Risk Factors for Spinal Osteoporosis As Compared with Femoral Osteoporosis in Urban Iranian Women

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Abstract

Background: We aimed to define and compare the risk factors of spinal and femoral osteoporosis in postmenopausal Iranian women.

Method: It was a multicentre based study carried out in two stages during 2002 to 2005 among post menopausal women in Tehran. In first stage case group included 140 women with diagnosed spinal osteoporosis using DEXA method as definition of WHO and Controls were 167 women with normal spinal BMD. In second stage, among the same study population case groups were 72 women with total femoral neck osteoporosis. The controls included 191 women with normal femoral BMD.` Odds Ratio was used for estimation the association of risk factors with spinal and femoral osteoporosis.

Results: Plus common well known osteoporosis risk factors, significant risk factors for each region with their odds ratios included: Steroid use (2.4) and low activity (3.6) for femoral osteoporosis and parity>3 (2) and lactation duration > 2 yr (1.9) for spinal osteoporosis.

Conclusions: There are some common and different protective and risk factors for spinal and femoral osteoporosis in this population.

Keywords: Osteoporosis risk factors, Femur, Spine, Iranian women, Postmenopausal women

Introduction

Osteoporosis characterized by low bone mass with micro architectural disruption and skeletal fragility, is a complex, multi factorial chronic disease leading to fractures of the hip, spine, wrist and other regions like humerus, and pelvis (1). Osteoporosis is a common disease particularly in old age population and osteoporotic fractures of the hip and spine rises mortality rate of 10 to 20 percent (2, 3). These fractures also cause substantial pain and disability, depression, increasing dependency and decreasing the quality of life (4). Vertebral fracture, a well-recognized complication of osteoporosis, is the most common osteoporotic fracture. Less than one third of these fractures are clinically identified. Regardless of whether they are symptomatic or are identified on imaging, vertebral fractures are associated with increased mortality and morbidity rates and prevalent vertebral fractures have been shown as a risk factor for future fractures in spine or other regions (5). Prevalence of osteoporosis varies country to country nutritional status, physical activity and lifestyle (6-9) differences in races (10, 11) may cause these variations.

The effect of protective and risk factors might be different for spine and femur. Previous studies

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conclude that age of attaining peak bone mass at the hip is younger than at the spine and BMC and BSA at the spine continue to increase through the early thirties in female (12, 13).

Discordant hip-spine BMD results and different patterns of fracture risk were reported in another study. This study showed that women with osteoporosis only at hip were at greatest risk for hip fracture, as compared with other fracture types. Women with osteoporosis only at spine were at increased risk for radiographic spine and nonhip - nonspine fractures (14).

There are some evidences that have shown the effect of environmental and genetic factors on spinal and femoral regions are different. In one study, they have found different effect of exercises on different sites of bone (15). In a study on BMD values in 3000 premenopausal Scottish women that were adjusted by regression to identify and account for nongenetic factors, Regression analyses revealed that approximately 39% of spine and 19% of hip rate of change in BMD was accounted for by nongenetic factors (16).

In this study we aimed to define the risk factors of spinal and femoral osteoporosis in postmenopausal Iranian women. This research assesses osteoporosis risk factors in spine versus femur. It assesses the association with osteoporosis of the following factors:

a) Demographic, b) menstrual, c) obstetrical factors, d) nutritional status, e) physical activity, f) medical disorders and g) medication in spinal and femoral osteoporotic subjects and comparing these associations in spine region versus femur.

Material and Methods

This is a hybrid of two case-control interview-based study. Initial data came from the samples of a multicentre-based study on osteoporosis risk factors. The sample was selected from all postmenopausal women whose bone mineral density was measured in selected centers in Tehran during the study period (2002 to 2005).

The study was carried out in two stages: Stage I: The case group included postmenopausal spinal osteoporotic women who were identified as

patients with bone density higher than 2.5 SD below average of young normal bone density (in L1-L4) spine region interest using DEXA method. The controls were chosen from post-menopausal women with normal bone density in spine (BMD lesser than 1 SD below average of young in L1-L4 spine using DEXA method).

Stage 2: The case group included postmenopausal femoral osteoporotic women who were identified as patients with bone density higher than 2.5 SD below average of young normal bone density total proximal femur region interest using DEXA method.

The controls were chosen from post-menopausal women with normal femoral bone density in spine (BMD lesser than 1 SD below average of young's in total proximal femur using DEXA method).

Data collected for this study included filling questionnaires through personal interviews, use of case records, files and documents. The questionnaire covered following information: a) demographic, b) menstrual, c) obstetrical factors, d) nutritional status, e) physical activity, f) medical disorders and g) medication. Statistical analysis was performed using SPSS. The association of risk factors with osteoporosis was estimated using Odds Ratio and Multinominal logistic regression applied for adjustment of confounds variables.

Ethical point

We have interviewed with patients who were agreed to participate. Identify was not revealed. The data was kept strictly confidential. Acknowledgment each particular centers when data published.

Results

In the first stage of study mean age of case group (140 women with spinal osteoporosis) and controls (167 women with normal spinal BMD) were found 58.1±6.9 and 56.7±6.2 yr respectively. Mean ages of case group and controls in the second stage of study (72 women with total femoral neck osteoporosis as case group and 191 women with normal Femoral BMD as controls) were shown 58.9±8.4 and 56.2±5.9 respectively (Table 1).

Table 1: Distribution of associated factors with osteoporosis in two regions

Variabels1		Spine				Femur			
		Case (n=140)	Control (n=167)	OR2 (0.95 CI)	OR3 (0.95 CI)	Case (n=72)	Control (n=191)	OR2 (0.95 CI)	OR3 (0.95 CI)
Demographic factors									
Age(mean)		58.1± 6.9	56.7±6.2			58.9±8.4	56.2±5.9		
<12 yrs schooling (%)		66.1	44.2	2.5 (1.5-4.2)	2.5 (1.5-4.4)	65.2	46.2	2.7 (1.5-4.8)	1.8 (0.8-4.0)
Anthropometric charcters (%)									
Weight <=60Kg (%)		36	15.3	3.1 (1.8-5.4)	----	37.1	19.7	2.4(1.3-4.4)	-----
BMI <=26 (%)		39.4	15.3	3.9 (2.3-6.7)	----	46.2	19.8	3.6 (1.9-6.6)	----
Menopausal factors									
Postmenopausal >5 yrs (%)		75.3	52.5	2.2 (1.3-3.7)	2.3 (1.3-4.0)	73.5	58.5	1.4 (0.7-2.7)	1.4 (0.6-3.2)
Menarche after 14 yrs (%)		52.5	38.9	1.7 (1-2.8)	----	64.9	43.3	1.6 (0.8-3.4)	1.4 (0.5-3.9)
Lactation>2yrs		71.7	59.7	1.7(1-2.1)	1.9(1-3.4)	68.5	59.1	NS²	NS²
Parity >3 (%)		55.2	38.8	1.9 (1.2-3.1)	2.2 (1.3-3.8)	46.4	44.9	NS²	NS²
Medication									
Steroid usage (%)		16.4	10.5	----	----	22.2	9.6	2.7 (1.3-5.6)	NS²
Calcium supplementation>1yr (%)		39.3	51.9	0.6 (0.4-0.9)	----	38.9	49.2	0.6 ((0.4-0.9)	----
HRT (%)		28.8	44.4	0.5 (0.3-0.8)	0.4 (0.2-0.7)	22.2	41.2	0.4 (0.21-0.8)	0.4 (0.4-0.8)
Other (%)									
Bone and join problem		24.5	17.3	2.3 (1.4-4.0)	2.3 (1.4-3.9)	33.3	18.8	2.2 (1.2-3.9)	2.2 (1.3-3.6)
Tooth problem		20.1	6.8	3.4(1.6-7.2)	2.8(1.3-6.3)	19.4	8.6	2.5(1.2-5.5)	2.6(1.2-5.6)
sunshine		76	88.8	0.4(0.2-0.8)	0.3(0.1-0.7)	80.4	84.9	NS	NS
History of fracture		25	13.2	2.2 (1.2-3.9)	2.5 (1.3-4.8)	26.1	13.9	2.2(1.1-4.3)	2.7(1.3-5.6)
History of fractures in relatives		5.8	4.9	------	------	9.9	2.7	3.9 (1.2-12.9)	----
pain		73.6	64	NS	NS	83.7	66.1	1.3(1.1-6.1)	3(1.2-7.6)
Low activity		51.4	45.4	NS	NS	85.7	62.6	3.6(1.6-8.2)	

1= Variables are dichotomous. 2=Non significant. OR2 = Adjusted for age. OR3 = Adjusted for age, height

Among total number of study cases (osteoporotic women in first and second stages of study), 33.1% were diagnosed with both spinal and femoral osteoporosis. It means that this percent of cases were similar or common in both stages of study. When we excluded this number of cases from the first stage of study, mean age of women with femoral osteoporosis (58.7±8.4) was higher than women with spinal osteoporosis (57.6±5.8), but it was not significant statistically.

Mean of weight and BMI were significantly lower in osteoporotic group in both spinal and femoral areas (*P*<0.05) (Table 1).

Education less than 12 years of schooling was shown as risk factors of osteoporosis for both spinal and femoral osteoporosis, it remained significant (*P*<0.05) as risk factor after age, height and weight adjustment in both regions)(Table 1).

Early menopause (before 45 years old and post menopausal duration more than 5 years were shown as significant risk factors in both areas. Parity more than 3 and lactation more than 2 years were shown as risk factors for spinal osteoporosis and they remained significant (*P*<0.05) after age, height and weight adjustment (Table 1).

Table 2: Distribution of nutritional associated factors with osteoporosis in two regions

Nutritional factors [1]	Spine				Femur			
	Case (n=140)	Control (n=167)	OR2 (0.95 CI)	OR3 (0.95 CI)	Case (n=72)	Control (n=191)	OR2 (0.95 CI)	OR3 (0.95 CI)
Milk								
>=1 cup/ day	48.2	60.5	0.6 (0.3-0.9)	0.6 (0.3-0.9)	56	59.1	NS2	NS2
Yogurt								
>= 3/ w	76.5	89.4	NS	NS	72.5	89.5	0.3 (0.2-0.6)	0.3 (0.1-0.6)
Fish								
>= 2/ w (%)	1.6	7.6	0.2 (0.04-0.5)	0.2 (0.03-0.9)	5.1	6.6	NS	NS
Eggs								
>=1/ w (%)	54.5	70.6	0.5 (0.3-0.8)	0.5 (0.3-0.9)	44.2	72.3	0.3 (0.2-0.6)	0.3 (0.2-0.6)
Chicken								
>=2/ w (%)	58.3	72.6	0.3 (0.2-0.7)	0.4 (0.2-0.7)	57.6	72.4	0.5 (0.3-0.9)	0.4 (0.2-0.8)
Almond								
No Almond (%)	63.6	47.3	1.9 (1.2-3.2)	2.1 (1.1-3.2)	56.9	41.6	1.9 (1.-3.3)	1.9 (1.1-3.6)
Salt								
Salt (%)	10	4.3	NS	3(1-8.7)	7.6	3.5	0.3 (0.2-0.7)	0.4 (0.2-0.9)
Fruits								
Daily (%)	73.1	82.3	NS	NS	58.3	83.6	0.3 (0.1-0.7)	0.3 (0.2-0.6)
Tea								
>=7cup/ w	10.4	27.9	0.3 (0.2-0.6)	0.3 (0.1-0.6)	10.4	21.6	0.3 (0.2-0.8)	0.3 (0.1-0.8)

[1]- Variables are dichotomous. [2]-Nonsignificant. OR2 = Adjusted for age. OR3 = Adjusted for age, height and weight

According to Table 1, bone and joint disorders, tooth problem and history of fracture during last 5 years were shown as risk factors of osteoporosis in both spine and femoral osteoporosis.

Medication with steroids was a risk factor for femoral osteoporosis. Hormone replacement therapy (HRT) and calcium supplementation have been shown as protective factors (Table 1). Pain and low activity were shown as risk factors for femoral osteoporosis (*P*<0.05) but there were no significant associations between these factors and spinal osteoporosis.

The percentage of women who were directly in sunshine exposure at least for 15 min per day was significantly higher among controls compared to spinal osteoporotic groups (*P*<0.01) and sunshine exposure was shown as a protective factor and it remained significant after age, weight and height adjustment (Table 1).

Regular consumption of chicken, eggs, and tea 7 cups per day and more, appeared to be significant protective factors in both spinal and femoral regions. Distribution of subjects based on food consumption in both stages of study with their odds ratios are shown in (Table 2).

In this study exercises was shown as protective factor in both spinal and femoral osteoporosis and it remained significant after adjustment for age, weight and height in Iran. Walking more than 3 times per week appeared as a protective factor for femoral osteoporosis (Table 3).

Table 3: Association of osteoporosis with exercises as protective factors in spine and femur

Variabels[1]	Spine				Femur			
	Case (n=140)	Control (n=167)	OR[2] (0.95 CI)	OR[3] (0.95 CI)	Case (n=72)	Control (n=191)	OR[2] (0.95 CI)	OR[3] (0.95 CI)
Walking >3.5/w (%)	17.5	23.5	NS	NS	11.3	22.4	0.4 (0.2-0.9)	NS[2]
Other exercises Yes (%)	22.2	40	0.4 (0.3-0.7)	NS	16.2	42.4	0.3(0.1-0.5)	0.3(0.1-0.6)

[1]- Variables are dichotomous. [2]-Non significant. OR2 = Adjusted for age. OR3 = Adjusted for age, height and weight

Discussions

Osteoporosis in femur and spine appears to be associated with several known and common risk factors.

As it was explained in several previous studies (17) aging is a major factor that affect bone mass. In this study the mean age of women with femoral osteoporosis was higher than women with spinal osteoporosis: 58.7±8.4 among women with femoral osteoporosis versus 57.6±5.8, among women with spinal osteoporosis, but it was not significant statistically. As mentioned before previous studies showed that the effect of aging on different regions is not exactly similar, for example the age of attaining peak bone mass at the hip is younger than at the spine (12, 13).

Weight is a protective factor for osteoporosis, in obese individuals, fracture risk is reduced. The role of anthropometric factors was reported in previous studies (18).

In this study weight less than 60 kg and BMI less than 26 have been shown as risk factors of osteoporosis in both spine and femoral regions. Body mass and, above all, body fat have been studied extensively. Several studies found that weight loss, body fat loss, and a low body mass index (body weight in kg/height in m^2) were associated with a higher risk of fracture in proximal femur (19). Thinness was reported as one of the larger risk factors from seven identified variables for bone loss in both spine and femoral regions (20).

Results of this study show that education less than 12 years of schooling was risk factor of osteoporosis for both spinal and femoral osteoporosis,

it remained significant (*P*<0.05) as risk factor after age, height and weight adjustment in both regions. Same results have been reported in previous studies. Negative association between education level and osteoporosis has been reported in some other studies (21, 22). The reason probably is the effect of education on lifestyle, nutrition and economic status. The other possibility is the effect of economic status in education level. People from well to do families have more facilities for continuing their education and they also have better nutritional and health status during childhood which affect the bone mass.

Menstrual factors such as late menarche age, early menopause, and amenorrhea have been shown as risk factors of osteoporosis in previous studies (23, 24). In this study menstrual factors such as late menarche (after 14 years old), early menopause (before 45 years old) and postmenopausal period more than 5 years has been shown as risk factors of osteoporosis in both regions.

It was also indicated that multi-parity more than 3 and lactation more than 2 years were risk factors for osteoporosis in spine area. Other studies also reported that there is a small loss of bone throughout pregnancy, between 1 and 4%, in the pelvis and lumbar spine and lose 3-6% in bone mineral density during lactation, most of it in the first 3 months (25).

Bone and joint and problems (include any bone and joint discomfort that need treatment) were risk factor for osteoporosis in both spine and femoral regions. The reason is probably effect of some diseases like rheumatoid arthritis, drugs like steroids and lack of ability for physical activity on

osteoporosis (26). Tooth discomforts also have been shown as risk factor for spinal and femoral osteoporosis. Same result was reported in previous studies: in a study the results suggest that dentists have sufficient clinical and radiographic information that enables them to play a significant role in early diagnosis of osteoporosis in postmenopausal women (27) and in another study they found that routine dental evaluation can be useful for the early diagnosis of osteoporosis in postmenopausal women (28).

It is widely believed that inadequate calcium intake throughout life is an important risk factor. Adequate calcium intake is critical in keeping bones strong and it is estimated that approximately 70% of people do not regularly ingest adequate amounts of calcium. The recommended amounts of calcium for adults (were made in 1998 by the institute of medicine (29) are as follows: For people over 50 (postmenopausal women), 1,500 milligrams of calcium per day is recommended along with 400-800 i.u. of vitamin D. For people 25-50 years old (premenopausal women), 1,000 milligrams of calcium per day is recommended with 400 i.u. of vitamin D. there are many studies who reported role of calcium intake through supplementation to prevention of post menopausal osteoporosis (30). In this study use of calcium supplements has been shown as a protective factor for osteoporosis in both spine and femur area.

Regarding to the literature it seems that three servings of dairy per day are necessary for healthy bone, not only because of dairy calcium, but for dairy protein and potassium as well (31). In this study daily consumption of milk and cheese =>30 g /d has been shown as protective factors of spinal osteoporosis. Almond was also reported as good sources of calcium in literature. The isoflavones in soybeans, act as phytoestrogens and antioxidants, may inhibit bone desorption (32).

Present study also indicated that chicken consumption more than 2 times per week as protective factor for osteoporosis in both sites. Adequate protein intake is important for optimal bone health in the elderly 50-69 years of age.

According to previous studies, higher fruit and vegetable intake was associated with greater BMD in men and women (33). In this study daily consumption of fruits was shown as a protective factor in spine and femur regions.

In this study black tea consumption more than 6 cups per day have been shown as protective factors for osteoporosis. Similar results have been reported in some previous studies (6). Nutrients found in tea, such as flavonoids, may influence BMD.

Estrogen deficiency after menopause predictably leads to bone loss and osteoporosis. Accordingly, HRT is the accepted standard of practice for the prevention and for the treatment of osteoporosis. In our study HRT found as a protective factor in both area. Medication with steroids has been shown as risk factor for femoral osteoporosis in our study. Regarded to literature a strong negative correlation was found between cumulative glucocorticoid dose and BMD at spine and hip (34).

Exercises have been shown as a protective factor in both regions in this study. Recent evidence indicates that some forms of physical activity may maintain or even increase BMD in selected population (35).

In this study women with no regular walking were at risk for femoral osteoporosis. There was no significant protective role in walking or the time and duration of walking for spine regions. Other kinds of exercises like aerobic, swimming, weight lifting and others have been shown as a protective factor in both region but it remained significant after age height and weight adjustment only in femur. Although the result of a meta-analysis on controlled clinical trials with individual patient data showed that the exercise protocols that were used in this individual patient do not improve femoral neck bone mineral density in post menopausal women (36) regarded to another study aerobics, weight bearing and resistance exercises were shown all effective in increasing the BMD of the spine in postmenopausal women. Walking was also effective on the hip (37).

Conclusion

In this study osteoporosis in femur and spine were shown to be associated with several known risk

factors as were described in previous studies. There are some common and different protective and risk factors for spinal and femoral osteoporosis in this population. It seems that risk factors for spine osteoporosis versus femur osteoporosis vary country to country.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc) have been completely observed by the authors.

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References

1. Arden N, Cooper C (1998). Present and future of osteoporosis: epidemiology. In: *Osteoporosis: diagnosis and management.* Ed, Meunier PJ. Mosby/Martin Dunitz Inc. London, pp.1-16.
2. Johnell O, Kanis JA(2006). An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. *Osteoporos Int*, 17(12):1726-33.
3. Ioannidis G, Papaioannou A, Hopman WM and et al (2009). Relation between fractures and mortality: results from the Canadian Multicentre Osteoporosis Study. *CMAJ*, 181(5): 265-271.
4. Adachi JD, Adami S, Gehlbach S and et al. (2010). Impact of prevalent fractures on quality of life: baseline results from the global longitudinal study of osteoporosis in women. *Mayo Clin Proc*, 85(9):806-813.
5. Kim SH, Choi HS, Rhee Y, Kim KJ, Lim SK (2011). Prevalent vertebral fractures predict subsequent radiographic vertebral fractures in postmenopausal Korean women receiving antiresorptive agent. *Osteoporos Int*, 22(3):781-7.
6. Hegarty VM, May HM, Khaw KT(2000).Tea drinking and bone mineral density in older women. *Am J Clin Nutr*, 71(4):1003-7.
7. Cheung EY, Bow CH, Cheung CL, Soong C, Yeung S, Loong C and et al (2012). Discriminative value of FRAX for fracture prediction in a cohort of Chinese postmenopausal women. *Osteoporos Int*, 23(3):871-8.
8. Brennan SL, Stanford T**,** Wluka AE, Henry MJ, Page RS, Graves SE and et al(2012). Cross-sectional analysis of association between socio-economic status and utilization of primary total hip joint replacements 2006–7: Australian Orthopaedic Association National Joint Replacement Registry. *BMC Musculoskeletal Disorders*, 13:63
9. Claudia CM, Burchfiel CM, Grove J, Fekedulegn D, Yuanan L, Andrew M and et al(2011). Risk factors for fractures among Japanese-American men: The Honolulu Heart Program and Honolulu–Asia Aging Study. *Archives of Osteoporosis***,** 6(1,2) :197-207
10. Cauley JA (2011). Defining Ethnic and Racial Differences in Osteoporosis and Fragility Fractures. *Clin Orthop Relat Res*, 469(7):1891-9.
11. Curtis JR, McClure LA, Delzel El, Howard VJ, Orwoll E, Saag KG and et al(2009). Population-Based Fracture Risk Assessment and Osteoporosis Treatment Disparities by Race and Gender. *Journal of General Internal Medicine*, 24 (8): 956-962.
12. Lin YC, Lyle RM, Weaver CM, McCabe LD, McCabe GP, Johnston C (2003). Peak spine and femoral neck bone mass in young women. *Bone*, 32(5): 546-553.
13. Lofman OL. Toss LG (2000). Bone mineral density in diagnosis of osteoporosis: Reference population, definition of peak bone mass and measured site determine prevalence. *J Clin Densitom,* 3(2):177-186.
14. Fink HA, Harrison SL, Taylor BC, Cummings SR, Schousboe JT, Kuskowski MA, et al (2008). Differences in Site-Specific Fracture Risk Among Older Women with Discordant Results for Osteoporosis at Hip and Spine: the Study of Osteoporotic Fractures. *J Clin Densitom*, 11(2): 250–259.
15. Kerr D., Morton A, Dick I, Prince R (1996) .Exercise effects on bone in post-menopausal women are site-specific and load dependant. *J Bone Miner Res*, 11; 218–225.
16. Giraudeau FS, McGinnis RE, Gray IC, O'Brien EJ, Doncaster KE, Spurr NK and et al (2004). Characterization of Common Genetic Variants in Cathepsin K and Testing for Association with

Bone Mineral Density in a Large Cohort of Perimenopausal Women from Scotland. *J Bone Miner Res*, 19(1):31-41.

17. Goldman B, Drazen G, Griggs K, Mandell PS (2007). *CECIL Text Book of Medicine,* 23rd ed. W.B. Sounders Inc, Philadelphia, pp:1366-1368.

18. Zhao LJ, Yong J, Liu PY, Hamilton J, Recker RR, Deng HW (2007). Relationship of Obesity with Osteoporosis. *The Journal of Clinical Endocrinology & Metabolism*, 92(5):1640–1646.

19. Laet DC, Kanis JA, Oden A, Johanson H, Johnell O, Delmas P and et al(2005). Body mass index as a predictor of fracture risk: a meta-analysis. *Osteoporos Int,* 16(11):1330–8.

20. Chairii I, Hannan MT, Felson DT, Dawson-Hughes B et al. (2000). Risk factors for longitudinal bone loss in elderly men and women: the Framingham Osteoporosis Study. *J Bone Miner Res*, 15(4): 710-720.

21. VarennaM, Binelli L, zucchi F, Ghiringhll D, Gallazzi M, Sinigaglia l(1999). Prevalence of Osteoporosis by Education Level in a Cohort of Postmenopausal Women. *Osteoporos Int*, 9(3): 236-241.

22. Bener A, Hammodeh M (2007). Prevalence and predictors of osteoporosis and the impact of life style factors on bone mineral density. *APLAR Journal of Rheumatology*, 10 (3): 227–233.

23. Saadi HF, Reed RL, Carter AO, Qazaq H, Al-Suhaili AR (2001). Bone density estimates and risk factors for osteoporosis in young women. *East Meditt Health J*, 4(5): 730-737.

24. Finkelstein JS, Lee MT, Sowers MF et al. (2002). Ethnic Variation in Bone Density in Premenopausal and Early Perimenopausal Women: Effects of Anthropometric and Lifestyle Factors. *The Journal of Clinical Endocrinology & Metabolism*, 87 (7): 3057-3067.

25. Desweiet M(2002). *Medical disorder in obstetric practice.* 4th ed. Blackwell Science Ltd Inc, London, pp. 463-464.

26. Fauci AS, Braunwald E, Longo K (2008). *Harrison's principle of internal medicine*, 17 th ed. Atlanta:MacGrow-Hill Inc, New York, p: 2228.

27. Vlasiadis K Z, Skouteris CA, Velegrakis GA, Fragouli I, Neratzoulakis JM, Damilakis J, Koumantakis EE(2007). Mandibular radiomor-phometric measurements as indicators of possible osteoporosis in postmenopausal women. *Maturitas, 58 (3): 226-235.*

28. Vlasiadis kz, Damilakis J, Velegrakis GA, Skouteris CA, Fragouli I, Goumenou A, and et al (2008).Relationship between BMD, dental panoramic radiographic findings and biochemical markers of bone turnover in diagnosis of osteoporosis. *Maturitas, 59(3): 226-233.*

29. Mahan LK,.stump SE(2000). *Krause's Food, Nutrition and Diet Therapy*, 10th ed, Sounders Inc. Philadelphia, pp: 612-613.

30. Shea B, Wells G, Cranney A, Zytaruk N, Robinson V, Griffith L(2002). Meta-Analysis of Calcium Supplementation for the Prevention of Postmenopausal Osteoporosis. *Endocrine Reviews*, 23(4):552-559.

31. Robert P. Heaney MD (2009). Dairy and Bone Health. *J Am Coll Nutr*, 28(1):82S-90S.

32. Al-Anazi AF, Qureshi VF, Javaid K, Qureshi S (2011). Preventive effects of phytoestrogens against postmenopausal osteoporosis as compared to the available therapeutic choices: An overview. *J Nat Sci Biol Med*, 2(2): 154–163.

33. Tylavsky FA, Spence L A, Harkness L (2008). The Importance of Calcium, Potassium, and Acid-Base Homeostasis in Bone Health and Osteoporosis Prevention. *Nutr*, 138 (1): 164S-165S.

34. van Staa TP, Leufkens HGM, Cooper C (2002). The epidemiology of corticosteroid-induced osteoporosis. *Osteoporos Int*, 13(10):777–87.

35. MacKelvie K, Khan KM , Petit MA, Janssen PA, McKay HA(2003). A School-Based Exercise Intervention Elicits Substantial Bone Health Benefits: A 2-Year Randomized Controlled Trial in Girls. *Pediatrics*, 112 (6): e447 -e452.

36. George A, Kelley F, Kristi S, Kelley M (2006). Exercise and bone mineral density at the femoral neck in post menopausal women: A meta-analysis of controlled clinical trials with individual patient data. *Am J Obs Gynecol*, 194(3): 760-767.

37. Bonaiuti D, Shea B, Iovine R, Negrini S, Robinson V, Kemper HC and et al(2003). Exercise for preventing and treating osteoporosis in postmenopausal women. *Evid Based Nurs,* 6(2):50-51.