

## Original Article

# Relation between Bone Mineral Density and Hand Grip in adult men

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## ABSTRACT

**Introduction / Background:** Osteoporotic fractures in men are becoming an increasing problem and are associated with high mortality. It is essential to determine the health condition of bone by using a simple method. The objective of the study is to find whether hand grip has a relationship with the quality of bone.

**Methodology:** The study was conducted on 203 right-handed men up to the age of 80 years. Subjects having history of drugs or diseases which could affect BMD were excluded from the study. Calcaneus bone was scanned for QUS to measure BMD. Right hand grip strength was measured in kg using Hand Dynamometer. The diagnosis of Osteoporosis was done according to WHO T-score criteria. The whole data was collected and statistically analyzed using One-Sample T-test and Sig. (2- tailed) value.

**Observations and Results:** One-Sample T- test showed a Significant relationship between Bone Mineral Density and Hand Grip with a P value (Sig. 2-tailed value) < 0.05.

**Conclusion:** Hand grip strength assessment might be a useful tool to predict calcaneal BMD and thus the bone quality of general population.

**Keywords:** Bone quality, Calcaneal BMD, Hand grip strength, Osteoporosis, men

## Introduction

Osteoporosis is a major component of public health all over the world. It is characterized by not only decreased bone mass but also by micro architectural deterioration of bone tissue. This ultimately results in increased bone fragility and susceptibility to fractures.<sup>[1]</sup> It is crucial to elucidate bone health to prevent osteoporosis in the general population. Dual-emission X-ray absorptiometry is the gold standard for bone mineral density (BMD) assessment and diagnosis of osteoporosis.<sup>[2]</sup> However, this method is associated with high costs and facilities.

Quantitative ultrasound (QUS) of the calcaneus, which is inexpensive and free of radiation emissions, rapidly provides a risk assessment of the fragility fractures caused by osteoporosis.<sup>[3]</sup> An earlier study demonstrated that both QUS and BMD evaluations were strongly and equally related with risk factors for osteoporosis.<sup>[4]</sup> Furthermore, QUS devices are portable and compact, measuring the speed of sound (SOS) of calcaneus in only 10 seconds. Thus, QUS is suitable to assess bone health in field works. Hand grip strength is an important parameter related to functional integrity of the hand. Hand grip strength is a simple and inexpensive method to assess functioning of forearm and hand. Several studies have described the relation between BMD and osteoporosis and grip strength.<sup>[5,6]</sup>

## Aims & Objectives

Recognizing bone health using a simple method such as grip strength assessment is significant. Few reports in relevant literature have described an association between hand grip strength and osteoporosis and the Quantitative ultrasound of calcaneus. This study aimed to investigate the relationship between the SOS of the calcaneus and hand grip strength in men. This would provide an even simpler method to determine the bone quality of general population.

### Material & Methods

The study was conducted in a camp organized by PIMS hospital in Jalandhar. 203 men were selected for the study. Subjects having history of diseases that might influence bone metabolism or taking drugs that might affect BMD were excluded from the study. An informed consent was taken from all participants and a relevant questionnaire was filled by them. The study was approved by local Ethical board.

A hand grip strength meter dynamometer was used to measure grip strength. Grip testing was conducted using the standardized position recommended by the American Society of Hand Therapists. Participants were seated with the shoulder in adduction and neutral rotation, elbow flexed at 90°, forearm in neutral position, and wrist between 0° and 30° of extension and 0° and 15° of ulnar deviation. The measurements were performed on Right Hand side and all the participants were right-handed. Those having prior operation or pain in upper extremity were excluded.

The SOS of calcaneus bone was measured using an ultrasound bone densitometer. The size and weight of this device allow it to be carried to any location for measurements. This device has a unique sensor to compensate for patient's heel temperature. This function provides accurate SOS measurements. Participants place their foot on the foot plate, which can be adjusted to accommodate any foot size. Ultrasound waves are conveyed from one transducer through the calcaneus and the other transducer. The T-score was calculated from the manufacture-specific SOS reference population database.

### Statistical method

The whole data was collected and statistically assessed using appropriate statistical methods. Osteoporosis was defined as a T-score below -2.5 X standard deviation (SD), according to the definition of World Health Organization (WHO) [7]. The whole data was collected and statistically analyzed using One-Sample T-test and Sig. (2- tailed) value. A p value of <0.05 was regarded as statistically significant.

**Table 1: Mean values**

	N	Mean	Std. Deviation	Std. Error Mean
BMD	203	2.3399	.94279	.06617
HG	203	61.90	13.791	.968

*BMD - Bone Mineral Density*

*HG - Hand Grip*

**Table 2: T test**

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
BMD	35.362	202	.000	2.33990	2.2094	2.4704
HG	63.945	202	.000	61.897	59.99	63.81

*One-sample t test*

**Table 3: Percentage of 2 groups**

	Frequency	Percent	Valid Percent	Cumulative Percent
Gp 1	67	33.0	33.0	33.0
Valid Gp 2	136	67.0	67.0	100.0
Total	203	100.0	100.0	

**Observations & results**

The participants were divided into groups according to their calcaneal SOS: Osteoporosis (n=136) and non-osteoporosis (n=67). The respective percentage of participants with and without osteoporosis were 67% and 33%. The mean Bone Mineral Density of the participants was 2.3 with a SD of 0.94. The mean Right Hand Grip value of the subjects was 61.9 kg with a SD of 13.791. Statistical analysis using One-sample T-test was applied to evaluate the relationship between Hand grip strength and BMD values. Sig. (2-tailed) value represented the p value and was found to be <0.05. This clearly demonstrated that there is a significant relationship between Bone Mineral Density and Hand grip.

**Discussion:**

In the present study, we noted a decrease in the Hand grip strength value with decrease in Bone Mineral Density. Osteoporosis is a common condition which can decrease bone strength by reducing mechanical loading to the

skeleton. Reduction of mechanical strength could result from decreased maximal force that weaker muscles produce and/or less time that the skeleton is loaded due to relative immobility, and thus bone formation is reduced.<sup>[8]</sup>

Muscle strength plays a widely recognized key role in overall functional status. Skeletal muscle impairment is closely associated with a decline of daily activities, increased risk of institutionalization, cognitive decline and accelerated morbidity.<sup>[9]</sup> In this study, we performed HG strength measurement to evaluate muscle strength. It has been found that isometric Hand Grip strength is strongly related with lower extremity muscle power, knee extension torque and calf cross sectional muscle area. In this study, the mean Hand grip strength value was 61.9 kg and subjects with osteoporosis had decreased hand grip strength compared to patients with normal BMD.

Previous studies have shown a significant relation between BMD and the risk of fragility fracture related with osteoporosis and grip strength. Dixon et al. demonstrated that low grip strength is a significant marker of low hip and spine BMD.<sup>[10]</sup> It is related with an increased risk of incident vertebral fracture. Furthermore, Cheung et al. revealed 1.24-fold increased odds for fracture with decrease in hand grip T-score.<sup>[11]</sup> However, few reports describe the SOS of Calcaneus and grip strength. In grip strength assessment, extrinsic muscles of the forearm consisted of flexor digitorum profundus and superficial muscles are apparently evaluated mainly without reflecting thumb muscle power. Angst et al. evaluated the predictive power of cofactors related with normative grip strength for a general population.<sup>[12]</sup> Results show that hand grip strength values are positively correlated with calcaneal SOS in men. Hand grip power assessment might suggest related factors of bone health.

Our study had several limitations. We were unable to investigate anthropometric variables such as muscle mass, fat mass, fat free mass and muscle strength except hand grip and physical activity. Further studies should be performed to elucidate the QUS assessment and grip strength with multiple-related factors in the general population.

### **Conclusions**

We evaluated relation between calcaneal BMD and Hand grip strength and found them to be positively correlated. Dividing the participants into osteoporosis and non-osteoporosis groups determined by QUS, significant correlations were found between osteoporosis and Hand grip strength. Thus, it can be concluded that hand grip strength assessment might be useful to predict calcaneal SOS in men.

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### **Conflict of Interest**

There are no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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