The Effect of Body Composition and Hand Grip Strength on Axial Bone Mineral Density in Turkish Postmenopausal Women Aged 50-65 Years: Is Lean Mass a Predictor?

Elli-Altmış Beş Yaş Arasındaki Postmenopozal Türk Kadınlarda, Vücut Kompozisyonu ve El Kavrama Gücünün, Aksiyal Kemik Mineral Yoğunluğuna Etkisi: Yağsız Vücut Kitlesi Belirleyici midir?

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Summary

Objective: Body mass index, lean mass, fat mass and peripheral muscle strength are often found the determinants of bone mineral density (BMD) in postmenopausal women. The aim of the present study is to investigate the effect of body mass index, body composition and hand grip strength on femoral neck and lumbar spine in postmenopausal women aged 50-65 years.
Materials and Methods: We studied 161 women aged 50-65 (55.6±3.9) years. Bone mineral density and body composition were measured by DEXA (Norland X-R 46). Hand grip strength was measured by JAMAR hand held dynamometer. Spearman's correlation's coefficients were calculated. Multiple linear regressions were performed using all variables possibly associated with BMD.
Results: Lean mass was correlated negatively with age. Lean mass was correlated with lumbar spine and femoral neck BMD. It was also correlated with hand grip strength and body mass index. Hand grip strength was correlated negatively with age and years since menopause.
Conclusion: These results suggest that, age related decline of lean mass and grip strength are associated with the decline of BMD in postmenopausal women aged 50-65 years. Therefore, we encourage these patients to increase lean mass by exercise. *Türk Fiz Tıp Rehab Derg 2006;52(1):28-30*
Key Words: Hand grip strength, body composition, bone mineral density

Özet

Amaç: Postmenopozal kadınlarda, vücut kitle indeksi (VKİ), yağsız vücut kütlesi, yağ kütlesi, ve el kavrama gücü, kemik mineral yoğunluğunun (KMY) belirleyicileridir. Bu çalışmanın amacı, 50 yaş ve üstü kadınlarda, VKİ, vücut kompozisyonu, ve el kavrama gücünün, lomber ve femoral boyun bölgesi KMY üzerine etkisini araştırmaktır.
Gereç ve Yöntem: Yaşları 50-65 (55,6±3,9) arasında olan 161 kadın hasta çalışmaya alındı. Kemik mineral yoğunluğu ve vücut kompozisyonu DEXA ile ölçüldü (Norland XR-46). El kavrama gücü JAMAR el dinamometresi ile değerlendirildi. Spearman korelasyon katsayıları hesaplandı. Çeşitli değişkenlerin KMY ile olası ilişkisi açısından multipl lineer regresyon analizi uygulandı.
Bulgular: Yağsız vücut kitlesiyle yaş arasında negatif korelasyon saptandı. Yağsız vücut kitlesi lomber ve femur boyun bölgesi ile korele idi. Yağsız vücut kütlesi aynı zamanda el kavrama gücü ve VKİ ile korele idi. El kavrama gücü, yaş ve menopoz süresi ile negatif olarak korele idi.
Sonuç: Yağsız vücut kitlesi ve el kavrama gücünün yaşa bağlı olarak azalması, 50-65 yaş arası kadınlarda KMY azalması ile ilişkilidir. Bu yüzden, bu hastalarda, egzersiz ile yağsız vücut kitlesi arttırılmalıdır. *Turk J Phys Med Rehab 2006;52(1):28-30*
Anahtar Kelimeler: El kavrama gücü, vücut kompozisyonu, kemik mineral yoğunluğu

Introduction

Human body composition changes with age, but the causes and consequences of these changes are partly understood. Studies have reported that fat mass increases with age, whereas lean mass, especially bone mass and muscle mass decline (1,2). Changes in body composition with aging have been associated with increased morbidity and mortality which predisposes to

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falls and osteoporotic fractures (3). Bone loss is influenced by various factors such as race, heredity, physical activity, and also body composition such as lean mass (LM) and fat mass (FM) (1).

FM and LM as well as both tissues reported to be the determinants of bone mineral density (BMD) (4). LM and FM increase mechanical load on weight bearing bones. LM may reflect physical activity levels and the associated effect of muscle contraction (4). FM may be influential in postmenopausal women not on hormone replacement therapy, via the conversion of adrenal androgens to estrogen (4).

Many studies have demonstrated that body mass index (BMI) is positively associated with bone mass (5). However some controversy exists over the effects of LM and FM. It has also been suggested that FM and LM and their distribution in the body have different relationships with regional BMD in men and women that differ by age (5).

Muscle strength also has been shown to be a predictor of bone density independent of body weight in women and men (5).

This paper presents a cross- sectional study of 161 women aged 50-65 years. Our main aim is to study the changes in body composition with aging in postmenopausal period to determine the relationship of FM and LM to axial bone mineral density in women aged 50-65 years. We also investigated the association between LM and hand grip strength in these patients.

Materials and Methods

One hundred-sixty one (161) healthy women aged 50-65 years were studied. They were ambulatory. All participated voluntarily in our study. Each woman underwent a medical history questionnaire and a general physical examination.

BMI was calculated by dividing weight by squared height (kg/m^2). Minimum waist girth and maximum hip girth were measured in a standing position. The waist hip ratio was used as a measure of fat distribution.

We excluded patients with diseases known to affect bone metabolism, such as hyperparathyroidism, hyperthyroidism, osteomalacia, hepatic dysfunction and diabetes mellitus.

BMD (in gr/cm^2) at the lumbar spine (L2-L4) and femoral neck as well as body composition represented by LM and FM expressed in kilograms were measured by dual energy X-Ray absorptiometry (DXA; Norland XR-46 Ford-Atcinson, U. S. A.).

Peripheral muscle strength was measured as grip strength of both the dominant and the non-dominant hands using JAMAR held hand dynamometer. The test was performed in a sitting position with the upper arm parallel to the trunk, the elbow at the 90 degree of flexion and the forearm and hand in zero position. The test was performed 3 times and the highest value was noted. For the final analysis, only the grip strength of the non-dominant hand was used.

The subjects had no history of tobacco smoking and alcohol consumption. All the subjects were at the postmenopausal period.

Statistical Analyses

Standard statistical methods were used to calculate means and standard deviations (SD). Spearman's correlation coefficients were calculated to assess the relationship of the BMD with subjects' characteristics. Multiple linear regressions were performed using all variables possibly associated with BMD. All analyses were performed using SPSS 9.01 and $p<0.05$ was considered significant.

Results

The study involved 161 healthy and functionally independent postmenopausal women aged 50-65 years. The subjects' characteristics and the results of BMD measurements, muscle strength, body composition are presented in Table 1.

Spearman's correlation coefficients between LM and subjects' characteristics are shown in Table 2.

LM was correlated negatively with age (r=-0.161, p=0.04), LM was correlated positively with lumbar spine and femoral neck BMD (r=0.426, p=0.01; r=0.455, p=0.01). LM was correlated with grip strength (r=0.313, p=0.01).

Grip strength was also correlated negatively with age and years since menopause (r=-0.191; p=0.01, r=-0.171; p=0.02). Grip strength was also correlated with femoral neck BMD (r=0.164; p=0.02).

Age was correlated negatively with lumbar and femoral neck BMD (r=-0.233, p=0.03; r=-0.417, p=0.01), respectively.

As expected, BMI was correlated with lumbar and femoral neck BMD (r=0.211, p=0.008; r=0.294, p=0.001).

Whatever the model considered, FM never appeared as a significant predictor of either femoral neck, or lumbar spine BMD.

Discussion

Bone mineral density has a strong genetic component; however, many factors may affect the status of BMD. LM, FM and muscle strength are the components of body composition which has an effect on BMD. However, it is unclear if these relationships are consistent with BMD especially in older persons at postmenopausal period (6).

The main result of the present cross sectional study is LM is associated with BMD and LM is also associated with hand grip

Table 1: Characteristics of the subjects

n=161	
Age (year)	55.6±3.9
Body mass index (kg/m^2)	28.6±4.7
Years since menopause	8.1±6.0
Menarche age (year)	13.6±1.3
Waist/Hip Ratio	0.86±7.1
Lumbar BMD (g/cm^2)	0.902±0.1
Femoral neck BMD (g/cm^2)	0.801±0.1
Hand grip strength (kg)	22.7±6.1
Lean mass (g)	37.6±5.2
Fat mass (g)	34.8±1.4

Table 2: Correlation between lean mass, BMD and some determinants of BMD

	r	p
Age (year)	-0.161	0.04
BMI (kg/m^2)	0.613	0.001
Waist/hip ratio	0.313	0.01
Grip strength (kg)	0.313	0.01
Femoral neck BMD (g/cm^2)	0.455	0.01
Lumbar BMD (g/cm^2)	0.426	0.01

strength in elderly postmenopausal women. Grip strength is also associated with femoral neck BMD, which is shown to be a predictor of bone density, although the relationship is not necessarily site specific (7-9).

The present study found an expected age related decline in BMD consistent with a loss of bone after the menopause. In agreement with a previous studies, aging was also found to be associated with a significant decrease in muscular strength (10,11). Weight was found to be the strongest predictor of lumbar spine and femoral neck BMD, confirming the protective effect of weight on bone loss in postmenopausal women previously reported (12).

This study demonstrates that LM but not FM correlated with lumbar spine and femoral neck BMD, appears to play a crucial role than FM regarding BMD. LM directly loads the skeleton via muscle contractions that result from performing every-day activities as well as physical activity (4). Frost and Burr (13,14) maintained that the greatest loads on the skeleton come from muscle forces and these forces are the result of muscle contraction. Doyle et al. (15) showed a strong association between vertebral dry ash weight and psoas muscle weight. Moreover Karlson et al. (16) reported an increased rate of bone and muscle mass loss where as FM increased. Chen et al. (17) reported LM is a significant independent predictor of hip and spine and whole body bone mass in postmenopausal white women. In addition, Taaffe et al. (4) reported that LM and FM were associated with bone mineral density depending on the bone site and bone index used.

Gillette-Guyonnet et al. (3) reported that higher values of FM and LM may have a protective effect on BMD.

Makovey et al. (18) suggested that LM and FM and their distribution in the body have different relationships with regional BMD in men and women that differ by age. Lim et al. (5) found that age, LM, FM, smoking and number of delivery in women were independent determinants of BMD. They pointed out that body composition changes with age, differ in men and women. Thus, maintenance of an optimal weight in women acts to prevent loss of bone. Van Langendonck et al. (19) also reported that LM is an important determinant of bone mineral content and BMD, but changes in BMD are related to changes in fat. They also reported that the relation between strength and BMD is mainly attributable to the relation between LM and BMD.

Mautalen et al. (20) demonstrated that FM in elderly postmenopausal women was significantly less than that in age and sex matched controls. In this study we did not find significant correlation between FM and BMD.

In conclusion, we suggest that LM is necessary to preserve BMD at advanced ages. Although LM, FM, muscle strength and BMD are under genetic control, all are amenable to environmental influences. The maintenance or increase in LM with age may have a positive effect on BMD in older postmenopausal women.

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