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Relationship of Age, BMI, Serum Calcium and Estradiol with BMD in Postmenopausal Osteoporotic Females

Mukhtiar Baig, Mehreen Lateef, Abid Azhar

Abstract

Introduction: The current study was designed to investigate the relationship of age, body mass index (BMI), serum calcium and estradiol with bone mineral density (BMD) in postmenopausal females with and without osteoporosis.

Subjects & Methods: One hundred females were included in this study and were divided into two groups (fifty in each group): postmenopausal females without osteoporosis (age: 54.36 ± 0.51 yrs) and postmenopausal females with osteoporosis (age: 59.92 ± 0.68 yrs). BMD assessment was done on calcaneous by peripheral ultrasound bone densitometry and T scores were calculated. Serum estradiol was measured by ELIZA and calcium levels were determined by using spectrophotometric kit.

Results: BMD was significantly lower in postmenopausal osteoporotic females as compared to postmenopausal non-osteoporotic females which indicated increased bone loss in osteoporotic group. Serum calcium levels were significantly lower in postmenopausal females with osteoporosis (8.73 ± 0.08) as compared to postmenopausal females without osteoporosis (9.04 ± 0.09). BMD was correlated with body weight (r= 0.50, $p<0.05$; r= 0.45, $p<0.05$) and BMI (r=0.61, $p<0.01$; r= 0.31, $p<0.05$) in both groups. Negative correlation of BMD was found with age (r= -0.67, $p<0.01$r= -0.57, $p<0.05$) and calcium (r= -0.44, $p<0.05$; r= -0.38, $p<0.05$) in postmenopausal females with and without osteoporosis respectively. Osteopenia was detected in postmenopausal females without osteoporosis.

Conclusion: It is concluded that increasing age, low body weight, low BMI, and low BMD are few of the contributing factors to osteoporosis.

Key words: Postmenopausal women, BMD, osteoporosis

Introduction

Osteoporosis is a metabolic bone disorder that affects more than 200 million people worldwide[1]. The disease is characterized by low bone mass, which makes bones fragile and susceptible to fractures. Osteoporotic fractures are more common in the elderly and result in excess morbidity and mortality in this population[2]. In 1994, the World Health Organization[3] (WHO) proposed a clinical definition of osteoporosis based on measurements of BMD. According to the WHO definition, a patient is osteoporotic based on a BMD measurement that is 2.5 standard deviations (SDs) below typical peak bone mass of young healthy white women. This measurement of standard deviation from peak mass is called the T score. Regarding the interpretation of bone densitometric findings, a T-score of more than 1 standard deviation (SD) but less peak value confirms osteopenia and a level more than 2.5 SDs below the mean peak value is diagnostic of osteoporosis.

The risk factors of osteoporosis are modifiable and non modifiable. The non modifiable factors are advanced age, female gender White/Asian race, low peak bone mass, family history of osteoporosis, personal history of fracture, low body mass index and modifiable factors are smoking, inadequate calcium intake, inadequate vitamin D, low body weight (BMI <21 kg/m^2), estrogen deficiency, hypogonadism, chronic glucocorticoid therapy[2].

The incidence of osteoporotic fractures is increasing in Pakistan because of the increasing age of the population and many other factors are also implicated in this process. Sultan et al[4]., (2006) found in their study that the frequency of osteoporosis was more common in poor, illiterate, multiparous, sedentary women with imbalanced diet.

The treatment of established osteoporosis is complex and costly and having many long term undesirable effects. Therefore, it is essential to find out the risk factors for developing osteoporosis, so that modifiable factors can be avoided to decrease the incidence of osteoporosis.

The current study was designed to explore the relationship of BMD with age, BMI, serum calcium and estradiol in postmenopausal females with and without osteoporosis.

Subjects & Methods

One hundred (100) female subjects were divided into two groups (fifty in each group: postmenopausal females without osteoporosis (age: 54.36 ± 0.51) and postmenopausal osteoporotic females (age: 59.92 ± 0.68). Subjects on corticosteroids and on hormone replacement therapy were excluded.

The postmenopausal females having age greater than fifty years with LMP > 5 yrs and no endocrinal disease were included in this study. For this obersavational study, newly diagnosed and untreated postmenopausal osteoporotoic females were selected

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from different osteoporotic clinics with age limit of not less than fifty years. These subjects were free from any endocrinal disease. Questionnaires were filled in by the subjects, including their case-history, fracture history (if any) along with their dietary habits and height, weight, waist circumference, hip circumference, age at menarche, years since menopause, and history of disease were recorded. Five mlilliliters of blood was drawn from each subject and after centrifugation (3,000 rpm) within an hour of blood collection; serum was stored at −70°C for subsequent analyses. The samples were analyzed for estradiol and calcium. Serum estradiol was measured by ELISA kits, supplied by DSL, USA. Serum calcium levels were determined by using spectrophotometric kit, supplied by International Diagnostic Links, USA. Bone mass density assessment was done on the calcaneous (heel) by peripheral ultrasound bone densitometry by Bone Sonometer (IEC 601-1 Class II Type BF.IPXO), and T-scores were calculated. Bone mass density was measured by quantitative ultrasound (QUS) as it has the advantage of being small, portable, relatively inexpensive, and using non ionizing radiation[5].

Statistical analyses: The statistical analyses were performed using statistical software Statistica 5.0 (Stat Soft, USA). The significant difference was determined by applying Student's t-test.

Results

Figure 1 shows comparison of BMD in the two groups. BMD was significantly lower in postmenopausal females with osteoporosis as compared to postmenopausal females without osteoporosis ($p < 0.05$) showing increased bone loss in osteoporotic group.

Table 1 shows the comparison of physical and biochemical parameters of postmenopausal females with and without osteoporosis. There was a significant difference in age ($p<0.05$) and serum calcium levels ($p<0.05$) in both groups.

There was a negative correlation between BMD and age (r= -0.67, p<0.01r= -0.57, p<0.05) in postmenopausal females with and without osteoporosis respectively (Table 2). Serum calcium was also negatively correlated with BMD (r= -0.44, p<0.05; r= -0.38, p<0.05) in both groups. BMD was correlated with body weight (r= 0.50, p<0.05; r= 0.45, p<0.05) and BMI (r=0.61, p<0.01; r= 0.31, p<0.05) in postmenopausal females with and without osteoporosis respectively.

Table1- Physical and Biochemical parameters of postmenopausal females with and without osteoporosis

Parameters	Postmenopausal females (n= 50)	Osteoporotic females (n= 50)
Age (yrs)	54.36 ± 0.51	59.92 ± 0.68*
BMI (kg/m^2)	25.69 ± 0.85	27.17 ± 0.81
Estradiol (ng/ml)	08.89 ± 2.61	05.97 ± 1.1
Calcium (mg/dl)	09.40 ± 0.09	08.73 ± 0.08*

*p < 0.05

Table 2- Correlation of BMD with Age, anthropometric and biochemical parameters

	r values	
Para-meters	Postmenopausal females (n= 50)	Osteoporotic females (n= 50)
Age (yrs)	r = -0.57, p < 0.05	r = -0.67 p < 0.01
Weight (kg)	r = 0.45 p < 0.05	r = 0.50 p < 0.05
Height (m^2)	r = -0.18	r = -0.16
BMI (kg/m^2)	r = 0.31 p < 0.05	r = 0.61 p < 0.01
Estradiol (ng/ml)	r = 0.17	r = 0.28
Calcium (mg/dl)	r = -0.38 (p<0.05)	r = -0.44 p < 0.05

Discussion

Present study shows hat the BMD in postmenopausal osteoporotic females is significantly decreased as compared to postmenopausal females without osteoporosis having similar BMI. Even though BMD values of non-osteoporotic postmenopausal females were higher than the osteoporotic but these females were also osteopenic suggesting a need for some intervention to prevent osteoporosis in such females.

It has previously been reported that in Faisalabad 20% postmenopausal women were osteoporotic out of 300 postmenopausal women, while 44% were suffering from osteopenia, and 36% had normal BMD[6]. Sharma et al[7]., (2006) found that a substantial female population had esteopenia and osteoporosis after the age of 45 years. The osteopenia (36.79%) with maximum number of both osteoporosis and osteopenic women recorded in the age group of (55-64 years).

Hafeez et al[8], (2009) observed that the risk factors in postmenopausal group were low BMD, low

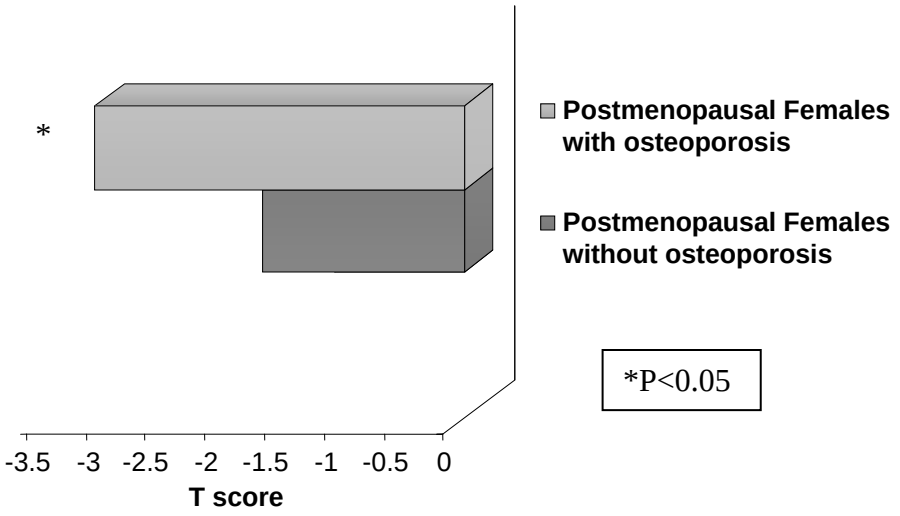

Figure 1 comparison of BMD in postmenopausal females with and without osteoporosis

oestrogen levels, poor intake of milk and calcium and lack of physical exercise. Therefore, it is recommended that diet should be balanced with proper calcium intake and daily exercise should be required to maintain BMD, while postmenopausal females require greater calcium intake to avoid osteoporosis.

There was a negative correlation found between serum calcium levels and BMD in postmenopausal females with and without osteoporosis. It seems that to maintain normal calcium levels in blood, bone resorption increases as indicated by decreased BMD. A deficiency of calcium intake itself is considered a major risk factor for osteoporosis[9]. Low calcium intake causes secondary hyperparathyroidism as the calcium homeostasis in blood must be kept stable. This causes resorption of calcium from the bone with ensuing bone loss and an increased susceptibility to fractures[10-11].

The importance of calcium in developing and maintaining bone mass varies throughout a person's life. At times of rapid and significant bone growth (during the teenage years) or rapid bone loss (after age 50 years), calcium is more important. Therefore, to reduce the risk of osteoporosis, calcium intake should be the highest during adolescence and after age 50 years[12]. It is suggested that postmenopausal women require greater calcium intake to maintain calcium balance.

Serum calcium level was significantly higher in postmenopausal females without osteoporosis as compared to postmenopausal females with osteoporotic. This was similar to reported higher calcium levels in other study[13].

Present study found that BMD is positively correlated with body weight. It means whenever there is increase weight there would be increased peak bone mass which is protective of osteoporosis. These results are similar as found by other studies[14-17]. Keramat et al[18]., (2008) found that weight less than 60 kg, height less than 155 cm and BMI less than 26 have been as a risk factor for osteoporosis. Robbins et al[19]., (2006) in their large epidemiological studies analysis observed that weight alone is a better predictor of BMD than BMI.

In the present study, BMI was significantly correlated with BMD. Several studies reported that obesity (greater body weight and BMI) is associated with higher BMD[14-15]. The protective effect of obesity on bone loss appears to be related to the both mechanical factors and estrogen synthesis in adipose tissues[20]. However, since obesity is an important risk factor for cardiovascu- lar disease and diabetes, therefore, appropriate body mass index (20-25 kg/m2) or prevention for leanness should be recommended for good general health[15].

Present study found negative correlation of BMD with age. These results are consistent with several other studies[4,15-16]. A study observed that when the menstrual cycles get irregular toward menopause, the serum calcium level rises rapidly and reaches maximum in 2–5 years after menopause, and then slight decrease afterwards[21-22]. Because of this reason there was decrease level of serum calcium in those women who have more duration of menopause as compared to those who have less duration.

The limitation of this study is that the mean value of BMD of non osteoporotic females was more than -1SD. It may be because of the low sample size and the sample for this study were also collected from osteoporosis clinics so the female came over there having some problems of bone and were referred by

the general practitioners.

Conclusion

Osteoporosis is a preventable problem. Therefore, it is recommended, that we should educate the masses about the consequences of osteoporosis and its preventive measures. Its awareness campaign should be started from the media. The primary approach for reducing osteoporosis is to reduce bone loss after menopause by maximizing calcium intake and guiding them to do exercise regularly and there should be some exposure to sunlight daily.

References

1. Lin JT, Lane JM. Osteoporosis: a review. Clin Orthop Relat Res 2004;126–34.

2. Wilkins CH. Osteoporosis screening and risk management. Clinical Interventions in Aging 2007;2: 389–94.

3. Kanis JA. Assessment of fracture risk and its application to screening for postmenopausal osteoporosis: synopsis of a WHO report. WHO Study Group. Osteoporos Int 1994;4:368-81.

4. Sultan A, Khan DA, Mushtaq M, et al. Frequency of Osteoporosis and its associated risk factors in postmenopausal women in clinical practice at Rawalpindi. Pak J Pathol 2006;17:115-8

5. Yang NP, Jen I, Chuang SY, et al. Screening for low bone mass with quantitative ultrasonography in a community without dual-energy X-ray absorptiometry: population-based survey. BMC Musculoskelet Disord 2006; 7.

6. Haq I, Masood Z. Osteoporosis; prevalence among the post menopausal women. Professional M J 2009;16:424-7.

7. Sharma S, Tandon VR, Mahajan A, et al. Preliminary screening of osteoporosis and osteopenia in urban women from Jammu using calcaneal QUS. Indian J Med Sci 2006;60:183-9.

8. Hafeez F, Zulfiqar S, Hasan S, et al. An assessment of osteoporosis and low bone density in postmenopausal women. Pak J Physiol 2009;5:41-4

9. Cho K, Cederholm T, Lo J. Calcium intake in elderly patients with hip fractures. Food & Nutrition Research 2008. DOI: 10.3402/fnr.v52i0.1654

10. Dvorak MM, Riccardi D. Ca^{+2} as an extra cellular signal in bone. Cell Calcium 2004; 35: 249-55.

11. Shoback D. Update in osteoporosis and metabolic bone disorders. J Clin Endocrinol Metab 2007; 92: 747-53.

12. Sunyecz JA. The use of calcium and vitamin D in the management of osteoporosis. Clin Risk Manag 2008;4: 827–36.

13. Iki M, Akiba T, Matsumoto T et al. Reference database of biochemical markers of bone turnover for the Japanese female population. Japanese Population-based Osteoporosis (JPOS) Study. Osteoporos Int 2004;15:981–91

14. Murillo-Uribe A, Carranza –Lira S, Martinez-Trejo N, et al. Influence of weight and body fat distribution on bone density in postmenopausal women. Int J Fertil Womens Med 2000; 45:225-31.

15. Yahata Y, Aoyagi K, Okano K. Metacarpal bone mineral density, body mass index and life style among postmenopausal Japanese women: Relationship of body mass index, physical activity, calcium intake, lcohol use and smoking to bone mineram density: The Hizen-Oshima Study. Tohoku J Exp Med 2002; 196:123-9.

16. Kadam N, Chiplobkar S, Khadilkar A, et al. Low bone mass in urban Indian women above 40 years of age: prevalence and risk factors. Gynecol Endocrinol 2010;26:909-17.

17. Multani SK, Sarathi V, Shivane V, et al. Study of bone mineral density in resident doctors working at a teaching hospital. J Postgrad Med 2010;56:65-70.

18. Keramat A, Patwardhan B, Larijani Bet al. The assessment of osteoporosis risk factors in Iranian women compared with Indian women. BMC Musculoskeletal Disorders 2008:9 doi:10.1186/1471-2474-9-28

19. Robbins J, Schott AM, Azari R, et at. Body mass index is not a good predictor of bone density: results from WHI, CHS, and EPIDOS. J Clin Densitom 2006;9:329-34

20. Ribot C, Tremollieres F, Poulles JM. The effect of obesity on postmenopausal bone loss and risk of osteoporosis. Adv Nut Res 1994;9:257-71.

21. Muneyyirci-Delale O, Nacharaju VL, Dalloul M, et al. Serum ionized magnesium and calcium in women after menopause: inverse relation of estrogen with ionized magnesium. Fertile Steril 1999;71:869-72.

22. Macdonald HM, New SA, Golden MH, et al. Nutritional associations with bone loss during the menopausal transition: evidence of a beneficial effect of calcium, alcohol, and fruit and vegetable nutrients and of a detrimental effect of fatty acids. Am J Clin Nutr 2004;79:155–65.