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A Comparison of Bmd Values in Upper Body, Dominant Leg and Non-Dominant Leg in Professional Female Handball and Futsal Players and Non-Athletes

N. Rahnama, E. Bambaeichi, K. Khayambashi and S. Jafarpour

Faculty of Physical Education and Sports Sciences,
University of Isfahan, Isfahan, Iran

Abstract: Bone health later in life may rely on bone mass accumulation during growth. In fact, the risk of osteoporosis is affected by the peak bone mass attained. In general, before the age of 20, the bone mass accrual is mostly marked between 11 and 14 years of age in girls. It has been demonstrated that weight-bearing physical activities increase bone mass acquisition. The purpose of this study was to compare BMD of upper body and dominant and non-dominant leg in professional female handball, futsal players and non-athletes. Fifteen handball players (mean ± SD, age: 23.6 ± 3.1 years, height: 169.4 ± 3.6 cm, weight: 62.9 ± 5.7 kg) and 15 futsal players (mean ± SD, age: 24.3 ± 2.8 years, height: 161.1 ± 4.4 cm, weight: 54.3 ± 7 kg) and 15 healthy non-athlete females (mean ± SD, age: 23.8 ± 2years, height: 160.9 ± 7 cm, weight: 51.5 ± 9.6 kg) were selected for the study. The level of activity and habits of all subjects were noted. BMD was measured by DEXA at the lumbar spines and femoral neck, femoral trochanter of dominant and non-dominant legs. ANOVA was used for analysis of data. BMD values of upper body (1263.2 mg/cm^2) in futsal players were significantly higher than two other groups (handball players: 1154mg/cm^2, non-athletes:1103 mg/cm^2) (F=7.3, P = 0.05). BMDs of dominant leg in futsal players were significantly higher than other groups (F= 42.1, P = 0.05). BMDs of non-dominant leg in futsal players were significantly higher than other groups (F= 74.8, P = 0.05). It can be concluded that BMDs of all measured parts in futsal players were higher than the other two groups and differences of these values between handball players and non-athlete females were not significant.

Key words: BMD % Handball % Futsal % Femoral Neck

INTRODUCTION

Bone is a complex tissue that provides lifelong structural support for muscles, protection of vital organs and stores calcium, which is essential for bone density [1]. All living bones are in a constant stage of breaking down and building up, referred to as remodeling. Specific chemical signals direct some bones cells, referred to as osteoclasts, to break down and remove bone. There are other bone cells, known as osteoblast, to deposit new bones. Shortly after puberty, bone mineral density reaches its peak [2]. The process of remodeling is regulated by a variety of factors, including physical stress and a multiple-hormone system [2].

Osteoporosis is a disease that causes bone to become gradually thin and so porous or brittle so that they can break easily. Fractures of the hip, spine, or wrist are often linked to osteoporosis. It takes years of steady bone loss before any signs of the disease are experienced. In fact, you may not know you have the disease until your bones are so weak that a strain, bump, or fall may cause a fracture.

In fact, the risk of osteoporosis is affected by the peak bone mass attained. In general, before the age 20, the bone mass accrual is mostly marked between 11 and 14 years of age in girls. It has been demonstrated that weight-bearing physical activities increase bone mass acquisition, particularly in weight-located skeletal regions in young population. The incidence of osteoporotic fractures is increasing and has become one of the major health problems in developed countries. Physical exercise has been found to be effective for the prevention of osteoporosis. However, the optimal amount of exercise is not known [3].

There is clear evidence demonstrating that weight-bearing sporting activities involving rapid directional changes, starts, stops and great ground reaction forces, promote bone deposition at prepuberal and postpuberal age [4].

Correspond Author: Dr. N. Rahnama, Faculty of Physical Education and Sports Sciences, University of Isfahan, Isfahan, Iran

Most of the osteoporosis-stricken individuals are women. Almost the halves of women are going to be afflicted during their lifetime [5]. Environmental factors affect quality of bone and physical activities especially the activities in which body weight would be tolerated, affect bone growth. Based on previous studies physical activity in girls is accompanied by a considerable increase in BMC and BMD. These two factors prevent osteoporosis [6].

Girls are usually less active than boys. However, handball is a sport widely participated by girls around the world. This sport involves several sprints, which provoke high mechanical stress on lower body bones due to high reaction forces during sprinting. During handball participation, a great number of rapid directional changes, starts, stops, jumps and landing occur. Additionally, the upper body has a relevant role in this sport, as it is involved in different actions like throwing, fall landings and ball blocks during defensive actions which may entail excellent osteogenic properties of axial and appendicular bones. This information could be used to propose scientifically grounded guidelines for sport participation designed to promote bone accumulation in girls [3].

Evidences from multiple small randomized, controlled trials suggest that the following exercise prescription will augment bone mineral accrual in children and adolescents: Impact activities, such as gymnastics, plyometrics and jumping and moderate intensity resistance training; participation in sports that involve running and jumping (soccer, handball and basketball) is likely to be of benefit, but scientific evidence is lacking. Regarding intensity of training, it should be high in terms of bone-loading forces; for safety reason and resistance training should be =60% of 1 RM. The training programme should be done at least 3 times a week and its duration between 10-20 minutes [7].

To determine the types of sport that could lead to improved bone mineralization, a few cross-sectional studies have been conducted and they have shown that strength-based and contact-type sports are most beneficial [8-10].

Egan and co-workers in a study compared bone mineral density among female sports participants and reported that all sport groups had higher BMD values than had the controls. They concluded that sports participation had positive effects on BMD [10].

Recently Lanay *et al*. conducted a study on BMD in collegiate female athletes and reported that runners had the lowest BMD compare with gymnasts and softball players. They also reported that runners and swimmers and divers demonstrated some deficits in site-specific BMD values when compared with athletes in others sports [11].

Burrows and colleagues reported a negative association between endurance running distance and lumbar spine and femoral neck BMD [12]. More recently, the effects of strength training on the BMD of postmenopausal women was also investigated. Results showed that 24 weeks of strength training improved body composition parameters, increased muscular strength and preserved BMD in postmenopausal women [13].

Since there has been no published data on the effects of participation in handball on BMD in professional female players and futsal, this study aimed to produce some information in this respect.

METHODS AND MATERIALS

Fifteen female professional handball players and fifteen futsal players and fifteen non-athletes were participated in this study. The professional players had at least 5 year of experience of playing in Iranian clubs at this level. The subjects had no secondary disease leading to bone loss, such as hyperthyroidism, hyperparathyroidism, diabetes, etc; and they did not have any medical condition such as cardiovascular disease or inflammatory or degenerative arthritis leading to immobility as well and they did not have a history of drug therapy known to affect bone metabolism including the administration of glucocorticostroids, methotrexate, duretics, heparin. None of them smoked. The demographic characteristics of all participants such as age, weight, height were noted.

The bone mass was measured using dual-energy X-ray absorptiometry (DEXA). Bone mineral content and density values of the lumbar spine (L_2-L_4) and femoral neck and trochanter were measured. ANOVA was used to analyze the data.

RESULTS

The subjects' age, anthropometrics (weight, height) are presented in Table 1. Data related to BMD values of measured parts in participants are presented in Table 2. In the present study, BMD value of lumbar spine (L_2-L_4) was considered as upper body and the sum of mean BMD values of femoral neck and trochanter were considered as BMD of one leg and mean BMD values of both legs were considered as lower body.

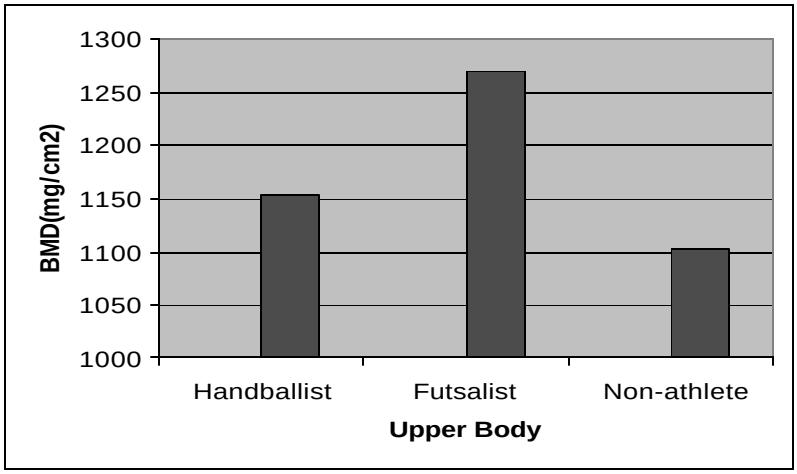

Fig. 1: Comparison of BMD of upper body in three groups (handball, futsal, control)

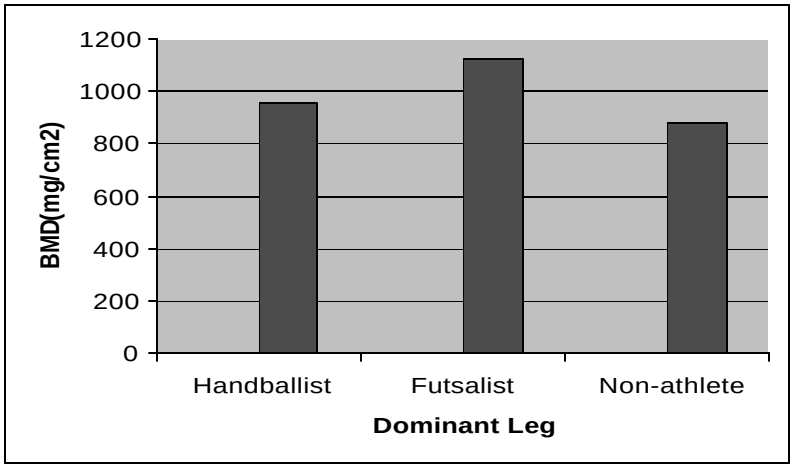

Fig. 2: Comparison of BMD of dominant leg in three groups (handball, futsal, control)

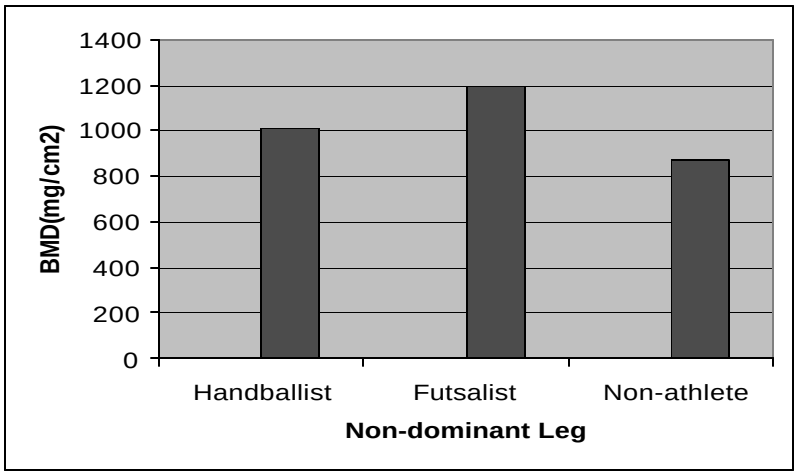

Fig. 3: Comparison of BMD of non-dominant leg in three groups (handball, futsal, control)

Table 1: Demographic characteristics of subjects

Variable	Handball player	Futsal player	Non-athletes
Age (years)	23.6 ± 3.1	24.3±2.8	23.8 ± 2
Height (cm)	169.4 ± 3	161.1± 4.4	160.9 ± 7
Weight (kg)	62.9 ± 5.7	54.3 ± 7	51.5 ±9.6

Table 2: BMD values (mg/cm^2) of Participants (mean ± SD)

Variables	Handball players	Futsal players	Non-athletes
Lumbar spine	1154 ± 76.22	165.8±1269.1	53.5±1102.4
Femoral neck	1054.12±112.61	81.6 ± 1161	63.2± 874.5
Dominant leg	956.41 ± 85.32	92.5±1125.9	64.6± 876.2
Non-dominant leg	1011.96 ± 73.21	80.1±1196	62.4±873
Total(Whole body)	1154 ± 76.22	83.5±1197	3.27±990.1

Futsal players' BMD values were found to be significantly higher than the two other groups in all measured parts. BMD values of upper body in futsal players were significantly higher than the other two groups (F=7.3, P = 0.05) (Fig. 1), but no significant difference was found in BMD values of this part between handball players and non-athletes. BMD values of dominant legs in futsal players were significantly higher than the other two groups (F=42.1, P= 0.05) (Fig. 2), but no significant difference was found between handball players and non-athletes. BMD values of non-dominant legs in futsal players were significantly higher than the other two groups (F=74.8, P= 0.05) (Fig. 3), but no significant difference was found between handball players and non-athletes.

DISCUSSION AND CONCLUSION

This study shows that participation in physical activities is associated with higher BMD in girls. Moreover, as expected, athletes have enhanced muscle mass and better physical fitness than their inactive matched counterparts.

Morel *et al*. [14] investigated the relationship between sports and bone mass in various sports. They reported that BMD values of football players in femoral neck were higher than all the other groups. In the present investigation, BMD values of upper body in futsal players were significantly higher than the other two groups. There are high strains in futsal and these stresses and strains cause to stimulate bone cells in loaded-sites and enhance bone mass subsequently. In football, bearing and kicking the ball was done by foot, while these actions were done by hands in handball. This may be the reason of higher BMD in futsal players.

This study showed that futsal players had higher BMD in their dominant legs than that observed in the other two groups. This suggests that intensity of sport is a determining factor in the improvement of bone mass. Mechanical loading from physical activity appears a vital osteogenic stimulator of bone mineral. Few studies, however, have accurately quantified loading in weight-bearing and weight-supported activities. Furthermore, the principle number of loading cycles required to achieve sustainable skeletal outcomes has not been determined [15].

In relation with non-dominant leg, our data revealed that futsal players had higher BMD in their non-dominant legs than that observed in the other two groups. Weight-bearing activities, particularly those that involve impact actions, have been associated with increased bone mass and density. In fact, sports like football and handball, ice hockey, badmintons which involve a large number of jumps, rapid directional changes, starts, stops and landing have been demonstrated to enhance BMD. It seems that intensity of futsal is more than handball, for this reason BMD value of futsal players was higher than handball players.

Mechanical forces are directly applied to bone by muscular attachments and individuals with high muscle strength are able to generate large forces during contraction. Thus, muscle strength is a measure of physical fitness that has been studied with respect to skeletal health. Research has shown that the relationship between muscle strength and bone demonstrates site specificity [16].

With regard to skills and techniques necessary in any kind of sports, some sites of body get more mechanical stress and subsequently muscles of these sites contract most of time of activity and then this contracted muscles

stimulate osteosits and cause enhanced bone mass. In this study, BMD values of upper body were higher than lower body, because of mobility of upper body in this sport.

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