

Comparison of Bone Mineral Density in Elite Skiers and Athletes

Recep Soslu¹, Mehmet Göktepe¹, Murat Ta², Öznur Akyüz² and Dursun Katkat³

¹Bartın University School of Physical Education and Sports, Bartın, Turkey

²Celal Bayar University School of Physical Education and Sports, Manisa, Turkey

³Mersin University School of Physical Education and Sports, Mersin, Turkey

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ABSTRACT Physical activity, as a case for increase in bone mass is a factor. Based on this, a comparison between elite level sport athletes and skiers was conducted to compare their bone mineral density. Standard DEXA at the lumbar spine and proximal femur study describes the measurement. The athletes' blood parameters (sodium, calcium, potassium) were determined in routine biochemistry. The results of analysis of bone mineral density levels of skiers compared to athletes $p < 0.05$ was determined to be significant. In addition, the potassium level in skiers was found to be significantly lower in athletes. Among groups, a significant difference in the levels of calcium and phosphorus was determined. Elite athletes and intense experience for exercising, training frequency and the different results depending on the type of sports activity is reported. As a result, for the skiers in the study their bone mineral density was higher as compared to athletes and therefore with increasing physical activity that may cause bone and muscle stress of intense exercise program can be said to differ from each other should be considered.

INTRODUCTION

Bone is mainly a tissue that supports the body, carries the weight, protects vital organs, and allows movement with adhesion of muscles. For fulfilling such tasks, it constantly carries a mechanical load due to gravity and other outside stimulants. Physical activity is a factor causing an increase in bone mass. Regular exercise and low energy intake plays a key role in development of bone density, acquiring it during adolescence and young adulthood and maintaining its level with minimum loss in subsequent years (Gibbs et al. 2013). Physical activity or mechanical loading is an important factor in determining bone mass, structure and strength (Sirin et al. 2009).

The objective of training for athletes is to improve factors such as body composition correct for their sport, physical fitness, technical, and psychological skills, and to optimize athletic performance (Buchheit et al. 2013; Bridge et al. 2014; Won-seo et al. 2015). Tension and compression forces caused by muscle contraction and weight bearing typically stimulate the growth of bone tissue. Weight transfer and physical activity stimulate growth plates and affect the bone, thus bone growth is affected and a stronger bone structure is provided. Physical activity in adolescence has been shown to

be associated with bone density in young adulthood (Finlay and Faulkner 2005; Harrison et al. 2005).

Osteoporosis is a skeletal disorder characterized by degradation in bone structure, a decrease in mineral density with a consequent increase in bone fragility and the risk of fracture (Temur et al. 2014). Considered to affect millions of people worldwide, osteoporosis is recognized as a major health problem that concerns the public at large today (Sirin et al. 2009). Calcium-rich foods in the diet, vitamin D and contact with the sun needed for regular physical activity are vital for maintaining bone health and preventing osteoporosis (Dougados 2006). The aim of this study was to investigate bone mineral density of elite level athletes and skiers.

MATERIAL AND METHODS

This study was conducted at the Ataturk University Medical Research and Practice Hospital's Central Laboratory. The ethics committee report required for the study was obtained, and the study subjects completed and signed a consent form. Blood samples of around 10 ml were collected from veins of volunteers from the control and study groups between 09:00 and 09:30 am after 10 to 12 hours of fasting, and transferred to routine biochemistry tubes. Some of the serums obtained from the blood samples were allocated for biochemical analysis and analysis of hormone parameters. The blood samples in routine biochemistry tubes for biochemistry and hormone analyses were centrifuged at 4000 rpm

Address for correspondence:
Recep Soslu
E-mail: recepsoslu@gmail.com

for 15 minutes after they were allowed to stand for 30 minutes. Then, the separated serums were frozen at -80°C and stored for further analysis at the end of the study. Measurements for biochemical tests (sodium, calcium, and potassium) were performed by the analyzer, Modular Systems Roche Diagnostics, Germany, using Roche Diagnostics kits, based on enzymatic-colorimetric method.

Standard DEXA works define lumbar vertebra and proximal femur measurements. During evaluation of proximal femur, osteoporosis (T-score <-2.5), osteopenia (T-score of -1 to -2.5) and bone mineral densities (g/cm^2) in the lumbar region (L1-L4) (BMD) were measured on femoral neck, trochanter and Ward's triangle region using the Dual-energy X-ray Absorptiometry (DEXA) method. There were a total of 26 participants, including 13 athletes and 13 skiers, in the study group. Height measurements of the subjects were obtained using the Holtain brand floating caliper in an upright position. The weight measurements were obtained using a Tanita.

The data obtained was transferred to a computer. The results were analyzed using a one-way ANOVA and LSD tests in terms of descriptive statistics as well as correlations and differences between the variables.

RESULTS

Values of age, height and weight of the study subjects were as follows: 16.44 ± 0.70 , 170.77 ± 6.36

and 62.77 ± 2.12 , respectively for the athletes, and 16.91 ± 0.70 , 170.52 ± 6.36 and 62.62 ± 5.65 , respectively for the skiers (Table 1).

When the bone mineral density level of the skiers is analyzed (Table 2), according to the total SBMD athlete skiers, the p-value <0.05 was determined to be significant. Fem Neck and L4 vertebrae skiers were found to be significant again compared to athletes. L1, L2, and L3 were statistically significantly different in terms of TROCAR not been established.

When the mineral levels in the blood of examined skiers calcium, potassium and sodium levels (Table 3) then athletes p <0.05 level was found to be the meaning.

DISCUSSION

Values of age, height and weight of the study subjects were as follows: 16.44 ± 0.70 , 170.77 ± 6.36 and 62.77 ± 2.12 , respectively for the athletes, and 16.91 ± 0.70 , 170.52 ± 6.36 and 62.62 ± 5.65 , respectively for the skiers.

Bonjour et al. (2001), found that the bone mass during puberty is faster than the prolonged of approximately thirty-three to sixty percent. In a study by Yörükoglu and Koz (2007) conducted on 17 basketball players with a mean age of 13 years from Ankara University Sports School and Ankara University Sports Club, a significant relationship was found between physical activity and height. Height increases as a result of growth

Table 1: Demographic characteristics of skier and athlete

Variables	N	Age	Height (Cm)	Weight (Kg)
Skiers	13	16.44 ± 0.70	170.77 ± 6.36	62.77 ± 2.12
Athletes	13	16.91 ± 0.70	170.52 ± 6.36	62.62 ± 5.65

Table 2: Bone mineral density of skiers and athletes (BMD g/cm^2)

Variables	N	L1	L2	L3	L4	Fem Neck	Troc	Total Sbmd
Skiers	13	-0.04 ± 0.25	-0.27 ± 0.09	-0.61 ± 0.09	$-0.97 \pm 0.04^*$	$1.20 \pm 1.71^*$	1.05 ± 1.27	$0.69 \pm 0.86^*$
Athletes	13	0.04 ± 0.62	-0.20 ± 0.21	-0.51 ± 0.22	-1.10 ± 0.33	1.64 ± 0.26	1.05 ± 1.61	0.73 ± 0.96

Table 3: Mineral levels of skiers and athletes in the blood

Variables	N	Calcium (mg/dl)	Potassium (mg/dl)	Sodium (mg/dl)
Skiers	13	$24.83 \pm 1.21^*$	$21.01 \pm 0.05^*$	$24.99 \pm 0.25^*$
Athletes	13	23.11 ± 1.0	21.54 ± 0.01	23.52 ± 0.13

*p <0.05

and maturation. Physical activity has been shown to contribute positively to this process by several studies (Boot et al. 1997; Kokino et al. 2004; Akin et al. 2004; Liu et al. 1999). Body weight is one of the important parameters in determining the skeletal bone mineral density and content. Low body weight poses an increased risk of osteoporosis. Mechanical load borne by the skeletal system increases bone production as well as mineralization, and decreases bone degradation. Such mechanical stimulus was reported to be insufficient in adolescents with low body weight (Temur et al. 2014). Madsen et al. (1998) studied BMD (Bone Mineral Density) of three different groups, including a group of athletes with low weight doing sports weighing down on the body, a group of sedentary people bearing low weights and another group of sedentary people bearing moderate weight. At the end of the study, they found significantly low BMD values in total body, lumbar spine and femoral neck for athletes with low weight, as compared to the sedentary people with low weight. However, a significant difference was only noted in the femoral neck for the sedentary people with moderate weight. Sirin et al. (2009) reported that there is a significant difference between weight and bone mineral density values of football or basketball players and sedentary people.

Rutherford (1997) identified that spine and femoral tip BMD values of women regularly doing sports involving high impact exercises were higher than those of the control group. Hatemi (2000) suggests that the enhancing effect of exercise on bone mineral density particularly emerges during adolescence. Ozen et al. (2007) noted that the most important factor that influences bone density is physical activity. This shows that physical activity has a significant impact on BMD. During physical activity, bones are exposed to forces from different directions. Bones, which are resistant to such forces, develop and become stronger. The findings obtained in this study were in line with this principle.

Many animal and human studies have indicated that short-term regular exercise increases BMD at a maximal level. Won Seo et al. (2015) carried out a study on four groups, including milk, exercise and milk, exercise and control groups, and discovered a significant difference in femur neck between the group of subjects who consumed milk in addition to performing the ex-

ercise program, and the other groups. Alison et al. (2013) found that a 12-month high impact exercise was significantly effective on BMD in older men and calcium consumption also increased bone mineral density. It is clear from the studies in the literature that physical activity and exercise has a positive effect on BMD. However, there is no consensus on the type, impact, duration and frequency of exercise programs (Yao et al. 2006; Englund et al. 2005). Petersen et al. 2015 suggest that a low load, high repetition resistance training program may be an effective method to improve bone mass in adults.

Recent works have reported that Tai Chi is an effective and reliable physical activity in improving BMD in post-menopausal women (Yao et al. 2006; Wayne et al. 2007). In a study by Chien et al. (2000) conducted on osteopenic women, a 24-week aerobic exercise program was applied three times a week for 50 minutes, and the walking program was started with 5 minutes of warm-up and ended with 5 minutes of cool-down. In the second part of the exercise program, the subjects did step exercises for 10 minutes using a 20 cm high platform. As a result of the study, exercise was found to significantly increase femoral neck BMD. The duration and intensity of training in that study are similar to those of the athletes and the skiers in this study.

CONCLUSION

In the present study on bone mineral density compared to the athlete skiers and mineral levels in the blood it has been found to be higher.

RECOMMENDATIONS

This study was planned to reveal the effects of exercise, an activity that may affect BMD, and as reported in the literature, it was concluded that bone mineral density is very important during adolescence depending on the duration, intensity and type of the exercise, and it can be suggested that both trainers and athletes should take account of the positive effects of dietary habits on BMD in their activities.

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