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Dietary Factors Contributing to Osteoporosis among Post Menopausal Saudi Women

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Abstract: This study was designed to investigate the dietary components which are likely to contribute to osteoporosis in postmenopausal Saudi women. In the present study, 36 osteoporotic postmenopausal and 25 healthy postmenopausal women as cases and controls respectively were selected from Armed Forces Hospital, Riyadh, Saudi Arabia. The study has designed to collect the data about the general characteristics (age, marital status, education, number of pregnancies, activity level, income and housing), anthropometric measurements, medical history and dietary intake by using both the methods (24 h recall, food frequency questionnaire). Serum samples were analyzed for calcium, phosphorus, vitamin D and Para Thyroid Hormone (PTH) and they were correlated with Bone Mineral Density (BMD). Food intake items were correlated with hip, neck and spin BMD. In results, cases found significantly older than controls and had history of bone fractures. Cases were consumed significantly less dietary calcium than controls. Serum parameters did not show any significant differences. However significant correlation was found between serum level of PTH and calcium with BMD of spine and right neck femur respectively. Banana and Mataziz (locally prepared dish with vegetables) showed positive correlation with hip BMD. A negative significant correlation was found between Arabian coffee and right neck femur BMD. In conclusion, Saudi women require encouragement to consume adequate amounts of calcium, fruits and vegetables in combination with maintaining a daily physical activity and space in child birth.

Key words: Osteoporosis, postmenopausal women, bone mineral density, dietary factors, physical activity

INTRODUCTION

Osteoporosis is defined as bone mineral density that is reduced by>2.5 standard deviations below the peak bone mass (Kanis, 1994). It is a one of the major public health threat for postmenopausal women worldwide and affects an estimated one third of women aged between 60 to 70 years and two third of those aged 80 years or older (Cashman, 2005). The incidence is expected to rise steeply over the next few decades, by the year 2020, it is estimated that over 60 million women and men will be affected (Fulton, 1999).

Diet and lifestyle play a crucial role in maintaining the health of this growing portion of the community. It is commonly held view that food or a food component can offer medical or health benefits (including the prevention or treatment of disease) above and beyond simple nutrition (Nahim and Straus, 2001). Medications such as hormonal replacement therapy are presently used in postmenopausal women for the prevention of osteoporosis (Lufkin *et al*., 1992). However, the non-acceptance and non-continuation with these therapies is common and mainly due to proven or patient-perceived side effects (Purdie *et al*., 1996). Food and food supplements constitute a much more desirable alternative (Johnston *et al*., 1997). Different recent reports showed that, calcium and vitamin D supplement are useful therapies in the prevention and treatment of osteoporosis (Morgan, 2001; Buckley and Hillner, 2003; Meier *et al*., 2004; Heaney, 2000). This is an evidenced by the rapid growth of the nutraceutical industry and the vast interest expressed by consumers.

El Desouki (2003) reported that, the prevalence of osteoporosis in postmenopausal women in different centers of the Kingdom of Saudi Arabia was about 50-70% and also reported in another study (El-Desouki, 1999) that the, prevalence of osteoporosis in type 1 diabetes females between the age 50-60 years was up to 24%. From a neighboring country Kuwait, the incidence of osteoporosis reported to be as high as in Great Britain and France (Memon *et al*., 1998). Saudi Arabia is an under developing country, the dramatic

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changes are taking place in population's living standards, lifestyle and their dietary habits. It will not be surprising to see more and more patients with osteoporosis, unless preventive steps are seriously considered. The present study was undertaken to investigate the dietary components and specially the local food preparations which are likely to contribute to osteoporosis in postmenopausal Saudi women.

MATERIALS AND METHODS

This case-control study was carried out in the Armed Forces Hospital, Riyadh, Saudi Arabia during the period from January to June, 2005. The study protocol was reviewed and approved by the hospital management and informed consents were obtained from all participants in the study.

Cases were 36 postmenopausal osteoporotic Saudi women who were referred to orthopedic and osteoporosis clinics. Bone mineral density of the hip and spine (neck and trochanter) were measured by dual-energy x-ray absorptionmetry (Lunar, Radiation Corp, Wisconsin). Osteoporosis was defined as BMD that is reduced by >2.5 Standard Deviation (SD) below peak bone mass (WHO Study Group, 1994). Twenty five normal postmenopausal women with normal BMD 1.0 SD were selected from primary clinics from the same hospital as controls. The criteria for the selection of controls were based on BMD results and the absence of osteopenia and osteoporosis. The cases and controls both had no other chronic disease like diabetes, hyperlipidemia, hypertension and cardiac problems.

A questionnaire was designed to collect data about general characteristics of participants (age, marital status and education, number of pregnancies, activity level, monthly income and current housing), medical history and anthropometric measurements. Dietary intake was assessed using the 24 h recall and food frequency questionnaire. Food intake in the in 24 h preceding the interview was collected from cases and controls. Participants were asked about details of food and beverages intake of main meals (breakfast, lunch and dinner) and snacks taken in between meals. Frequency of consuming 57 food items per week was measured to assess the habitual consumption of the selected food items during previous week. The food frequency questionnaire was used as rough estimate of the qualitative aspect of dietary intake. Foods chosen were categorized into the following groups: diary product, vegetables and fruits, legumes, animal protein and carbohydrates.

After completing the interview blood samples were collected and centrifuged at 3000 rpm for 10 min. Serum samples were kept in deep-freezer until analysis. Total calcium, phosphorus, 25-hydroxy vitamin D were estimated in serum by using enzymatic kits and the parathyroid hormone concentrations were determined by using radioimmunoassay kits.

To analyze the data, variables were presented as mean and Standard Error (SE). The statistics was done by using SPSS (version 10) computer software program. Comparison between different variables was made using student t-test and Chi-square. Association among important variables was studied using Pearson correlation. Statistically significant is considered if (p-value) value less than 0.05.

RESULTS

Mean age of the cases and controls were 62±1.14 and 58±1.33 years respectively and the difference was statistically significant ($p<0.05$). Body mass index of cases (31.0±1.32) were as same as the controls (34.0±1.14). However, according to the classification both the groups had grade II obesity.

Marital status, educational level, number of pregnancies, activity level and exposure to the sun did not differ significantly between cases and controls. Women who had more than 5 pregnancies were 89% of cases and 80% of control. A significant number of cases had history of bone fracture compared to controls. According to the information collected, a significant number of controls (64%) were taking multivitamins as supplements compared to 36% cases (Table 1).

There was no statistically difference with regard to energy and protein intake between cases and controls (Table 2). However, the cases consumed less calcium than controls and this difference showed statistically significance. Dietary fiber, phosphates, sodium and potassium intake levels were found similar in osteoporotics as controls.

Table 3 show the estimated calcium, phosphate, 25-hydroxy vitamin D and parathyroid hormone concentrations in serum of cases and controls were not different. Table 4 shows correlation of BMD at different sites with serum levels of calcium, vitamin D, phosphorus and parathyroid hormone in osteoporotics. Significant correlation was found between parathyroid hormone and BMD of the spinal ($p<0.05$) and it also found significant correlation between calcium and BMD of the right neck femur ($p<0.01$).

Table 1: General characteristics of the osteoporotic and control subjects

	Control (n = 25)		Cases (n = 36)		
Variable	No.	Percent	No.	Percent	p-value
Marital status					
Married	25	100	35	97	
Unmarried	0	0	1	3	0.29
Educational level					
Illiterate	17	68	32	89	0.15
Literate	8	32	4	11	
No. of pregnancies					
1 – 5	4	16	4	11	0.49
> 5	20	80	32	89	
None	1	4	0	0	
Activity level					
Sedentary	2	8	7	19	0.25
Mild	10	40	17	47	
Moderate	13	52	12	33	
Exposure to the sun					
Daily	9	36	10	28	0.63
Monthly	1	4	2	6	
Once a week	4	16	3	8	
None	11	44	21	58	
History of any bone fracture					
Yes	2	8	12	33	0.02*
No	23	92	24	67	
Usage of multivitamins supplement					
Yes	16	64	12	33	0.05*
No	9	36	24	67	

*p<0.05 Statistical significance

Furthermore, the correlation between BMD at different sites with different food items consumed during a week was tested (Table 5). The data showed a significant positive correlation between right and left total hip BMD with the frequency of banana consumption

Table 2: Micro and Macro nutrients consumption by cases and controls using 24 h recall

Dietary intake per day	Control (n = 25) (Mean±SE.)	Cases (n = 36) (Mean±SE.)
Energy (Kcal)	1502.1±103.6	1359.0±133.07
Protein (g)	55.1±4.40	47.4±5.56
Calcium (mg)	742.0±133.88	378.0±13.32 *
Phosphates (mg)	1000±106.60	822.0±118.00
Fiber (g)	16.9±1.66	17.4±1.98
Sodium (mg)	2122.3±203.00	1812.5±187.20
Potassium (mg)	1799.8±199.90	1437.9±194.47

*p<0.05 statistically significant difference in consumption between the groups

Table 3: Differences in some serum level parameters in cases and controls

Dietary intake per day	Control (n = 25) (Mean±SE.)	Cases (n = 36) (Mean±SE.)
Calcium (mmol L^{-1})	2.35±0.02	2.36±0.02
Phosphorus (mmol L^{-1})	1.18±0.036	1.14±0.032
25-hydroxy vitamin D (mmol L^{-1})	43.58±4.44	34.00±3.70
Parathyroid hormone (ng L^{-1})	68.92±9.70	94.75±8.95

p<0.05 Cases was statistically compared with controls

Table 4: Correlation between BMD (right hip, left hip, right neck femur, left neck femur and spinal card) and some serum level parameters of cases and controls

	Right hip		Left hip		Right neck femur		Left neck femur		Spinal	
Variables	r-value	p-value	r-value	p-value	r-value	p-value	r-value	p-value	r-value	p-value
Parathyroid hormone (mmol L^{-1})	0.248	0.687	0.012	0.958	0.346	0.077	0.003	0.992	0.375	0.045*
Calcium (mmol L^{-1})	0.509	0.381	0.487	0.406	0.537	0.004*	0.175	0.549	0.157	0.147
Vitamin D (mmol L^{-1})	0.320	0.600	0.152	0.807	0.044	0.829	0.045	0.880	0.111	0.575
Phosphorus (ng L^{-1})	0.628	0.257	0.383	0.524	0.317	0.107	0.179	0.541	0.040	0.836

*p<0.05 Significant correlation

Table 5: Correlation between BMD (right hip, left hip, right neck femur and left neck femur) and consumption of some foods

	Right hip	Left hip		Right neck femur	Left neck femur
Variables	r-value (p)				
Meat	0.08 (0.65)	0.18 (0.31)		0.19 (0.26)	0.07 (0.65)
Fish	0.04 (0.81)	0.15 (0.39)		0.09 (0.60)	0.07 (0.68)
Egg	0.23 (0.19)	0.20 (0.25)		0.23 (0.17)	0.06 (0.73)
Whole milk	0.20 (0.24)	0.21 (0.23)		0.03 (0.84)	0.23 (0.18)
Cheeper cheese	0.23 (0.18)	0.07 (0.68)		0.07 (0.68)	0.23 (0.18)
Laban	0.21 (0.22)	0.13 (0.43)		0.24 (0.15)	0.17 (0.20)
Rice	0.14 (0.43)	0.18 (0.29)		0.04 (0.81)	0.02 (0.90)
Macaroni	0.09 (0.58)	0.04 (0.79)		0.09 (0.60)	0.19 (0.26)
Bread	0.02 (0.87)	0.08 (0.63)		0.07 (0.67)	0.04 (0.81)
Potato	0.08 (0.62)	0.05 (0.75)		0.09 (0.60)	0.07 (0.65)
Apple	0.03 (0.84)	0.05 (0.75)		0.06 (0.70)	0.12 (0.47)
Orange	0.10 (0.56)	0.01 (0.92)		0.04 (0.80)	0.00 (0.98)
Banana	0.34 (0.04)*	0.36 (0.03)*		0.17 (0.31)	0.22 (0.20)
Broccoli	0.13 (0.44)	0.12 (0.50)		0.17 (0.32)	0.12 (0.46)
Date	0.07 (0.65)	0.07 (0.66)		0.03 (-)	0.00 (0.98)
Coffee	0.30 (0.08)	0.21 (0.23)		-0.40 (0.01)*	0.16 (0.35)
Tea	0.00 (0.98	0.03 (0.83)		0.06 (0.69)	0.00 (0.96)
Table sugar	0.12 (0.48)	0.25 (0.14)		0.04 (0.79)	-0.35 (0.03)*
Qursan	0.00 (0.97)	0.05 (0.77)		0.06 (0.70)	0.24 (0.15)
Jareesh	0.07 (0.69)	0.04 (0.78)		0.07 (0.67)	0.02 (0.89)
Kabsah	0.08 (0.65)	0.16 (0.34)		0.06 (0.73)	0.06 (0.78)
Margoog	0.01 (0.51)	0.13 (0.45)		0.01 (0.91)	0.00 (0.98)
Mataziz	0.42 (0.01)*	0.37 (0.03) *		0.09 (0.58)	0.25 (0.14)

*p<0.05 Significant correlation (p<0.03)

and a locally prepared dish called Mataziz (which include different types of vegetables) was positive significant ($p<0.03$) correlation with total left and right hip BMD. However, a negative significant ($p<0.01$) correlation between right neck femur BMD and coffee intake was seen. High table sugar intake also showed significantly ($p<0.03$) negative effect on spinal BMD.

DISCUSSION

Osteoporosis is a disease which increases with age (Kin *et al*., 1991). In the present study, a significant correlation between age and osteoporosis was found. Among present study subjects, about 89% were illiterate in cases compared with 68% of controls, this agree with life style include educational level intervention might help in reducing the risk of osteoporosis (Newman *et al*., 2003). Majority of the cases (89%) had more than 5 pregnancies and this was in agreement with Ghannam *et al*. (1999) who showed multiple pregnancies were found to be related inversely to BMD. Present results showed 33% of cases and 62% of controls were considered as moderate physical activity. Ruiz *et al*. (1995) reported that a positive association between BMD of both spine and hip with increasing physical activity.

In the present study our goal was to determine the dietary factors which are likely to contribute osteoporosis in postmenopausal Saudi women, we correlated these with BMD in cases. Several studies have identified the association between dietary intake of different nutrients and BMD and rate of bone loss and fracture incidence in postmenopausal women in Western societies (Cashman, 2004; Cohen and Roe, 2000). However, such data does not exist in Saudi postmenopausal women. Calcium has been studied most extensively and is considered the nutrient most important for maintaining skeletal mass along with other nutrients. However, the recommended dietary calcium intake varies widely from country to country (Department of Health, 1998). The observations of the present study showed a significantly low intake of dietary calcium in cases (<400 mg day^{-1}) compared to controls (>700 mg day^{-1}). Similar correlation was also found in earlier studies (Chee *et al*., 2003; Whiting *et al*., 2004). Antich *et al*. (1993) reported that, supplementation with calcium to normal postmenopausal women caused decrease in appendicular bone loss.

Increasing dietary protein increases urine calcium excretion such that for each 50 g increment of protein consumed, an extra 60 mg of urinary calcium is excreted (Kerstetter and Allen, 1994). Recently, several reports showed that the high intake of proteins increases the bone fractures (Feskanich *et al*., 2003; Meyer *et al*., 1997). However, the epidemiological and clinical data addressing this hypothesis are controversial. Most (Geinoz *et al*., 1993; Cooper *et al*., 1996) but not all (Metz *et al*., 1993) epidemiological studies found a positive association between protein intake and BMD. In the present study, dietary protein intake was similar in both the groups.

Dietary phosphorus intakes have raised 10-15% over the past two decades because of the increased use of phosphate salts in fold additives and cola beverages (Institute of Medicine, 1997). And it also reported that, the rise in dietary phosphorus increases serum phosphorus concentration, producing a transient fall in serum ionized calcium resulting in elevated parathyroid hormone secretion and potentially bone resorption. However, present study subjects did not show significant difference in phosphate intake.

A number of studies suggest that increasing sodium intake can increase bone resorption in postmenopausal women (Doyle and Cashman, 2004; Harrington and Cashman, 2003). However, it is worth noting that these studies were relatively short-term (1-4 weeks) and thus may not have allowed sufficient time for bone to reach a steady-state after the sodium intervention. The present results showed no significant difference in between cases and controls sodium intake.

There has been increasing interest in the potential beneficial effects of dietary potassium on bone. Various mechanisms have been proposed by which potassium may prevent the sodium-induced calciuria and increased rate of bone resorption. In the present study, dietary phosphorus intake was less (not significant) in cases than controls. Significant positive correlation ($p<0.03$) was observed with high banana intake and right and left hip BMD. *Mataziz* is a traditional dish consumed more in the central region of Saudi Arabia, this preparation contain wheat and vegetables (zucchini, eggplant, pumpkin, beans and tomato). A significant positive correlation ($p<0.03$) was observed with right and left hip BMD, respectively. Thus it may attribute that, eating large number of fruits and vegetables prevent the osteoporosis. The high potassium content of these foods had shown to decrease urinary hydroxyl praline and increase serum osteocalcin thereby reducing bone resorption and increasing bone formation (Sebastian *et al*., 1994; Katherine *et al*., 2002). However, the present results showed a negative correlation ($p<0.03$) between right neck femur BMD and Arabic coffee intake. Several earlier reports has conformed these findings. Harris and Dowsan-itushes (1994) reported that, daily consumption of 2-3 cups coffee may accelerate bone loss in postmenopausal women. Similarly, Rapuri *et al*. (2001) reported that if

postmenopausal consume more than 300 mg coffee per day, it may increase the bone resorption. Furthermore, the present study showed a significant negative correlation ($p<0.05$) between table sugar intake and left neck femur BMD. Several studies showed agreement with our findings that, high sugar diet may reduce the calcium content of bone (Leman *et al*., 1969) and promote osteoporosis (Yudkin, 1973). This possibility was supported by an experimental study on hamsters that, 56% dietary sucrose caused osteoporosis despite adequate intake of calcium (Saffar *et al*., 1981).

In conclusion, the present results revealed that consumption of fruits and vegetables promotes bone density of osteoporotics while coffee and sugar intake had a negative effect. However, to prevent osteoporosis women need adequate dietary calcium intake, increase physical activity level and exposure to sun. Furthermore, the high level of awareness about the disease and its affordable precautions can reduce osteoporosis in Saudi women.

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