ORİJİNAL ARAŞTIRMA ORIGINAL RESEARCH

Evaluations of Bone Mineral Density, Body Composition, Nutritional Habits and Muscle Strength of Turkish Professional Female Folklore Dancers: A Pilot Study

Profesyonel Türk Bayan Halk Dansçılarında Kemik Mineral Yoğunluğu, Vücut Kompozisyonu, Beslenme Alışkanlıkları ve Kas Kuvvetinin Değerlendirilmesi: Bir Pilot Çalışma

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ABSTRACT Objective: The aim of this study was; to examine bone mineral density (BMD), body composition, muscle strength and eating behavior of professional Turkish female folk dancers. **Materials and Methods:** Twenty healthy (mean age=35.55 ± 2.66 year) professional Turkish female folklore dancers were voluntarily participated in this study. BMD from lumbar spine (L1-L4, dual energy x-ray absorptiometer), height, body weight, back extensor-leg muscle and hand grip strength (dynamometer), body composition (bioelectrical impedance analyze), dietary intake were assessed. Age at menarche, total year of dancing, menstrual cycles and hours of training per week were asked. There were no problems in their menstrual cycles. **Results:** A significant correlation was found between BMD and body fat weight (r= -0.514, p< 0.05), lean body weight (r= 0.514, p< 0.01), back extensor muscle strength (r= 0.446, p< 0.01), hours of training per week (r= 0.537, p< 0.05), height (r= 0.562, p< 0.05), energy (r= 0.471, p< 0.05) and protein (r= 0.447, p< 0.05). **Conclusion:** Training hours, fat weight, lean body weight, height, back extensor muscle strength, energy and protein affect the level of and changes on BMD in female folk dancers. These results may be due to Turkish folkloric dance styles.

Key Words: Folklore dance, bone mineral density, body composition, muscle strength

ÖZET Amaç: Bu çalışmanın amacı, profesyonel Türk bayan halk dansçılarının kemik mineral yoğunluğu (KMY), vücut kompozisyonu, kas kuvveti ve yeme alışkanlıklarını değerlendirmekti. **Gereç ve Yöntemler:** Bu çalışmaya 20 sağlıklı (ortalama yaş: 35.55 ± 2.66 yıl) profesyonel Türk bayan halk dansçısı gönüllü katılmıştır. Lumbar vertebradan (L1-L4, dual energy x-ray absorbsiyometre) KMY, boy uzunluğu, vücut ağırlığı, sırt ekstansör- bacak kas ve el kavrama kuvveti (dinamometre), vücut kompozisyon analizi (bioelektriksel empedans analizi) ve beslenme değerlendirilmiştir. Menarj yaşı, total dans yılı, menstrual siklusları ve haftalık çalışma saatleri sorgulanmıştır. Menstrüel sikluslarında problem yoktur. **Bulgular:** KMY ile vücut yağ ağırlığı, (r= -0.514, p< 0.05), yağsız vücut ağırlığı (r= 0.514, p< 0.01), sırt ekstansör kas kuvveti (r= 0.446, p< 0.01), haftalık çalışma saati (r= 0.537, p< 0.05), boy uzunluğu (r= 0.562, p< 0.05), enerji (r= 0.471, p< 0.05) ve protein (r= 0.447, p< 0.05) arasında anlamlı ilişki bulunmuştur. **Sonuç:** Çalışma saatleri, yağ ağırlığı, yağsız vücut ağırlığı, boy uzunluğu, sırt ekstansör kas kuvveti, enerji ve protein bayan halk dansçılarında KMY'daki değişiklikleri ve seviyesini etkilemektedir. Bu sonuçlar Türk halk dans stillerine bağlı olabilir.

Anahtar Kelimeler: Halk dansı, kemik mineral yoğunluğu, vücut kompozisyonu, kas kuvveti

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Physical activity, body composition, nutrition, genetics, hormonal status, muscle strength, oral contraceptives play major roles in the attainment of peak bone mass.[1-3] These factors except genetics can also decrease or increase peak bone mass during middle or old age. Regular weight bearing exercises during growth enhances peak bone mass.[2-4] Increasing bone mass during and immediately following growth may prove to be an important prevention strategy for osteoporosis.[5] On the other hand there is a longitudinal study in dancers showed that amenorrheic dancers have a significantly lower bone mineral density (BMD) when compared with normal controls.[6] Many factors in daily life affect BMD.

Body composition and impact of exercise on bone health assessment has received a great deal of interest especially in the area of sports science in latest years.[7-10]

On the other hand evaluation of body composition is still a controversial issue and there are various techniques for this purpose in the literature. At the same time there is a cross sectional study which has reported that aerobic training does not alter the density and composition of fat free mass (FFM).[11]

Recently it has been proposed that muscle strength is the most important of these factors because voluntary muscle forces place greater loads on the skeleton than the gravitational forces associated with body weight.[12] A longitudinal study indicates that strength training and high load intensity endurance training increase bone density.[1]

Turkish folk dance like other types of danced-based exercises, involves a high degree of leg, back and hand activity and is a complex dance style including ballet, modern dance styles, sportive movements and special figures belong to Turkish history.[13]. Dancers participated in to the international competitions and also show their dance in different cities in Turkey and different countries in all over the world.

The purpose of this study was to examine the effects of dance training on bone mineral density, body composition, dietary intake and muscle strength of Turkish professional female folklore dancers.

MATERIAL AND METHODS

Twenty professional healthy female folklore dancers were participated voluntarily in this study. Menarche age (13.50 ± 0.94 yıl), total year of dance (16.65 ± 2.92 yıl), menstrual cycles (26.2 ± 2.02 gün) and hours of dancing per week were asked to the dancers.[2,6] There were no problems in their menstrual cycles according to their response. Women who were pregnant, lactating or taking oral contraceptives were excluded from the study. Information of the evaluation procedure was given to the dancers prior testing.

BMD-DXA

Dual energy x-ray absorptiometry (DXA) (Hologic QDR-4500A) was used to measure BMD from lumbar spine (L_1-L_4). Test scans for each subject were performed and analyzed by the same technician. Scanning instructions and procedures were standardized for all subjects. Subjects were wearing no metal when the scan was done.

ANTHROPOMETRY

Weight was determined using an electronic scale (TANİTA- TNT-HD 318) to the nearest 0.1kg. Height was measured using a wall mounted stadiometer with subjects light clothing and without shoes to the nearest 0.5 cm. Body mass index (BMI) was calculated using the formula BMI=weight (kg)/height² (m²). Waist and hip circumferences were measured to a precision of 0.5cm. using a plastic tape measure.

BODY COMPOSITION

In recent years bioelectrical impedance analyzer (BIA) (Bodystat 1500- Bodystat Ltd British Isles) has described as a simple and easy method used to evaluate fat free mass (FFM) and fat mass in large epidemiological studies.[14,15] Because of its low cost, easy and rapidity of use one of the greatest potential uses of BIA is in studies of large populations. BIA represents a substantial improvement in the epidemiological method to measure body composition.[14,16]

Determination of body resistance was made using a standard four surface electrode BIA (Bodystat 1500) on the right side of the body after 10-15 minutes of supine rest utilizing standardized procedures.[17]

MUSCULAR STRENGTH

Back extensor and leg isometric muscle strength was measured with a back and leg dynamometer (MED-DYN 100). Hand grip isometric strength was measured with a hand held dynamometer (Jamar-JM 105). Dynamometers converted the force into a digital readout in kilograms. All tests were repeated 3 times. Each of three recorded trials consisting of a 5 second contraction was followed by a 30 second resting period. The largest force from the three trials was recorded as the maximal strength. For testing back strength, dancers were stand upright on the base of the dynamometer with their feet shoulder-width apart, their arms straight and fingers extended downward as far as possible on the fronts of their thighs. The bar was then attached to their chain so that it was 1 to 2 inches below their fingertips. Then they were bending forward slightly and grasp the bar. They were lift steadily; keep legs straight and feet flat on the base of the dynamometer. At the completion of the test back came to the straight position.

For leg muscle strength same position with back extensor muscle strength test was obtained. Dancers were hold center of the bar with both hands together and palms was facing toward the body. They were tried to straighten their legs while they were keeping their back straight.

When measuring the grip strength they squeezed the dynamometer as tightly as possible. Their arm was positioned at nearly 45° flexion from shoulder and 45° flexion from elbow. The force exerted was read from the dial of the dynamometer and recorded.

NUTRITIONAL ASSESSMENT

The nutritional status of subjects was estimated by 3 days food dietary intakes analyze.[18] Carbohydrate (171.86 ± 51.42), protein (59.91 ± 16.01), fat (65.24 ± 15.36), calcium (578.7 ± 268.8) and energy (1514.25 ± 32.47 kcal) were evaluated from this analyze.

STATISTICAL ANALYSIS

The statistical analyses of the data were made by SPSS 11.5 program (SPSS for windows release, Inc., Chicago, IL). Means and standard deviations were used for description of the subject characteristics and body composition analyses of the dancers. Pearson correlation and coefficient analyze was used to test the relations. Statistical significance was set at the $p < 0.05$ and $p < 0.01$ level.

RESULTS

Subject characteristics were summarized in Table 1, body composition analysis obtained from BIA are presented in Table 2.

No statistically significant correlation was found between BMD at the lumbar spine and age at menarche, total body weight, total year of dancing and strength of hand grip and leg muscles, BMI, calcium intake, total body water, carbohydrate and age ($p > 0.05$) (Table 3).

Statistically significant correlations were found between bone mineral density at the lumbar

TABLE 1: Subjects characteristics and dietary intake results.

Characteristics	Mean	SD
Age (year)	35.55	2.67
Height (cm)	166.25	4.30
Body Weight (kg)	58.55	4.74
BMI (kg/m^2)	21.04	1.80
BMD (g/cm^2)	1.0362	0.09
Total year of Dancing	16.65	2.92
Age at menarche (year)	13.50	0.94
Protein (g)	59.91	16.01
Energy (kcal)	1514.25	32.47
Calcium intake (mg)	578.7	268.8
Carbohydrate (g)	171.86	51.42
Fat (g)	65.24	15.36

TABLE 2: Body composition analysis of the dancers.

Parameters	Mean	SD
Fat %	29.25	3.48
Fat Weight (kg)	17.24	3.15
Lean Body %	70.74	3.48
Lean Body Weight (kg)	41.34	2.93
Water %	50.65	2.58
Total body water (lt)	29.61	1.8

SD: Standard deviation.

TABLE 3: Correlation results between BMD and other analyses.

Parameters	BMD (r)
Age at menarche (year)	-0.216
Total body weight (kg)	0.046
Total year of dancing	0.147
Hand grip strength (Nw)	0.225
Leg muscle strength (Nw)	-0.025
BMI (kg/m^2)	-0.309
Calcium intake (mg)	0.225
Total body water (lt)	0.272
Carbohydrate (g)	0.313
Age (years)	0.434

p> 0.05, BMI: Body Mass Index.

spine and body fat weight (BFW), lean body weight (LBW), back extensor muscle strength, hours of dancing per week, height, energy and protein ($p< 0.05$, $p< 0.01$) (Table 4).

DISCUSSION

Mechanical loading creates high peak bone strains on the skeleton and this provides the most effective stimulus for bone mineral density.[19] In general high levels of physical activity is associated with an increased bone mineral content (BMC) and BMD.[19-21] Hetland et al reported decreased vertebral BMC that was negatively correlated to the weekly distance run in long distance runners.[22] Similar findings were reported by Rico et al in cyclists.[21]

Pruitt and et al. reported that BMD was not influenced by either high or low intensity resistance training.[23] In contrast Kernet et al suggested that maximum load was more important than the number of load cycles for influencing BMD.[24]

According to the literature in sedentary women normal BMD is 0.9 ± 0.02 g/cm^2 and its 1.01 g/cm^2 for ages between 22-25 years. In this study mean BMD value of the dancers was 1.03 ± 0.09 g/cm^2 and their mean age was 35.55 ± 2.67 year. This results of BMD show that dance training for a long period of time can prevent BMD but it can't be said that this long term training can enhance lumbar BMD of dancers. Although there was (+) correlation found between BMD and energy, protein and hours of dancing per week, this (+) correlation couldn't be enough to enhance BMD.

BMD, BODY COMPOSITION AND NUTRITIONAL STATUS

A positive relationship has been observed between body weight (BW) and BMD in several studies and BMD can be influenced by age and body composition at the same time.[25,26] In the study of Reid et al, there was no significant correlation found (r= 0.21) between body weight and femoral neck BMD in athletes.[26] but no correlation found between fat mass and total body BMD, L_2-L_4 BMD and femoral neck BMD. There was no correlation found between body weight and lumbar BMD in our study. But there was a positive correlation between BFW and BMD, a negative correlation between LBW and BMD. These results show that the relationship between BW and BMD and between BFW and BMD are not always statistically significant. Madsen et al were found LBW to be a better predictor of BMD than BFW.[25]

BMD measurements from different sites of body such as femoral neck may show different results. Femoral neck rather than the lumbar spine is the site that benefits most from the weight bearing nature of dance training. Femoral neck may be protected from decreases in BMD by being the major weight bearing site.

BMD AND MUSCLE STRENGTH

Wolman et al found that elite female runners has significantly higher mid-shaft femur BMD than did rowers, dancers and sedentary controls. Because

TABLE 4: Correlation results between BMD and other analyses.

Parameters	BMD (r)
Body fat weight (kg)	-0.514 *
Lean body weight (kg)	0.514 *
Back extensor muscle strength (Nw)	0.446 *
Hours of dancing per week	0.537 **
Height (cm)	0.562 **
Energy (kcal)	0.471**
Protein (g)	0.447**

*p< 0.01, **p< 0.05.

the dancers spent most of their work time in movements involving coordination, balance and flexibility with less than 10% involving jump.[27]

Skeletal tissue response to exercise depends on several factors such as duration, intensity and type of exercise.[8] The optimal duration of exercise is unknown but 30-60 min weight bearing exercise, 2-3 times per week can be sufficient to maintain as increase bone mass according to the literature.[19,28] Female football players have been shown to have increased lumbar spine and femoral neck bone mass.[19,29] For example Heinonen and co-workers reported that the bone mass gained after 18 months of supervised high impact training in premenopausal women (35-45 year of age) can be maintained, or even enhanced in some regions, just by attending "aerobic" and "step" classes of 60 min duration twice a week during the following 8 months.[28]

Beverly et al reported %5 increase in distal radius after 6 week of training using maximum isometric contraction.[29] In a 12 month study by Nelson et al lumbar BMD was increased by 1% after training at 80% 1RM.[30] Similar results were also reported in study of Taaffe et al[31] In contrast, studies using low to moderate muscular endurance type activities such as walking and aerobic dance programs have typically reported no changes or decreased values for lumbar BMD.[32,33]

Lumbar BMD was correlated with back muscle extensor strength in this study and this result may be due to the increase in back strength may produce changes to the lumbar BMD because increased stress must placed on the muscles that are attached at this site.

It has been accepted that weight bearing forms of vigorous exercise are associated with greater levels of BMD.[34]

The physiological mechanisms involved in the response of bone cells to mechanical stress are still unclear. A possible explanation may be that osteocytes acting as mechanoreceptors respond and release chemical factor capable to promoting osteoblast proliferation at the local bone site.[1]

Additionally we couldn't assess but environmental factors like previous physical activity as a child, hormonal homeostasis and genetics all may play a role on BMD.

In conclusion long term dance training appears to have a beneficial effect on bone mass.

Although Turkish folk dance style involves a high degree of leg, back and hand activity there was no correlation found between hand grip-leg muscle strength and BMD except back extensor strength. These results suggesting muscle strength alone is not entirely responsible for the increased BMD in dancers. Hours of training per week, BFW, LBW, height and back extensor muscle strength, energy and protein affect the level of and changes in BMD in Turkish female folk dancers. Although total year of dancing of the dancers was very long, this study could not suggest that long term dance training has a detrimental effect on BMD at the lumbar spine.

Our results do not support a major role for current calcium intake in determining BMD in Turkish female folk dancers. But energy obtained from dietary intake place a very important role for the performance of these dancers. Although we did not include the dancers who were using oral contraceptive pills or have problems in their menstrual cycles, these factors can also affect BMD content of the dancers. We hope that this study will be a light for new researches in folkloric dances.

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