management of osteoporosis and sarcopenia are essential for preventing frailty and improving patient outcomes.

**Keywords:** ASMMI, Bone mineral density, Osteoporosis, Sarcopenia

### INTRODUCTION

Osteoporosis and sarcopenia are two prevalent age-related conditions that have profound implications for the health and functional independence of older adults. Osteoporosis is a systemic skeletal disorder characterized by reduced bone mineral density (BMD) and structural deterioration

of bone tissue, leading to greater susceptibility to fractures.<sup>1</sup> Sarcopenia, on the other hand, is a progressive loss of skeletal muscle mass, strength, and function that is increasingly recognized as a muscle disease with major impacts on mobility and survival in the elderly.<sup>2</sup> When these two conditions coexist, the resulting syndrome often termed “osteosarcopenia” poses a compounded risk of frailty, falls, disability, and mortality.<sup>3</sup>

The global burden of osteoporosis and sarcopenia is rising as populations age. By 2050, the number of individuals aged 60 years or older is expected to more than double, placing a significant strain on health systems.<sup>4</sup> In Bangladesh, elderly individuals represent 7.7% of the population, with the majority in the 60-64 age group, and their numbers are projected to rise sharply in the coming decades.<sup>5</sup> Despite this trend, sarcopenia is underdiagnosed in clinical practice, unlike osteoporosis, which is more commonly recognized. The lack of awareness and limited diagnostic capacity for sarcopenia result in many older adults being left untreated, thereby increasing their vulnerability to frailty and fractures.

Emerging evidence highlights the interdependence of bone and muscle health, frequently described as the “bone muscle unit.” This concept emphasizes the anatomical, mechanical, and biochemical links between bone and muscle, suggesting that deterioration in one system accelerates decline in the other.<sup>6</sup> Reduced muscle mass and strength decrease mechanical loading on bone, worsening osteoporosis, while skeletal fragility limits physical activity, further promoting sarcopenia.

Studies have confirmed significant associations between sarcopenia and reduced BMD. The European Male Ageing Study, for example, reported strong links between sarcopenia and osteoporosis, where lower muscle mass and strength were consistently associated with decreased BMD.<sup>7</sup> Similarly, longitudinal evidence indicates that reductions in muscle performance often parallel declines in bone microarchitecture, suggesting that muscle deterioration actively contributes to bone fragility.<sup>8</sup> Together, these findings underscore the clinical importance of assessing sarcopenia alongside osteoporosis in elderly patients.

In South Asian settings, research on the co-occurrence of sarcopenia and osteoporosis remains limited. Lifestyle factors such as low protein intake, inadequate physical activity, and economic constraints may exacerbate the risk of osteosarcopenia, yet diagnostic infrastructure remains scarce.<sup>5</sup> Addressing this gap is particularly important in Bangladesh, where the aging population is increasing rapidly.

This study, therefore, seeks to explore the association between BMD and sarcopenia indicators including muscle strength, muscle mass, and physical performance in elderly osteoporotic patients. By examining these relationships, the study aims to provide evidence for integrated clinical strategies that target both conditions, intending to reduce frailty, prevent fractures, and improve quality of life in the elderly population.

## METHODS

This hospital-based cross-sectional descriptive study was conducted in the Department of Medicine, Cumilla Medical College Hospital, Bangladesh, from January 2020

to January 2021. A total of 100 elderly patients ( $\geq 60$  years) diagnosed with osteoporosis were enrolled. The study population included both admitted and outpatient individuals with clinical suspicion of muscle wasting or weakness.

### *Inclusion criteria*

Age  $\geq 60$  years, confirmed osteoporosis (T-score  $\leq -2.5$ ), and willingness to provide informed consent were included.

### *Exclusion criteria*

Participants were excluded if they refused to participate; were critically ill; had known neuromuscular disorders (including myopathies or neuropathies); had conditions affecting muscle or bone metabolism; or were using medications such as steroids, bisphosphonates, lipid-lowering agents, antipsychotics, antiretrovirals, antimalarials, or chemotherapy.

### *Data collection and study procedure*

Ethical clearance was obtained from the Institutional Review Board of Cumilla Medical College. Written informed consent was taken from all participants or their legal guardians. Data collection included demographic details, medical history, and physical examination. BMD was assessed using dual-energy X-ray absorptiometry (DEXA). Sarcopenia was diagnosed according to EWGSOP2 criteria through hand grip strength (dynamometer), appendicular skeletal muscle mass index (ASMMI, DEXA), and Timed Up and Go test (TUG). Data were analyzed using SPSS version 20. Continuous variables were expressed as mean  $\pm$  SD, and categorical data as proportions. Chi-square, Student's t-test, and Pearson correlation were applied, with significance set at  $p < 0.05$ .

## RESULTS

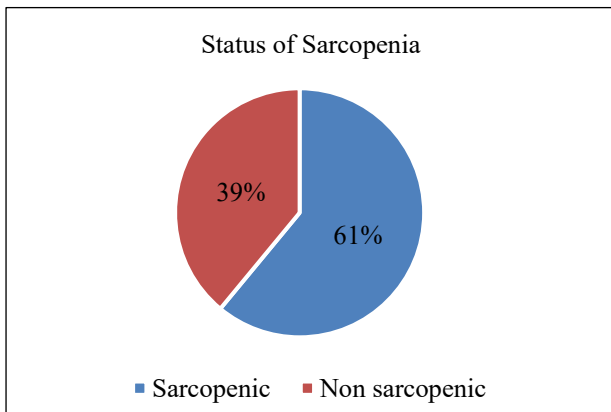
Table 1 presents baseline demographic and social characteristics of the study population. The majority of participants were aged 60-69 years (74%), predominantly female (88%), all were married, and most were housewives (80%).

Figure 1 shows that sarcopenia was present in 61% of osteoporotic patients, while 39% were non-sarcopenic, indicating a high prevalence of sarcopenia in these elderly osteoporotic cohort.

Table 2 summarizes the clinical and functional characteristics of the study group, highlighting reduced BMD, diminished hand grip strength, low walking speed, and low ASMMI, all of which are consistent with sarcopenic and osteoporotic features.

**Table 1: Baseline demographic characteristics of the study population.**

Characteristic	Frequency (n)	Percentage (%)
Age group (years)	60-69	74
	70-79	20
	80-89	4
	≥90	2
Mean±SD	66±7	
Sex	Male	12
	Female	88
Marital status	Married 100 (100%)	
Occupation	Housewife	80
	Service holder	6
	Farmer	6
	Bussiness	5
	Labour	3



**Figure 1: Status of sarcopenia among osteoporotic patients.**

**Table 2: Clinical parameters related to osteoporosis and sarcopenia.**

Parameter	Mean±SD
BMD (T-score, gm/cm <sup>2</sup> )	Lumbar spine -3.29±1.04 (0.804±0.14 gm/cm <sup>2</sup> )
	Femoral neck -3.09±1.56 (0.632±0.17 gm/cm <sup>2</sup> )
Walking speed (m/sec)	0.65±0.12
TUG (sec)	13.5±3.2
Hand grip strength (kg)	Right 17.76±5.94
	Left 16.0±5.71
BMI (kg/m <sup>2</sup> )	24.15±4.57
ASMMI (kg/m <sup>2</sup> )	5.39±0.86

Table 3 presents correlation analyses between BMD and ASMMI. Both lumbar spine and femoral neck BMD values demonstrated significant positive correlations with ASMMI (p=0.008), suggesting strong associations between bone and muscle health.

**Table 3: Correlation between BMD and ASMMI.**

Correlation	Correlation Coefficient (r)	Significance (p-value)
BMD-Lumbar spine and ASMMI	0.264	0.008
BMD-Femoral neck and ASMMI	0.356	

**DISCUSSION**

This study investigated the association between BMD and sarcopenia indicators among elderly osteoporotic patients. The findings highlight significant correlations between reduced BMD and impaired muscle health, reinforcing the concept of the bone-muscle unit.

The demographic profile of the participants showed that the majority were women (88%), with most in the 60-69 years age group, which is consistent with existing evidence that osteoporosis is more prevalent in older women due to hormonal decline after menopause.<sup>9</sup> Similar findings have been reported in Asian populations, where low muscle mass and high osteoporosis prevalence are noted among postmenopausal women.<sup>10</sup> The predominance of housewives (80%) in this cohort may also reflect reduced lifetime physical activity, a known risk factor for both osteoporosis and sarcopenia.<sup>11</sup>

The prevalence of sarcopenia in this study was 61%, with higher occurrence among severely osteoporotic patients (72.4%). Yoon et al found that 36% of women with osteoporotic fractures also had sarcopenia.<sup>12</sup> The high prevalence in this study reinforces the hypothesis that osteoporosis and sarcopenia share common risk factors, including age-related hormonal changes, chronic inflammation, and nutritional deficiencies.<sup>13</sup>

Key functional parameters further emphasize the musculoskeletal deficits in this population. Mean hand grip strength was 17.76 kg (right hand) and 16.0 kg (left hand), values well below EWGSOP2 cut-offs, confirming reduced muscle strength. Walking speed (0.65 m/s) and Timed Up and Go (13.5 seconds) also indicated poor physical performance, consistent with frailty profiles described in sarcopenic patients.<sup>14</sup> These results collectively demonstrate that muscle impairment is not only common but clinically significant among osteoporotic patients.

The correlations between BMD and appendicular skeletal muscle mass index (ASMMI) were statistically significant (lumbar spine r=0.264, femoral neck r=0.356, p=0.008). This suggests that patients with higher muscle mass tend to maintain better BMD. Similar associations were described by Kim et al, who demonstrated that ASMMI reliably predicted osteoporosis risk.<sup>15</sup> Furthermore, Nielsen et al showed that sarcopenic individuals consistently had lower femoral neck BMD compared to non-sarcopenic controls.<sup>16</sup> Our findings thus support the

growing body of evidence that muscle mass preservation plays a protective role against osteoporosis progression.

The presence of comorbidities, particularly diabetes mellitus (31%), adds another dimension to the observed associations. Diabetes has been linked to impaired muscle function and bone microarchitecture deterioration.<sup>17</sup> Sarcopenia in diabetic patients is a well-documented contributor to poor outcomes, including increased risk of fractures and frailty.<sup>18</sup> These comorbid conditions may act synergistically to exacerbate musculoskeletal decline in the elderly.

Our study supports the notion of “osteosarcopenia” as a combined syndrome, wherein osteoporosis and sarcopenia coexist and compound each other’s effects. As highlighted by Huo et al. and Morley, this syndrome represents a new frontier in geriatric medicine.<sup>19,20</sup> Early diagnosis and integrated interventions, including resistance training, protein-rich diets, and vitamin D supplementation, have demonstrated efficacy in improving both bone and muscle outcomes.<sup>21,22</sup> However, in low-resource settings such as Bangladesh, implementation of these strategies remains challenging.

In summary, the findings demonstrate a strong association between BMD and sarcopenia indicators, confirming that muscle deterioration significantly contributes to osteoporosis progression in elderly patients. Addressing sarcopenia alongside osteoporosis may be crucial in preventing fractures, frailty, and disability in aging populations. This study was limited by its cross-sectional design, single-center setting, relatively small sample size, and convenience sampling, which restricts the generalizability of the findings. Additionally, potential confounders such as dietary intake, physical activity, and hormonal status were not assessed.

## CONCLUSION

This study confirms a significant association between bone mineral density and sarcopenia indicators in elderly osteoporotic patients. Reduced muscle mass, strength, and physical performance were strongly correlated with lower BMD, highlighting the interdependence of bone and muscle health. The findings emphasize the importance of screening for sarcopenia in patients with osteoporosis to prevent frailty, fractures, and disability. An integrated clinical approach addressing both osteoporosis and sarcopenia is essential to improve quality of life and functional independence in the elderly population, particularly in resource-limited settings.

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