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BONE DENSITY DIFFERENCES IN MALE WATER-POLO PLAYERS, FOOTBALL PLAYERS AND BODY-BUILDERS

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ABSTRACT

It is generally known that physical activity has a positive effect on bone mineral density (BMD) and body bone mass increase. The aim of this study is to determine at what extent BMD is affected by various sports involving different movement patterns and to find out the differences comparing with sedentary people. This study was conducted on two groups; a study group consisting of nine water-polo players, eleven football players, nine bodybuilders and a control group consisting of 12 sedentary subjects. In all subjects, BMD (g/cm^2) measurements were taken at L 2-3-4 vertebra, neck, trochanter major and Ward's triangle of the left femur by using Dual Energy X-Ray Absorptiometry (DEXA). The data were evaluated with the non-parametric Mann-Whitney U Test. As a result, BMD values were found significantly higher ($p<0.001$) in L 2-3-4 vertebra, neck, the trochanter and Ward's triangle of the left femur in football players than in water-polo players. BMD values of football players were also found significantly higher ($p<0.001$) in L 2-4, neck, and trochanter of the left femur and ($p<0.05$) in L3 and Ward's triangle than the control group. In body-builders, BMD values were found significantly higher ($p<0.001$) in the trochanter of the left femur and significantly higher ($p<0.005$) in Ward's triangle of the left femur than in controls. No significant

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difference was found between water-polo players, body builders and the control group. It was concluded that sports activities which involve different movement patterns (especially jumping) and exerting higher stress on bones, stimulate more bone density increase compared with other sports.

Keywords: Bone density, football, water-polo, body-building

ÖZET

SUTOPU, FUTBOL VE VÜCUT GELİŞTİRME SPORU YAPANLARDA KEMİK DANSİTESİ FARKLILIKLARI

Genel olarak fiziksel aktivitenin vücut kemik kütlesini arttırmada ve korumada olumlu etkisi olduğu bilinmektedir. Bu çalışmanın amacı kemik mineral dansitesinin (BMD), farklı hareket şekilleri içeren değişik spor türlerinden ne düzeyde etkilendiğinin araştırılması ve sedanter yaşayan kişilere göre gözlenebilecek farklılıkların incelenmesidir. Çalışmada dokuz sutopu oyuncusu, 11 futbolcu, dokuz vücut geliştirme sporcusu ve sedanter yaşayan 12 kişilik kontrol grubu ele alınmıştır. Tüm örneklerde Dual Energy X-Ray Absorpsiyometri yöntemi kullanılarak L 2-3-4 vertebra ve sol femurun boyun, trochanter major ve Ward's üçgeni bölgelerinde BMD (g/cm^2) ölçümleri yapıldı. Veriler nonparametrik Mann-Whitney U testi ile değerlendirildi. Ölçümler sonucunda futbolcularda sutopu oyuncularına göre L 2-3-4, femur boyun, trochanter ve Ward's üçgeni bölgelerinde ($p<0.001$); kontrol grubuna göre ise L 2-4, femur boyun ve trochanter ($p<0.001$), L3 ve Ward's üçgeni ($p<0.05$) bölgelerinde anlamlı olarak yüksek BMD değerleri saptanmıştır. Vücut geliştirme sporu yapanlarda ise bu değer kontrol grubuna göre, femur trochanter ($p<0.001$) ve Ward's üçgeni ($p<0.05$) bölgelerinde anlamlı olarak yüksek bulunmuştur. Sutopu oyuncularında ölçümler sonucunda vücut geliştirme sporu yapanlar ve kontrol grubuna göre BMD açısından anlamlı bir fark elde edilememiştir. Sonuç olarak, oyun sporlarındaki gibi çok yönlü hareket biçimleri (özellikle sıçramalar) içeren ve kemik dokusuna yük bindiren aktivitelerin kemik yoğunluğunu arttırmada daha fazla uyaran oluşturdukları düşünülmektedir.

Anahtar sözcükler: *Kemik dansitesi, futbol, sutopu, vücut geliştirme*

INTRODUCTION

In an animal study on the subject, Kiuchi et al. (9) who made use of on young male rats concluded that running exercise leads to increased cortical bone associated with enhanced periostal bone formation and bone mass level which do not diminish immediately after cessation of training.

In humans, many studies have demonstrated that bone mineral content (BMC) of adults is positively influenced by regular exercise in early age (6,8). Apart from this, it is indicated that BMC is related to the type of exercise (1,10,14). For instance, high impact bone loading activities such as gymnastics, football, basketball etc. were found to be more effective than low impact bone loading activities such as swimming and water-polo, on BMD (3). Regular exercise and calcium enriched diet may lead to increase BMC in middle age and elderly people. However, this influence is smaller, compared with regular exercise since early age. Physical activity during adolescence may contribute signifi-cantly towards increasing BMD scores of athletes (4,15).

It has been denoted that after menopause, female athletes show greater bone mass, indicating that they do not share the accelerated decline in BMC observed in the non-athletic population (13). Several studies have demonstrated that the type of exercise is responsible for the BMD differences of adults (5,10,11,12,13,14). The purpose of this study was to determine at what level the BMD is affected by various sports involving different movement patterns in young male athletes, a group which has not been extensively studied, and to find out the differences comparing with their sedentary counterparts.

METHODS

In the study; nine water-polo players, eleven football players, nine bodybuilders and twelve sedentary people serving as controls were examined. The physical characteristics of the subjects are summarized in Table 1. The athletes had been doing regular exercise for at least three years, six days a week and approximately an hour and a half or two hours a day. Characteristics of diet for the participants were similar to eachother. In all participants BMD was measured on L 2-3-4, the trochanter and neck of the left femur and Ward's triangle by using Dual

Energy X-Ray Absorptiometry (DEXA). Results of the measurements were evaluated with non-parametric Mann-Whitney U Test.

Table 1. Physical characteristics of the subjects.

	N	Age ± SD(yr)	Height ± SD (cm)	Weight ± SD (kg)
Water-polo players	9	21.9 ± 4.1	179.4 ± 4.8	75.9 ± 3.7
Football players	11	21.8 ± 3.3	182.6 ± 4.9	73.5 ± 6.9
Body-builders	9	21.7 ± 3.9	178.0 ± 6.1	76.4 ± 8.5
Controls	12	23.2 ± 3.1	180.2 ± 5.6	76.7 ± 3.9

RESULTS

For all regions evaluated, the BMD values of football players were found higher than in water-polo players and controls. No significant differences were found in L 2-3-4 BMD between bodybuilders and the control group, whereas in the trochanter and Ward's triangle of the left femur BMD values of bodybuilders were found significantly higher than in the control group. After comparing BMD values of water-polo players with the control group, no significant differences were indicated. BMD results for the different groups and the statistical analysis are summarized in Table 2.

Table 2. Average BMD values (g/cm^2) of groups which are obtained in our study and their statistical analysis.

	Football (n:11)	Body-building (n:9)	Water-polo (n:9)	Control (n:12)
L2	1.36 ± 0.13^b	1.12 ± 0.10	1.07 ± 0.11^a	1.06 ± 0.16
L3	1.38 ± 0.12^c	1.15 ± 0.11	1.05 ± 0.11^a	1.04 ± 0.13
L4	1.25 ± 0.10^b	1.12 ± 0.15	1.00 ± 0.11^a	1.01 ± 0.17
FT	1.07 ± 0.11^b	0.94 ± 0.11^b	0.80 ± 0.09^a	0.78 ± 0.15
FN	1.23 ± 0.13^b	1.06 ± 0.13	0.97 ± 0.10^a	0.92 ± 0.16
FW	1.27 ± 0.24^e	1.06 ± 0.14^e	0.87 ± 0.13^d	0.81 ± 0.15

L 2-3-4: Lombar vertebras, FN: Femoral neck, FT: Trochanter, FW: Ward's Triangle
a: $p<0.001$ with regard to football players, b: $p<0.001$ with regard to controls, c: $p<0.005$ with regard to controls, d: $p<0.05$ with regard to football players, e: $p<0.05$ with regard to controls,

DISCUSSION

Cassel et al. (3) indicated that high impact bone loading activity (e.g. gymnastics) is more effective than low impact bone loading activity (e.g. swimming) to increase BMD among 7-9 year old girls. Grimston et al. (8) reached similar results in children. Dayson et al. (6) demonstrated that the BMD values in 7-11 year old gymnasts were higher than in age-matched non-athletic girls. The results obtained in the present work are in line with these studies.

Brewer et al. (2) compared the skeletal status of premenopausal middle-aged (30-49 yr) women of diverse physical activity level. Of the subjects, 42 were marathon runners and 38 were sedentary females. The middle phalanx of the fifth digit and os calcis BMD were measured by using X-Ray Dansitometry and midshaft radius BMD was measured by using Photon Absorptiometry. They found that mean values for bone mineral content and bone density were greater in the marathon runners at the midshaft radius and the middle phalanx of the fifth digit. As opposed to the general consideration, mean density of the os calcis was found higher in the physically inactive women. Because of these results, further studies had to be made in this area.

Taaffe et al. (14) compared lombar vertebra and femoral neck BMD of the eumenorrhoeic gymnasts, swimmers and controls. As a result of this study, they found that gymnasts had higher BMD values than the other groups. Dook et al. (5) examined 42-50 year old postmenopausal women who had done regular exercises. Some of them who engaged in high impact bone loading sports (basketball, volleyball, hockey etc.) had significantly greater whole body and regional leg BMD than the others who engaged in low impact bone loading sports (e.g. swimming) and non-exercising group. Our results again parallel these findings. These results denoted that postmenopausal BMD levels are influenced by different types of sports which are trained before menopause.

In studies concerning the male population, Tsai et al. (15) had evaluated 29 male adolescents from different types of sports and eight non-athletic male participants in their study. They found higher BMD values in the exercise group than in the control group. They also found different BMD levels among the athletes from different types of sports. For instance, judo majors had significantly greater BMD of L 2-4 than

baseball majors, swimming majors and control group. Conversely, baseball majors had significantly higher femoral neck BMD than other groups.

Conroy et al. (4) found significantly higher BMD values in L 2-3-4, femoral neck, trochanter and Ward's triangle in 17-18 year old weightlifters (n: 25) than in a non-athletic control group. The BMD values of weightlifters were higher than the reference values of 20-29 year old adults. Lee et al. (10) obtained similar results. They found higher BMD values of the humerus and femur in volleyball and basketball players than in the others. Leichter et al. (11) determined BMD values by using Compton scattering technique on the right and left tibia of 223 military recruits aged 18-21 years after strenuous physical training for a period of 14 weeks. As a result they found an increase of 7.5% of BMD.

Block et al. (1) tried to identify the factors associated with greater bone density among athletic individuals. The participants of their study were 20 water-polo players, 19 people who engaged weight-training programs and 20 people who did no exercise. As a result, they found that differentiation based on exercise status was more important to increase bone density. Movements of the body put more pressure onto the joints. For instance, during the step phase of walking, six or seven times greater pressure occurs on the hip joints than the pressure exerted in standing-up on single foot. It was measured that 311 kg impact occurs on the knee joint while kicking the ball (7). After considering the effects of these simple movements on joints, it would be easy to predict the effects of different movement patterns which give stress on bones. Again, all these findings are in accordance with the ones obtained in the present study for young athletes.

Water-polo players in the study had BMD scores similar to the controls, and may be at a risk for osteopenia. In 1994, WHO published BMD values associated with risk of osteoporosis (16). According to these criteria, five water-polo players (average T= -1.85) and eight sedentary people (average T= -1.95) were found to have risk values of osteopenia. But the effects of nutritional and genetic factors, diseases and participation rate for sports should be investigated carefully. In spite of this, we can advice regular exercises which involve different movement patterns (especially jumping) by using body-weight and additional weight for these people.

In conclusion, significant differences of BMD were found between a high impact loading sport (football) and a low impact loading sport (water-polo) in our study. Generally, water-polo players had slightly greater BMD values than in sedentary people in spite of the absence of statistically significant differences. These findings may support the idea that exercise is a main factor to stimulate BMD. It is considered that the high peak bone mass is effective to prevent osteoporosis. Therefore, for athletes who engage in low impact sports, the aforementioned exercises would be an advantage in their daily life and further ages.

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