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Dominant and Non-Dominant Leg Bone Mineral Density in Professional Soccer Players and Non-Athlete Subjects

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Abstract: The purpose of this study was to compare the bone mineral density (BMD) in dominant and non-dominant leg between professional soccer players and non-athlete subjects. Fifteen professional soccer players (mean±SD; age: 23.2±0.3 years, height: 174±1cm, weight: 70.3±1.8 kg) and fourteen healthy non-athlete subjects (mean±SD; age: 22 years, height: 173±1.2 cm, weight: 61.6±2.4 kg) participated in this study. All soccer players and control group were free of any illness such as diabetes, hyperthyroidism, hyperparathyroidism, cardiovascular disease and were not taking any medication. The participants did not report use of any anti-seizure drugs, alcohol and cortoon consumption, neither smoking cigarette. The activity levels and dietary habits of all subjects were noted. BMD was measured by Dual Energy X-Ray Absorptiometry (DEXA) at the femoral neck and femoral trochanter of dominant and non-dominant legs. Paired sample and independent t-test were used to analyze the data. The results of this study showed that non-dominant leg of soccer players had significantly higher BMD than their dominant leg (T= 2.92, P= 0.01), (1335 versus 1288 mg/cm²). No significant difference was observed between dominant and non-dominant leg of control group (T= 0.05, P= 0.95), (941.1 versus 941.5 mg/cm²). The level of BMD of both legs of soccer players were significantly higher than control group (T=8.03, T= 8.58, P= 0.000), (1335 and 1288 mg/cm² versus 941.5 and 941.5 mg/cm²). Due to more frequent engagement of non-dominant leg in take off, landing and stance in shooting, BMD is higher than the other leg. Furthermore, it seems that soccer leads to increase of BMD in non-dominant and dominant leg in soccer players, which may be beneficial in the prevention of osteoporosis.

Key words: BMD % Dominant leg % Lower body % Osteoporosis, Soccer

INTRODUCTION

It is commonly accepted that physical exercise and sport training are important factors in the acceleration and maintenance of bone mineral density (BMD). The mechanism of the beneficial effects of exercise on bone metabolism has been the focus of intensive research [1].

Soccer is probably the most popular sport among the male population in the world [2] and it characterized by various types of running with rapid changes in direction, starts, stops, jumping and kicking; resulting in large ground reaction force (GRF) at the skeleton and thus can be classified as an impact loading sport [3]. Although most soccer players favour one particular foot for kicking the ball, it is not known whether this preference causes on asymmetry in the BMD of their dominant and non-dominant legs. Numerous factors such as age, gender, ethnic and body size, nutrition habitual and level of physical activity can affect BMD. However physical activity has more important role in increasing BMD [1, 4-6]. Soccer is an impact loading sport affecting specific bones. It is known that these bones have higher BMD than non-weight bearing skeletal regions. However, these bone advantages diminish with following retirement from professional soccer. Uzunka *et al*. (2005) measured the BMD of various bone regions in soccer players and stated that BMD values of soccer players were significantly higher at the lumbar spine, femur neck, femur trochanter, distal tibia and calcaneus when compared with control subjects. Furthermore they stated that former soccer players in sites which carried more weight of the body have a higher BMD [1]. Nazarian *et al*. (2009)

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indicate that bone mineral density in femoral bone and lumbar spines of soccer players were significantly higher than femoral bone and lumbar spines of control group [7]. Early studies have shown that soccer players have a greater BMD in all bone-loaded regions [8, 9]. Wittich *et al*. (1998) exhibited that BMD values of pelvic regions of soccer players were 34.2 percent more than non-athlete people [10]. Another study have shown that non-dominant leg of handball players have more BMD than their dominant leg [11]. McClanahan *et al*. (2002) stated that soccer players have more BMD values in non-dominant leg in comparison with their dominant legs [12]. Evidence demonstrating that weight-bearing sport activities involving rapid directional changes, starts, stops and GRF promotes bone deposition in pre pubertal and post pubertal age [9]. Physical activity involving high-impact or weight bearing movements provides an osteogenic stimulus that may enhanced bone mass at any age [13, 14]. How ever little information about BMD of dominant and non-dominant legs of soccer players were found, so in the present study we measured the BMD of the femoral neck and trochanter of dominant and non-dominant leg of soccer players and were compared in a group of non-athlete subjects. This information may be important for coaches when attempting to design the training program.

MATERIALS AND METHODS

Fifteen professional soccer players (mean±SD; age: 23.2±0.3 years, height: 174±1cm, weight: 70.3±1.8 kg) and fourteen healthy non-athlete subjects (mean±SD; age: 22 years, height: 173±1.2 cm, weight: 61.6±2.4 kg) participated in this study. All subjects were free of any disorders known to affect bone metabolism, such as bone fractures, osteoporosis, diabetes and cardiovascular disease. The participants did not report use of any anti-seizure drugs, alcohol and cortoon consumption, neither smoking cigarette. Participants completed a questionnaire about their intake of milk and other dairy products and provided information about physical activities such as duration, sessions and their dominant and non-dominant leg. Soccer players at least had three years history of regular activity and six day/week training. Non-athlete subjects did not participate in any regular exercise training. Aerial BMD was measured using Dual Energy X-Ray Absorptiometery (DEXA) instrument (Norland Medical Systems, Fort Atkinson, WI, USA). Femur neck and trochanter BMD of both legs according to the manufacturer's procedures were measured. Dominant foot was determined by the foot used to kick the ball [15]. The subjects standing height was recorded in triplicate (in cm) to the nearest 0.1 cm with the use of wall standing and weight was recorded in kilograms to the nearest 0.5 kg, while the subjects were wearing light clothing and no shoes.

Statistical Procedures: T-tests for independent samples were employed to compare BMD values between dominant and non-dominant leg of soccer players and non-athlete subjects. Also paired t test to compare BMD values of both legs in each group were used.

RESULTS

The results of this study show that there is a significant difference between dominant and non-dominant legs in soccer players (1288±33.8 mg/cm² versus 1335±37.9 mg/cm²), (T= 2.92, P= 0.01) (Fig. 1).

No significant difference was found between dominant and non-dominant legs in non-athlete subjects (941.1±26.1 mg/cm² versus 941.5±24.4 mg/cm²), (T= 0.05, P= 0.95) (Fig. 2).

Significant difference was found between dominant leg of soccer players and non-athlete subjects (1288±33.8 mg/cm² versus 941.1±26.1 mg/cm²), (T= 8.03, P= 0.000) (Fig. 3).

Significant difference was found between non-dominant leg of soccer players and non-athlete subjects (1335±37.9 mg/cm² versus 941.5±24.4 mg/cm²), (T= 8.58, P= 0.000) (Fig. 3).

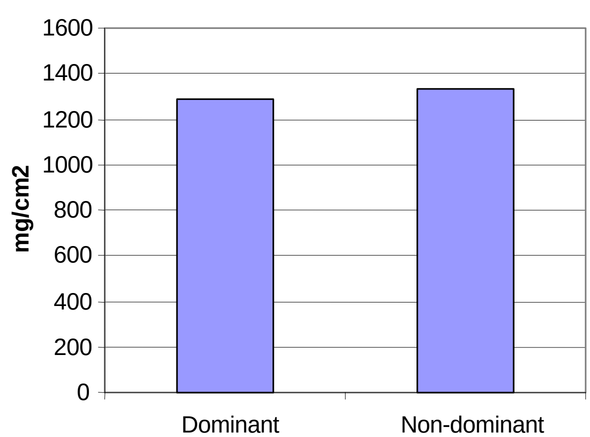

Fig. 1: Comparison of BMD between dominant and non-dominant leg of soccer players

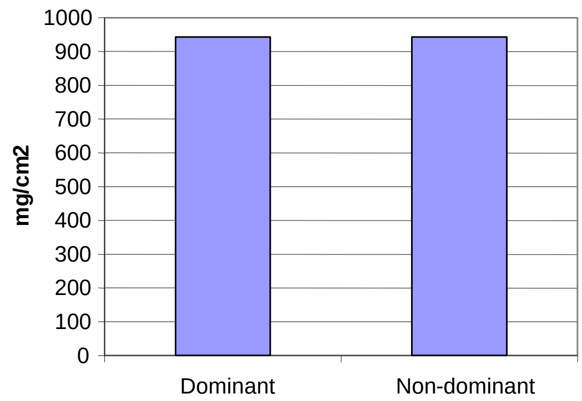

Fig. 2: Comparison of BMD between dominant and non-dominant leg of non-athlete subjects

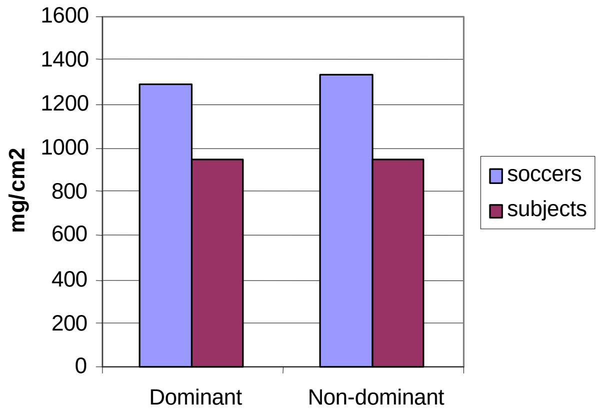

Fig. 3: Comparison of BMD between dominant and non-dominant legs of soccer players and non-athlete subjects

DISCUSSION

Soccer players favored one foot for kicking and receiving the ball. This preference affected BMD of dominant and non-dominant legs of soccer players. Results of present study show that BMD values of non-dominant leg of soccer players were significantly higher than their dominant leg, but there were no significant differences between dominant and non-dominant legs of non-athlete subjects. This results support McClanahan and co-workers finding (2002) [12]. It seems that mechanical loading is affected to BMD in particular sites of bone. Soccer players use the non-dominant leg in activities such as take off, landing and support leg for shooting. Such activities can lead to stimulate the bone cells and increases more BMD in non-dominant leg rather than dominant leg. For soccer players, the supporting leg on the ground during kicking with stands high strains that have comparable loading to the kicking leg [3]. On the premise that it's only those activities that generate GRFs in excess of 2.5 times body mass that is likely to provide a significant osteogenic stimulus [16, 17]. Activities producing GRFs below 2.5 were not included within the calculations of the weight bearing score. So, a low intensive activity does not stimulate the bone cells. Previous studies have demonstrated higher BMD in the dominant upper extremities bone of tennis players [18, 19]. Volleyball players were shown to have higher bone mass in their smashing arms compared with their non-dominant arms [20, 21]. Kannus *et al*. (1995), were measured the BMD of the dominant and non-dominant arms of tennis players and found that their dominant arm had more BMD than their non-dominant arm. They indicated that regular intensive exercise training lead to increases BMD [22]. Kun *et al*. (2001) stated that weight bearing activities lead to increasing BMD and they expressed that mechanical loading lead changes in bone formation, if the stretch values is more than bone tolerance. This mechanism can stimulate the bone cell and may increases BMD [23]. Vincent-Rodriguez *et al*. (2004) indicated that BMD values of non-dominant leg of handball players were significantly higher than dominant leg. Actually, their results show that the leg contra lateral to the dominant arm, which is mainly use for take off and landing in handball, had enhanced BMD compared to the dominant leg in the handballers [11].

McNitt-Gray *et al*. (1993) stated that: walking, running and jumping have been shown to generate ground reaction force (GRF) that equate to approximately 1.1, 2.5 and 6.0 times body mass, respectively [24]. The vertical GRFs produced during common gymnastic exercises have been reported to equate to 12-14 times body mass. Also rate of GRF in swimming less than 1x body weight, dancing between 1 and 4 x body weight and soccer more than 4 x body weight and can be classified as low, moderate and high impact exercise respectively [25]. The relationship between loading magnitude and bone can be explained by the bone mechanostat theory proposed by Frost [26], who stated that exercise has a combine effect on bone modeling and remodeling, in that bone mass increased by modeling and the added bone is retained by remodeling [26]. If a load is imposed, the bone will accommodate and undergo an alternation in mass external geometry and internal micro-architecture [27]. Previous studies show that upper extremities of tennis and volleyball players had more BMD in dominant hand than their non-dominant hand, but in soccer players non-dominant leg had more BMD than dominant leg [20, 21]. This means that GRF more than muscle strain can lead to increases BMD. Although muscle strain an increases BMD of dominant leg but it seems GRF is more effective to increases BMB. Result of this study show that there were a significant difference between dominant and non-dominant leg of soccer players and none-athlete subjects.

CONCLUSION

The BMD characteristic of non-dominant leg of soccer players were significantly higher than their dominant leg, but there were not any significant difference between dominant and non-dominant leg of non-athlete subjects. Due to more frequent engagement of non-dominant leg in take off, landing and stance in shooting, BMD is higher than the other leg and it seems gravity force more than muscle strength can lead to BMD increases of lower extremities in soccer players.

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