

Relationship between Lifestyle Factors and Bone Density in Women Referring to Bone Densitometry Research Center in Shiraz, Iran

Iran Jahanbin^{1,*}; Elham Aflaki²; Haleh Ghaem³

¹School of Nursing and Midwifery, Shiraz University of Medical Sciences, Shiraz, IR Iran

²Department of Rheumatology, Shiraz University of Medical Sciences, Shiraz, IR Iran

³Department of Statistics, School of Health, Shiraz University of Medical Sciences, Shiraz, IR Iran

*Corresponding author: Iran Jahanbin, School of Nursing and Midwifery, Shiraz University of Medical Sciences, Shiraz, IR Iran. Tel.: +98-7116474254, E-mail: jahanbii@sums.ac.ir

Received: November 15, 2013; **Revised:** December 25, 2013; **Accepted:** January 25, 2014

Background: Osteoporosis is a serious problem worldwide, mainly because of the consequences of the diagnosis. However, many osteoporotic fractures can be prevented and treated.

Objectives: The aim of the study was to determine the relationship between lifestyle and bone mineral density (BMD) in women referring to bone densitometry Research center.

Materials and Method: This cross-sectional study was conducted on 1170 Pre-menopausal and post-menopausal women. Demographic, anthropometric, lifestyle data including physical activities, smoking habits, dairy intake and its consumption pattern, calcium intake, as well as, history of steroid intake was asked. Lumbar and femoral bone mineral density (BMD) was measured by dual energy X-ray absorptiometry (DXA). Based on the WHO definition the T-score value was considered for analysis.

Results: Participants' mean age was 52.77 (\pm 9.8) years. Adjusted for age, the BMD significantly correlated to body weight for women. A lower body weight was a risk factor for the osteoporotic process in our participants ($P < 0.001$). The BMD of women who had more than four pregnancies showed a positive relationship with the osteoporosis of femoral neck and lumbar spine ($P < 0.001$). Physical activities were positively associated with BMD. This effect was stronger with hip than with spine BMD. Weakly positive associations were found between consumption of dairy products and BMD at the two measurement sites. Low dietary calcium intake and poor physical activity together with advancing age since menopause were independent risk factors for low BMD.

Conclusions: Bone densitometry should be used to assess the severity of bone loss, and to identify those in need of therapy. The follow up and early diagnosis of osteopenia should be carried out in order to institute proper therapy and prevent further osteoporosis.

Keywords: Lifestyle; BMD; Osteoporosis; Osteopenia; Women

1. Background

Osteoporosis is a common problem in women. Annually, this disorder leads to thousands of injuries with exorbitant cost of treatment. According to national statistics of health institute, about ten million people in America suffer from osteoporosis of which eight million are women (1). In addition, 18 million have low bone mass and are at risk for osteoporosis. Half of women aged 50 years and older will have at least one osteoporosis-related fracture in their lifetime (2). The prevalence of osteoporosis in Caucasian and Asian women is higher than others (3). Other risk factors are late menarche, early menopause, lack of regular physical activity, sedentary lifestyle, smoking, and caffeine, alcohol, drugs and steroids consumption, and inadequate vitamin D and calcium intake (4). Osteoporosis can affect people's mental and social performance. Living with anxiety due to a chronic bone disease leads to depression, reduced social tasks, decreasing individual's inde-

pendence in performing daily activities and loss of confidence. In a 1998 survey in the United States to determine the prevalence of osteoporosis in 537 white women aged 50 years and above referred to the Bone Densitometry Center, 53.3% were diagnosed with osteoporosis, with 37.7% exhibited decreasing bone mass and only 8.7% had normal bone. In 2004, Larijani and colleagues examined bone mineral density (BMD) in lumbar spine and femur in 553 (34% men and 66% women) healthy population of Tehran, randomly selected from 50 blocks. The results of bone densitometry showed that the bone density was higher in men than in women. Bone mass at age 60-69 years was decreased by 19.6% in spine and 18.5% in femur in women. The prevalence of osteoporosis in the lumbar spine and neck of femur in women at this age group was 33.4% and 5.9%, respectively (5). Bone density determination is one of the effective measures to reduce the risk of osteoporosis. Bone

Implication for health policy/practice/research/medical education:

Identifying lifestyle factors will aid in detecting those at greater risk of osteoporosis. So it can be instrumental in suggesting appropriate lifestyle changes to prevent osteoporosis. The present study will provide a basic data for further researches in modifications of osteoporosis risk factors. It is suggested to establish a counseling clinic beside the bone densitometry research centers.

Copyright © 2014, Health Policy Research Center, Shiraz University of Medical Sciences. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

density is affected by lifestyle. Several studies have shown the relationship between lifestyle and incidence of osteoporosis (6). Taking calcium and vitamin D, regular exercise, reduced alcohol and caffeine consumption, and avoidance of smoking can increase bone mineral density (7). Since osteoporosis can be controlled significantly, the present study was conducted to explore the lifestyles of healthy and osteoporotic women in southern Iran.

2. Objectives

The aim of the study is to determine the relationship between lifestyle and BMD in women referring to bone densitometry Research center.

3. Material and Methods

This cross-sectional study was carried out on 1170 women, referred to Namazi bone densitometry research center from Oct 2011 to Dec 2011. The data collection consisted of two parts. The first part was subjects' demographic data including age, number of pregnancies, number of children, age at last pregnancy, menopause, height, and weight and body mass index. The second part was information on the subjects' lifestyle including consumption of dairy foods, white meat, vegetables, soft drinks, supplements such as calcium, tea, coffee, smoking, kind of physical activity, drugs including steroids and thyroid problems (hypothyroidism and hyperthyroidism), surgery on uterus or ovaries, and exposure to sunlight. After receiving acceptance from Ethics Committee of Shiraz University of Medical Sciences, we measured the subjects' height and weight and their Body Mass Index (BMI) was calculated. The questionnaires were filled out at interview. Bone density in the lumbar region and neck of femur was assessed using Dual energy X-ray Absorptiometry (DEXA) by trained and qualified personnel of the research center. The results of DEXA were analyzed based on the definition of T-score value according to World Health Organization guideline (8). Having completed the questionnaire, coding was done and the statistical analysis was done using SPSS software (version 18). One-way ANOVA, post Hoc and chi-square tests. The level of significance was $P \leq 0.05$.

4. Results

A total of 1170 women with mean age 52.77 ± 9.8 participated in this study. The demographic characteristics of

the subjects are shown in Table 1. Comparison between variables among healthy women and those with osteoporosis and osteopenia at neck of femur is shown in Table 2. Comparison between variables in healthy women and those with osteoporosis and osteopenia at vertebral spine is shown in Table 3. Our findings showed no relationship between risk of vertebral osteoporosis and smoking, consumption of dairy product, fish, vegetables, drinking large amount of tea and coffee, soft drinks, steroids, as well as sports and regular exercise, thyroid disorders, uterine and ovarian surgery. However, there was a positive relationship between vertebral osteoporosis and exposure to sunlight, consumption of alcohol and calcium supplement ($P = 0.05$). Osteopenia of femur did not correlate with any of the foregoing factors. However, there was a significant relationship between osteoporosis of femur neck and smoking, consumption of dairy and poultry products, fish and having regular exercise ($P = 0.05$). There was a direct relationship between the risk of vertebral and neck of femur osteoporosis and osteopenia and the number of pregnancies, number of children, age and BMI, based on the ANOVA statistical test ($P < 0.0001$). Interestingly, although the healthy women consumed more vegetables and poultry products and fish than women with osteoporosis, the difference was not statistically significant (53.6% vs. 46.7%). In addition, consumption of soft drinks by healthy women was much lower than that of women with osteoporosis (4.4% vs. 6.3%). Among women with osteoporosis at the neck of femur, 68.2% did not have exercise, and 12.7% of those with osteoporosis were tobacco smokers.

Table 1 Demographic Characteristics of Women Referring to Bone Densitometry

Variables	No.	Mean \pm SD
Age	1129	52.77 \pm 9.8
No. of pregnancy	1055	4.63 \pm 2.5
No. of children	1055	4.03 \pm 2.07
Age at last pregnancy	1035	31.14 \pm 6.33
Age of menopause	748	47.65 \pm 5.72
Weight	1151	67.05 \pm 11.41
Height	1151	158.66 \pm 6.34

Table 2. Comparison Between Variables among Healthy Women and those with Osteoporosis and Osteopenia at Femur Neck

Variable	Neck of femur osteoporosis	Neck of femur osteopenia	Neck of femur healthy	P Value
Age	60.82 \pm 9.24	53.23 \pm 9.24	48.94 \pm 8.74	$P < 0.0001$
BMI	25.50 \pm 4.92	25.97 \pm 3.85	27.95 \pm 4.41	$P < 0.0001$
No. of pregnancies	4.67 \pm 3.05	4.77 \pm 2.54	4.02 \pm 2.06	$P < 0.0001$
No. of children	4.93 \pm 2.39	4.16 \pm 2.14	3.51 \pm 1.67	$P < 0.0001$

Table 3. Comparison Between Variables among Healthy Women and those with Osteoporosis and Osteopenia at Vertebral Spine

Variables	Vertebral osteoporosis	Vertebral osteopenia	Healthy women	P Value
Age	57.45 ± 8.67	52.87 ± 9.81	49.30 ± 9.22	P < 0.0001
BMI	25.51 ± 4.07	26.68 ± 4.18	27.33 ± 4.53	P < 0.000
No. of pregnancies	5.44 ± 2.77	4.60 ± 2.48	4.08 ± 2.21	P < 0.0001
No. of children	4.80 ± 2.44	4.2 ± 2.03	3.54 ± 1.83	P < 0.0001

5. Discussion

The findings of this study showed significant correlations between the incidence of osteoporotic vertebrae and smoking, dairy, white meat consumption, drinking plenty of tea and coffee, soft drinks consumption, regular exercise, thyroid disorders, and drugs including corticosteroids. The study conducted by Kajita in 1995 in Japan showed no relationship between physical activity and smoking habits (9). Also according to the studies conducted by Gu et al. (10), and Yahata et al. (11), there was no significant correlation between dairy consumption and physical activity. However, a relationship existed between vertebral osteoporosis and sun exposure and calcium supplementation ($P < 0.05$). The study of Nguyen in 1994 in Australia showed that there was a relationship between calcium supplementation and bone mineral density (12). A survey conducted by Piaseu et al., in Thailand showed a significant correlation between BMD and exposure to sunlight (13). They also found a significant relationship between continuous activity and increase in bone mineral density of femur ($P < 0.0001$), which was consistent with the study of Muraki et al., who revealed a relationship between exercise and increased BMD (14). Also Muraki et al., in Japan and showed that regular physical activity of women played a significant role in the prevention of osteoporosis (14, 15). Number of pregnancies, number of children, age and body mass index (BMI) were significantly associated with risk for neck of femur and lumbar spine osteoporosis and osteopenia. ($P < 0.0001$) A study conducted by Shtrugna et al., in India concluded that bone density was greater with increasing BMI (16). And in Japan in 2007, Muraki's research also determined that increasing BMI is associated with higher bone density. The study of Young et al., revealed a positive relationship between BMI and neck of femur, and not lumbar spine, bone density (17). A study conducted by Ghannam et al., showed a relationship between multiple pregnancies and bone loss, and a significant decrease in BMD with increasing age and onset of menopause (18). These results were in agreement with those of Pongchaiyakul et al. (19), the Jarupanich et al. (20), Guzman et al. (21), and El-Desouki et al. (22).

The findings of this cross-sectional study showed a gradual and rapid decrease in BMD during the period before and after menopause respectively. Aging in women was an important risk factor for decreasing BMD. Estab-

lishing the appropriate BMI, and examining the suitable lifestyle, testing for BMD at the appropriate time, identifying those at risk are the necessary measures to be taken for preventing osteoporosis and osteopenia, thus circumventing the associated disability and social consequences. According to our study and other investigations, the inadequate knowledge of women about healthy lifestyles and their lack of timely awareness to assess the risk factors and screening tests account for developing this debilitating condition. Most patients do not visit their doctors after bone densitometry for evaluation and subsequent follow-up and solve their problem by arbitrary consumption of supplements. Thus, it is recommended to set up a counseling clinic for preventing the osteoporosis and osteopenia in the Namazi BMD research center. This will provide sufficient and necessary information on improving the health of individuals, and women in particular, referred to this center.

Acknowledgements

I wish to express my sincere gratitude to prof. Omrani, the head of the BMD research center of Namazi hospital affiliated to Shiraz University of medical sciences for his valuable cooperation. And also appreciate the generous assistance of all personnel of BMD research center.

Authors' Contribution

All authors have made substantial contributions to all of the following: The conception and design of the study, analysis and interpretation of data.

Financial Disclosure

There is no conflict of interest.

Funding/Support

This study was financially supported by Vice Chancellor for Research Affairs, Shiraz University of Medical Sciences.

References

1. Ziccardi SL, Sedlak CA, Doheny MO. Knowledge and health beliefs of osteoporosis in college nursing students. *Orthopaedic Nurs.* 2004;23(2):128-33.
2. Ailinger RL, Braun MA, Lasus H, Whitt K. Factors influencing osteoporosis knowledge: a community study. *J Commun Health Nurs.* 2005;22(3):135-42.
3. Iacono MV. Osteoporosis: A national public health priority. *J Peri-*

- Anesthesia Nurs.* 2007;22(3):175-83.
4. Korpelainen R, Korpelainen J, Heikkinen J, Väänänen K, Keinänen-Kiukaanniemi S. Lifestyle factors are associated with osteoporosis in lean women but not in normal and overweight women: a population-based cohort study of 1222 women. *Osteoporos Int.* 2003;14(1):34-43.
 5. Larijani B, Hossein-Nezhad A, Mojtahedi A, Pajouhi M, Bastanagh MH, Soltani A, et al. Normative data of bone Mineral Density in healthy population of Tehran, Iran: a cross sectional study. *BMC Musculoskeletal Disorders.* 2005;6(1):38.
 6. Loh KY, Shong HK. Osteoporosis: primary prevention in the community. *Med J Malaysia.* 2007;62(4):355.
 7. Cadarette SM, Beaton DE, Hawker GA. Osteoporosis Health Belief Scale: minor changes were required after telephone administration among women. *J Clinic Epidemiol.* 2004;57(2):154-66.
 8. El Maghraoui A. Interpreting a DXA Scan in Clinical Practice. .
 9. Kajita E, Iki M, Nishino H, Dohi Y, Moriyama T, Tobita Y, et al. [Bone mineral density of the lumbar spine and its relation to biological and lifestyle factors in middle-aged and aged Japanese women (Part 1). Relationship of age and menopause to bone mineral density of the lumbar spine measured by dual-energy X-ray absorptiometry]. *Japanese J Hygiene.* 1994;49(3):674-83.
 10. Gu W, Rennie KL, Lin X, Wang Y, Yu Z. Differences in bone mineral status between urban and rural Chinese men and women. *Bone.* 2007;41(3):393-9.
 11. Yuichirou Y, Kiyoshi A, Kunihiko O, Itsuro Y, Yosuke K, Minatsu K, et al. Metacarpal bone mineral density, body mass index and lifestyle among postmenopausal Japanese women: relationship of body mass index, physical activity, calcium intake, alcohol and smoking to bone mineral density: the Hizen-Oshima study. *The Tohoku journal of experimental medicine.* 2002;196(3):123-9.
 12. Nguyen TV, Kelly PJ, Sambrook PN, Gilbert C, Pocock NA, Eisman JA. Lifestyle factors and bone density in the elderly: implications for osteoporosis prevention. *J Bone Mineral Res.* 1994;9(9):1339-46.
 13. Piaseu N, Komindr S, Chailurkit LO, Ongphiphadhanakul B, Chansirikarn S, Rajatanavin R. Differences in bone mineral density and lifestyle factors of postmenopausal women living in Bangkok and other provinces. *J Med Associat Thailand.* 2001;84(6):772.
 14. Muraki S, Yamamoto S, Ishibashi H, Oka H, Yoshimura N, Kawaguchi H, et al. Diet and lifestyle associated with increased bone mineral density: cross-sectional study of Japanese elderly women at an osteoporosis outpatient clinic. *Journal of Orthopaedic Science.* 2007;12(4):317-20.
 15. Wu XP, Liao EY, Huang G, Dai RC, Zhang H. A comparison study of the reference curves of bone mineral density at different skeletal sites in native Chinese, Japanese, and American Caucasian women. *Calcified Tissue Int.* 2003;73(2):122-32.
 16. Shatrugna V, Kulkarni B, Kumar PA, Rani KU, Balakrishna N. Bone status of Indian women from a low-income group and its relationship to the nutritional status. *Osteoporosis Int.* 2005;16(12):1827-35.
 17. Tzay-Shing Y, Yue-Rong C, Yi-Jen C, Cheng-Yen C, Heung-Tat N. Osteoporosis: prevalence in Taiwanese women. *Osteoporosis Int.* 2004;15(4):345-7.
 18. Ghannam NN, Hammami MM, Bakheet SM, Khan BA. Bone mineral density of the spine and femur in healthy Saudi females: relation to vitamin D status, pregnancy, and lactation. *Calcified Tissue Int.* 1999;65(1):23-8.
 19. Pongchaiyakul C, Nguyen TV, Kosulwat V, Rojroongwasinkul N, Charoenkiatkul S, Eisman JA, et al. Effects of physical activity and dietary calcium intake on bone mineral density and osteoporosis risk in a rural Thai population. *Osteoporosis Int.* 2004;15(10):807-13.
 20. Jarupanich T. Prevalence and risk factors associated with osteoporosis in women attending menopause clinic at Hat Yai Regional Hospital. *J Med Associat Thailand.* 2007;90(5):865.
 21. Guzmán IM, Ablanado AJ, Armijo DR, García REM. [Prevalence of osteopenia and osteoporosis assessed by densitometry in postmenopausal women]. *Ginecología y obstetricia de México.* 2003;71:225.
 22. El-Desouki MI. Osteoporosis in postmenopausal Saudi women using dual x-ray bone densitometry. *Saudi Med J.* 2003;24(9):953-6.