Original Article

Comparison of nutritional, biochemical and anthropometric measures as comparative risk factors between young and postmenopausal women

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ABSTRACT

Objective: To determine the differences between young women and postmenopausal women in terms of bone mineral density, body composition, physical activity, nutrition; and levels of serum leptin, homocysteine, folate and blood lipids.

Methodology: This descriptive study was carried out on 60 young women and 45 postmenopausal women. It was designed to include anthropometric measurements, biochemical analyses, bone mineral density, nutritional assessment and calculation of energy expenditure.

Results: Cholesterol, triglyceride, homocysteine, leptin and folate levels of postmenopausal women were found to be significantly higher than those of young women ($p<0.05$). The daily energy intake from foods and daily energy consumption levels of the postmenopausal women were higher than those of young women ($p<0.05$). Daily amounts of protein, thiamine and riboflavin consumed by the postmenopausal women were also higher than those of the women ($p<0.05$).

Conclusion: Age is an important parameter affecting body composition, energy and nutrient intakes. Young women and postmenopausal women are significant risk groups in terms of nutrition and health. It is suggested that some nutritional recommendations specific to young women and postmenopausal women should be formulated.

KEY WORDS: BMD, Leptin, Homocysteine, Folate, Physical activity, Blood lipids, Nutrition, Young women, Postmenopausal women.

Pak J Med Sci April - June 2011 Vol. 27 No. 2 333-338

How to cite this article:

Sanlier N, Koksal E. Comparison of nutritional, biochemical and anthropometric measures as comparative risk factors between young and postmenopausal women. Pak J Med Sci 2011;27(2):333-338

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* Received for Publication: July 22, 2010

* Accepted: December 24, 2010

INTRODUCTION

Osteoporosis is an important public health problem in elderly. Osteoporosis and low bone density are significant risk factors for morbidity and mortality. Although it can affect either gender, 80% of those affected are women. Maximizing peak bone mass during growth years is extremely important for optimal skeletal health. The highest increase in bone mineral density occurs during adolescence; between the ages of 11 and 14 accumulation of bone mass peaks at age 18. In the postmenopausal period, total bone mass can decline by 40% or more.[1,2] Genetic (e.g. age, race, family history, and gender) and lifestyle factors (e.g. physical activity, body weight, nutrition) affect the bones during the lifetime.[3,4]

Cagnacci et al[5] reported that an association between serum folate and BMD is stronger than relationships with all other osteoporosis risk factors except body weight. Neuhouser and Beresford[6] reported that low serum folate was associated with a reduction in folate status, as documented in cases of elevated homocysteine. Homocysteine can distort collagen cross-links and thus, by deteriorating the bone mineralization and matrix structure, it can have a role in osteoporosis and hyperhomocysteinemia increases osteoclasts, but does not affect osteoblasts. Previous study did not find a relationship between high homocysteine and low bone mineral density.[7] However, it was reported that high homocysteine levels increased the risk of osteoporosis by 2.2 times.[8] Leptin was reported to have a significant role in cell division and bone mineralization. Leptin expression was indicated in the normal mineralization of human osteoblasts and/or in the period when it turns into osteocyte. It was found that as daily energy and fat consumption increases, serum leptin levels also increase.[9] It was also reported that one-day fasting reduced leptin level by 30%, while excessive food intake increased leptin level by 50% in two hours. Leptin had a positive effect on body fat mass, bone density and bone formation.[10] However, other studies have reported that leptin had a negative effect on bone formation, or that it had no function on the tissue and cholesterol and its metabolites affected osteoblast activity.[11] Previous study found a negative relationship between LDL-cholesterol and BMD; and a positive relationship between HDL-cholesterol.[12]

Body composition is thought to have an effect on BMD. However, it is not clear whether the amount of fat or muscle mass has a greater effect on BMD and a significant correlation between regional muscle mass and regional BMD values.[13] According to the WHO, the most important risk factors of non-communicable diseases in many countries included high blood pressure, high concentrations of cholesterol in the blood, inadequate intake of fruit and vegetables, excess weight or obesity, physical inactivity and tobacco use. Regular physical activity and proper dietary habits can maintain and improve the individuals' physical and mental health and wellbeing. Furthermore, participation in health-enhancing physical activity is a key determinant of energy expenditure in youth and leads to improved cardiovascular and metabolic fitness as well as bone health.[14]

The aim of this study was to determine the differences between bone mineral density, body composition, serum leptin, homocysteine, folate, blood lipids and physical activity and nutrition status among young women and postmenopausal women.

METHODOLOGY

Participants: This study was carried out on 60 young women and 45 postmenopausal women. The mean age of the women was 20.6 ± 1.3 years; the mean age of the postmenopausal women was 52.4 ± 0.8 years. None of the participants used any medication, vitamins, mineral supplements or oral contraceptives. All participants were informed about the subject, purpose and rules of the research. Each participant signed a voluntary participation form.

Anthropometric Measurement: Height was measured to the nearest 0.1cm, and weight to the nearest 0.5 kg in light clothing and without shoes. BMI was calculated as weight (kg) / height (m^2). Participants were classified, according to their BMI, into 3 groups as underweight (BMI<18.5 kg/m^2), normal weight (BMI: 18.5-24.9 kg/m^2) and overweight (BMI>25.0 kg/m^2) people.[14,15]

The skinfold thickness was measured at four sites on the left side of the body: biceps, triceps, subscapular and suprailiac thickness. The sum of the four skinfold thickness measurements was considered an indicator of total subcutaneous fat, and the sum of trunk skinfold thickness as an index of central obesity. The waist-hip ratio (WHR) was used to assess body fat distribution, and specifically as an indicator of intra-abdominal or visceral fat deposition.[15] Measurements were taken of the mid-upper arm circumference (MUAC) on the bare arms of the participants, who stood in a straight position with the left arm bent at a 90° angle. The distance between acromion and olecranon was measured with a tape measure and marked at the middle point. Later, the circumference was measured at the marked point, using a non-stretch measuring tape, with arms at sides and inner palms towards the femur.

Waist circumference was measured with a non-elastic tape at a point midway between the lower border of the rib cage and the iliac crest at the end of normal expiration. Hip circumference was measured, to the nearest half-centimeter, at the widest part of the hip at the level of the greater trochanter.[14,15] Percentage of fat body mass and lean body mass and percentage were calculated by bio-electrical impedance analyzer on the basis of age and height.

Biochemical Analysis: Early morning venous blood samples were obtained from each participant for biochemical screening tests, following a 12-hour overnight fast. Professional staff performed venipuncture,

using vacutainers to obtain 15 mL of whole blood. Roche Diagnostic Kits were used for analysis of triglyceride, HDL cholesterol and total cholesterol analysis and Modular D + P (Roche Diagnostics GmbH, Monnherin, Germany).

The level of serum leptin was analyzed by means of a Biosource Leptin Easia Kit (Catalogue no: KAP2281) Homocysteine level was analyzed using a Chromsystems chemicals (Munich - Germany) Kit System, and an Agilent 1100 Isocratic HPLC Analyzer (Hewlett – Packard) (Waldbnoon Germany) was used as florescent detector. Folate was measured in a single assay, simultaneously, with the SimulTRAC-SNB radioimmunological kit (ICN, Pharmaceuticals, Orangeburg, NY, USA).Bone density was measured at the lumbar spine (L2-L4) and femur by dual energy X-ray absorptiometry (Lunar DPX, Madison WI, USA).

Nutritional Assessment: Food consumption data was collected by a 24-hour recall survey technique. Daily average energy, protein, lipid, calcium, iron, zinc, thiamine, riboflavin, niacin, vitamin A and vitamin C content were analyzed for each individual's diet. Data were analyzed using the BEBIS program (Nutrition Information System).

Calculation of the Energy Expenditure: Physical activities of all participants were calculated for minimum five-minute time periods using a record method. The sum of the periods spent for grouped activities were kept at 24 hours (1440 minutes). All kinds of physical activities over a period of three days were evaluated, and the time spent on the activities, resting metabolic rate, the time spent for physical activity, thermal effect of the foods, the energy consumed for 10% of the RMR and total energy consumption were calculated.[16]

Statistical Analysis: The data were analyzed by using the SPSS program (SPSS Inc, Chicago, IL, USA; Version 10.0 for Windows). When evaluating the

Table-I: Anthropometric measurements and biochemical findings of young women and postmenopausal women ($\bar{x}$±SD).

	Young women (n:60)	*Postmenopausal women (n:45)*	*t test*	*p value*
Anthropometric measurements				
Weight (kg)	56.7±9.5	76.8±3.8	14.88	<0.05
Height (cm)	163.0±5.4	160.7±3.1	2.75	<0.05
BMI (kg/m^2)	21.2±2.8	29.6±1.3	20.53	<0.05
Biceps SFT(mm)	7.5±2.9	10.2±1.8	5.87	<0.05
Triceps SFT (mm)	17.0±5.6	21.1±2.3	5.01	<0.05
Suprailiac SFT(mm)	21.3±9.2	19.4±9.8	1.01	0.33
Sub scapular SFT(mm)	16.6±7.2	21.0±5.9	3.44	<0.05
Total Skinfold Thickness (mm)	62.4±21.8	73.8±28.3	2.25	<0.05
MUAC (cm)	25.2±3.5	32.2±1.7	13.54	<0.05
Waist circumference (cm)	71.1±7.5	99.9±3.3	26.54	<0.05
Hip circumference (cm)	95.1±6.3	127.4±3.8	32.62	<0.05
WHR	0.74±0.04	0.74±0.02	8.47	<0.05
FFM (%)	70.0±4.6	67.5±3.10	3.32	<0.05
FM (%)	30.0±4.6	36.9±13	7.90	<0.05
Biochemical Findings				
Cholesterol(mg/dL)	164.7±29.4	219.3±12.8	12.85	<0.05
Triglyceride (mg/dL)	78.0±29.0	156.8±26.3	14.54	<0.05
HDL cholesterol(mg/dL)	63.9±12.3	45.3±14.3	0.53	NS
Homocysteine (nmol/L)	11.6±4.0	13.2±5.5	6.99	<0.05
Leptin (ng/mL)	5.9±7.0	8.7±5.9	2.22	<0.05
Folic acid (ng/mL)	10.4±4.4	15.9±7.3	4.48	<0.05

MUAC: Mid Upper Arm Circumference; SFT: Skinfold Thickness, BMI: Body Mass Index, WHR: Waist Hip Ratio; FM: Fat Mass, FFM: Fat Free Mass

demographic properties of the participants, numbers and percentages were taken. The mean and standard deviation of the parameters were calculated. Student's (t test) was performed to determine the difference between the data groups for young women and postmenopausal women. Statistical significance was established at a p-value of <0.05.

RESULTS

Anthropometric measurements and biochemical findings of postmenopausal women and young women are given in Table-I.

All anthropometric measurements of postmenopausal women were found to be higher than those of young women. There was a statistically significant difference for all parameters except suprailiac skinfold thickness (p<0.05).Cholesterol, triglyceride, homocysteine, leptin and folate levels of postmenopausal women were found to be higher than those of young women. There was a statistical significance between the levels (p<0.05). HDL-cholesterol levels of the women (63.9±12.3 mg/dL) were found to be higher than those of the postmenopausal group (45.3±14.3 mg/dL), but the difference was not statistically significant (p>0.05).

Daily energy, protein, thiamin, riboflavin, vitamin A05), and vitamin C intake of postmenopausal women were higher than those of young women (Table-III).

Total energy consumption of the postmenopausal group was higher than that of the women (t: 20.87, p<0.05). Due to their relatively young age, the RMR and thermal effect of the foods were found to be higher in women; however, energy consumption for physical activity of the women was found to be lower (Table-III).

DISCUSSION

Osteoporosis is a clinical condition that presents a significant risk for reduced quality of life and increased morbidity and mortality. There are many factors affecting bone mass and BMD, but body weight and body composition have a significant role. However, it is not clear whether fat amount or muscle mass have a greater effect on BMD.[13] Douchi *et al* reported that women with an inactive lifestyle had higher body fat mass and that, unlike women who participate in exercise, body fat mass was correlated with BMD.[17] Other studies reported that there were significant correlations between BMD and muscle mass.[13] We found that all anthropometric measurements of young women were lower than those of postmenopausal women; L2-L4, femur bone mineral densities of the women were higher and there was a statistically significant difference (p<0.05) between these levels (Tables I and II). Body weight affects bone density by putting a mechanical load on the skeleton. There was a linear and consistent relationship between body weight and BMD. In addition, in hip fractures, it was higher in persons with low body weight and lower in obese persons.

In recent years, the relationships between blood lipid parameters and bone mineral densitometers have been investigated. There was a strongly negative relationship between LDL-cholesterol and BMD and a positive relationship between high cholesterol levels and low BMD in the female population.[18] Here, age appears as a significant factor. It was reported that this effect can result from the negative effect of the LDL-cholesterol on bone metabolism, and that it can be associated with the negative effects of possible oxidized forms of LDL-cholesterol particles. High HDL-cholesterol might have a protective effect in terms of loss of bone.[12] LDL-cholesterol and total cholesterol levels increased significantly in postmenopausal women and that the rate of osteopenia decreased among women with high HDL-cholesterol levels. In another study, it was found that total cholesterol and

Table-II: Bone mineral densities of young women and postmenopausal women ($\bar{x}$±SD).

Bone Mineral Density (g/cm³)	*Young Girl Mean±SD*	*Postmenopausal Women Mean±SD*	*t test*	*P value*
Lumbal 2	1.18±0.22	0.89±0.02	10.36	<0.05
Lumbal 3	1.23±0.18	0.91±0.01	13.91	<0.05
Lumbal 4	1.21±0.17	0.89±0.02	14.54	<0.05
Lumbal 2.4	1.20±0.18	0.90±0.01	13.04	<0.05
Lumbal 2.3	1.20±0.19	0.90±0.01	12.50	<0.05
Lumbal 2.4	1.84±0.24	0.89±0.02	30.64	<0.05
Lumbal 3.4	1.22±0.17	0.90±0.01	14.61	<0.05
Femur	1.07±0.14	0.82±0.03	13.44	<0.05

LDL-cholesterol levels and osteoporosis development were associated, and it was stressed that patients with hyperlipidemia should be examined for osteoporosis.[19] Altindag, Soran and Sert reported that, rather than total body weight, the total fat mass of female study participants was related to BMD. Particularly during the postmenopausal period, decrease in body total muscle mass, increase in fat tissue and serum lipid level pose a risk for both osteoporosis and cardiovascular diseases.[20] In the present study, it was found that postmenopausal women had higher cholesterol, triglyceride, homocysteine, HDL cholesterol and folic acid levels than those of young women; however, they had lower HDL cholesterol level and bone mineral density (Tables I and II) ($p<0.05$).

Nutrition and dietary habits have a significant role in the development of osteoporosis. Calcium intake is directly related to bone mass in all ages. Sufficient calcium intake in adolescence and young adulthood increases bone mass to the peak level and helps to maintain bone volume in old age and a positive correlation was found between bone density and protein intake.[3] It was reported that excessive calcium output in urine results from excessive intake of animal protein,[21] high consumption of vegetables, fruit and also low consumption of animal protein reduce the extent of bone loss. The optimal ratio of calcium to phosphorus intake is approximately 2:1; with higher phosphorous intake, calcium absorption is hindered and bone loss occurs. While the ratio between calcium and phosphorus is positively correlated with bone mineral density, excessive phosphorus intake decreases osteoid volume.[22] Excessive sodium intake increases output of calcium in urine and reduces ionized calcium ratio in the blood.[23] Furthermore, vitamin C deficiency might distort the integration of collagen molecules. In the present study, it was found that both young and postmenopausal women consumed very little calcium, iron and zinc (Table-III). Consumption of recommended levels of nutrients can play a role in preventing osteoporosis in postmenopausal women and in maximizing BMD in youth.

Starting from an early age, exercises that put load on the bones have a significant role in prevention of osteoporosis. Such exercises include regular and permanent levels of walking, jogging and, during the postmenopausal period, exercises that increase physical strength. Previous studies have reported that physical activity prevents loss of bone mass. In this study, physical activity level was found to be low among both these women grades (Table-III). The reason for low physical activity might be lack of the habit of doing exercises, limited sports facilities and a lack

Table-III: Daily energy and nutrients intake and energy expenditures of the participants ($\bar{x}$±SD).

	Young Women Mean±SD	*Postmenopausal Women Mean±SD)*	*t test*	*P value*
Daily energy and nutrients intake				
Energy(kcal)	1429.9±56.2	1816.2±28.3	4.60	< 0.05
Protein (g)	55.6±23.8	62.0±13.1	1.76	< 0.05
Fat (g)	55.3±27.3	56.0±12.7	0.10	NS
Calcium (mg)	544.5±314.6	423.9±231.0	2.26	< 0.05
Iron (mg)	10.0±7.4	9.8±8.3	0.13	NS
Zinc (mg)	7.7±3.1	7.8±4.3	1.28	NS
Thiamin (mg)	0.6±0.2	0.81±0.3	3.39	< 0.05
Riboflavin(mg)	1.0±0.5	1.0±0.7	1.67	< 0.05
Niacin (mg)	8.7±4.9	10.0±3.8	1.56	NS
Vitamin A (IU)	3018.6±878.9	5169.0±870.3	24.08	NS
Vitamin C (mg)	80.2±41.3	112.6±50.9	3.49	NS
Energy Expenditure				
Total Energy Expenditure(kcal/day)	1997.2±47.8	2178.6±41.1	20.87	<0.05
RMR (kcal/day)	1482.9±11.4	1388.1±8.4	49.04	<0.05
Physical Activity (kcal/day)	426.8±23.4	642.3±36.7	34.48	<0.05
SDA (%10 of BMR) (kcal)	190.9±5.86	138.8±6.82	41.12	<0.05

NS = non significant

of cultural emphasis on the concept of engaging in sport.

In conclusion, the ideal method for prevention of osteoporosis is to maximize bone mass in adolescence and early adulthood. Sufficient and balanced diet is the principle condition for increasing quality of life. Furthermore, maintaining ideal body weight and regular physical activity also have positive effects. Determination of patterns of BMD among different age and gender groups is necessary for the planning of preventative measures and future screening programs.

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