Bone Mineral Density and Its Associated Factors in Vietnamese Women over 40 Year Old at Cantho University of Medicine and Pharmacy Hospital

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BONE MINERAL DENSITY AND ITS ASSOCIATED FACTORS IN VIETNAMESE WOMEN OVER 40 YEARS OF AGE: A DESCRIPTIVE CROSS-SECTIONAL STUDY

1. INTRODUCTION

Osteoporosis is an insidious disease which has represented as an enormous social and economic burden worldwide because of its mortality, disability and exorbitant health-care costs for osteoporotic fractures.

In terms of bone fractures, about half of women die within 7 years as compared to 5 years in men. For patients who are fortunate enough to survive, they also have to undergo a variety of complications leading to a significant reduction in

their quality of lives. Osteoporotic fractures bring out not only serious consequences but also pricey and long-term treatment costs. In 2015, total direct medical costs for fatal and non-fatal fall injuries were $637.5 million and $31.3 billion, respectively. By 2025, the cost of fractures in the United States is expected to exceed $25 billion each year in order to deal with more than three million predicted fractures. Effective preventive measures need to be taken in order to stop this phenomenon from increasing. Therefore, our main goal is to manage osteoporosis and its associated consequences so as to not only enhance the quality of life but also reduce the economic burden on the health care system by decreasing medical visits, hospitalizations, and nursing home admission. [1]

In 2001, the definition of osteoporosis was introduced by the National Institutes of Health (NIH): "Osteoporosis is defined as a skeletal disorder characterized by compromised bone strength predisposing a person to an increased risk of fracture" and the definition is still valid and widely accepted up until now [2] [3]. Bone strength can be estimated by BMD, which is measured by Dual Energy X-ray Absorptiometry (DEXA) test. This method has always been considered as one of the most precise and effective tests to measure BMD at clinically relevant skeletal sites due to its high sensitivity (98%) and specificity (93%) with minimal measurement error [4]. In addition, World Health Organization (WHO) has officially accepted the use of bone mineral density to diagnose osteoporosis in clinical settings [5] and large-scale epidemiological studies have also demonstrated that low BMD is the most essential risk factor for bone fractures [6]. Although estimation of BMD can be taken at many skeletal sites to predict overall fracture risk, lumbar spine and femoral neck are highly suggested for some particular reasons. Since femoral neck fracture always has a high prevalence and is often associated with significant morbidity and mortality in clinical settings, DXA of the femoral neck is generally regarded as the best site for the diagnosis of osteoporosis. On the other hand, the lumbar spine is more helpful when it comes to screening and treatment. The greatest BMD loss in early menopause is usually seen at the spine in which the respond to osteoporotic therapy is also firstly detected [7]. On top of that, severe lumbar spine and femoral neck fractures could even be fatal in some cases [8]. Specifically, a Vietnamese study reported that a majority of women aged over 40 starts to suffer from osteoporosis, which could be well-explained by the onset of their menopause starting from the age of 40 [9]. There have been many studies in Vietnam on subjects having diseases that affect their BMD such as the elderly or menopausal women. However, in the Mekong Delta in general and Can Tho city in particular, little is known about BMD values in healthy women over 40 years old due to a scarcity of qualified studies in this area.

With all being written, this study was conducted to evaluate the mean BMD at the lumbar spine (LS) and the femoral neck (FN) as well as the correlation between BMD and its associated factors in women over 40 years old. We believe that a better understanding of BMD and its relative factors on this subject would act as a solid platform to provide a more reasonable approach and beneficial impact on osteoporotic outcomes.

2. MATERIALS AND METHOD

Study design

A prospective cross-sectional research was performed in Can Tho University of Medicine and Pharmacy Hospital from June 2022 to May 2023.

Study population

The study group included 168 healthy women aged over 40 years having annual health checkup at the study hospital. We excluded patients suffering from disease that affect the BMD such as lumbar spine fracture, femoral neck fracture, chronic renal failure, liver failure, multiple myeloma, hyperthyroidism, hyperparathyroidism, diabetes, Cushing's syndrome, malabsorption syndrome, and metastatic cancer; patients who use drugs that can affect BMD such as corticosteroids, heparin, antiepileptic drugs; patients whose osteoporosis are being treated; patients undergoing acute diseases, loss of consciousness, coma, prolonged immobilization, having uterine and ovarian removal, pregnancy; patients who do not agree to participate in the study. All patients with inclusion and without exclusion criteria were eligible to enroll in this cross-sectional research.

Measurement and variables

BMD at the lumbar spine, BMD at the right femoral neck, BMD at the left femoral neck and the mean BMD at the femoral neck including the left and right ones were measured by DEXA method with PRODIGY / DPX HV-P8 (GE-US) at Department of Functional Diagnosis in Can Tho University of Medicine and Pharmacy Hospital. The final result was calculated as the average of the indices in the measurement area.

We evaluated the bone mineral density according to some demographic and anthropometric characteristics. In terms of demographic characteristics, we divided them into some groups and subgroups: age (41-50 years, 51-60 years, 61-70 years and >70 years old), occupation (farmers, housewives, sellers, office workers and others), place of residence (rural and urban), levels of education (illiterate, primary, secondary, high school, and upper secondary education). (Table 1). There are several groups and subgroups in anthropometric aspects including height (<150cm and ≥150cm), weight (<50kg and ≥50kg), BMI (underweight-BMI<18.5kg/m2, normal weight-BMI=18.5-22.9kg/m2 and overweight-obese-BMI≥23kg/m2) (Table 2). In addition, we also analyzed the correlation between mean BMD at the lumbar spine and at the femoral neck and some factors including age, height (cm), weight (kg), BMI (kg/m2), time elapsed since menopause (TESM) and number of giving births.

Statistical Analysis

Data were entered and analyzed using version 18.0 of the SPSS statistical program. Qualitative variables were presented in the form of frequency and percentage while for quantitative variables were mean ± standard deviation. We evaluated the relationship between quantitative and qualitative variables by Independent Samples T-Test (average comparison between 2 groups) and One-way ANOVA (average comparison of more than 2 groups). The correlation among quantitative variables was analyzed by simple linear regression and described by dot chart. The correlation level was determined by the correlation coefficient (r symbol). All differences were considered statistically significant when P-values <0.05 with 95% confidence interval.

4. RESULTS

The mean BMD at the lumbar spine was 0.92 ± 0.2 g/cm^2 and the mean BMD at the femoral neck was 0.84 ± 0.15 g/cm^2 (Table 3).

Mean BMD in all sites decreased gradually by age group, which was highest in the 41-50 age group and lowest in the age group of over 70 years. The difference was statistically significant (p <0.001). The difference in BMD by occupation, place of residence and levels of education were statistically significant (p <0.05) (Table 3). BMD in the group whose height was less than 150cm and weight was under 50kg were lower than that of the other groups with statistical significance (p<0.05). BMD increased with BMI and the difference was statistically significant (p <0.001). (Table 4).

Age, TESM and number of giving birth were negatively correlated with mean BMD at the lumbar spine and the femoral neck with moderate, moderate-weak and weak level, respectively. There would be a decrease of 0.011 g/cm^2 and 0.008 g/cm^2 in BMD at the lumbar spine and the femoral neck respectively with the increase in one year of age. Similarly, every 1 year after menopause corresponded to the decrease of 0.008 g/cm^2 in the lumbar spine and 0.007 g/cm^2 in the femoral neck while the reduction after each parturition will be 0.028 g/cm^2 and 0.015 g/cm^2. Age accounted for about 37.1% and 31.5% of changes in BMD at the lumbar spine and the femoral neck respectively which was highest among the negatively correlated groups. (Figure A, B, I, J, K, L).

Height, weight and BMI all had a positive correlation in the weak level with BMD at the lumbar spine and the femoral neck. Each 1cm increased in height corresponded to the increase of 0.014 g/cm2 and 0.011 g/cm^2 at the lumbar spine and the femoral neck respectively while each 1cm increased in weight corresponded to the increase of 0.01 g/cm^2 and 0.007 g/cm^2 and that of each 1kg/m^2 increased in BMI are 0.02 g/cm^2 and 0.013 g/cm^2.

Weight accounted for about 18.9% and 17.1% of changes in BMD at the lumbar spine and the femoral neck respectively which was also highest among the positively correlated groups. (Figure C, D, E, F, G, H).

5. DISCUSSION

In our study, the mean BMD at the lumbar spine and femoral neck which were rather high had a significant correlation with age, TESM, number of giving birth, height, weight and BMI. Especially, age and weight contributed to a large amount of BMD changes. Therefore, those two risk factors might need to be monitored carefully in clinical settings so as to prevent osteoporotic fractures.

The mean BMD at the lumbar spine and the femoral neck were 0.92±0.2g/cm2 and 0.84±0.15g/cm2, respectively. The results of our research differed from Margaret L. Gourlay et al. (2014) in 109 menopausal women aged 50-64 years, showing BMD at the lumbar spine was 1.012± 0.141 g/cm2 (p<0.001) and BMD at the femoral neck was 0.771±0.135g/cm2 (p<0.05) [10]. This difference could be explained by the extended age range in our research including both menopausal and non-menopausal women who were over 40 years old. Moreover, the mean BMD values at the femoral neck and lumbar spine in Vietnamese women were lower than that of subjects in other continents [11][12]. Among Asian subjects, the BMD values in our study were higher than Indian and Korean [13] subjects for all measured sites but the values in the lumbar spine were slightly lower when compared to Iranian subjects [14]. All the discrepancy above could be due to the differences in ethnicity, diet, lifestyle, and different body size among countries.

It was recorded by our study that BMD had a significant positive correlation with height, weight, BMI and significant negative correlation with age, TESM and time of giving birth, which had shown the importance of socio-demographic factors and body measurement data. According to Ranu Patni (2010), among healthy Indian females: BMD increased gradually in the age of 30-39, stabilized from the age of 40-49, then gradually decreased after 50 years old and dropped most significantly after 60 years of age. Therefore, BMD would gradually decrease when the age was higher and our research recorded similar results: BMD in both the lumbar spine and the femoral neck positions decreased gradually by age group 41-50, 51-60, 61-70 and over 70 years old ($p < 0.001$) [13]. The results of our study recorded that women with higher height had higher BMD ($p<0.05$). According to Rana EL Bikaia (2015), BMD was significantly related to height ($p<0.001$) and the lower the height was, the lower the BMD was [15]. Our study also pointed out that women with higher weight also had higher BMD ($p<0.001$). Similarly, Margaret L. Gourlay (2014) also noted that the higher the women's weight was, the higher the BMD was ($p<0.001$) [16] Our research results showed that BMD increased gradually corresponding to BMI group and the difference was statistically significant ($p<0.001$). Similarly, Nyaradzo M. Mgodi's study found that low BMD was associated with low BMI ($p<0.001$) [17]. Meanwhile, Compston (2013) also identified below 19kg/m2 BMI as a crucial risk factor for low BMD and osteoporotic fracture [18]. As can be seen, age and weight took up a large amount of BMD changes. Therefore, those two risk factors might need to be put concern on. Another research performed in India also pinpointed that age and height were high-risk factors of osteoporosis. This study also reported that the risk of osteoporosis in postmenopausal women was double [18]. With the understanding that BMD had a negative correlation with TESM and number of giving birth, elder women who already underwent menopause and gave birth several times need to be prioritized when it comes to osteoporosis screening. Another study from A. Faisal-Curry among women older than 49 years in Brazil recorded that BMI was directedly related to BMD. Moreover, it also stated that reproductive and anthropometric variables outweighed the lifestyle-related risk factors [19]. According to our research, BMD at the lumbar spine was lowest in the farmer group and the next was the housewife group ($p < 0.001$), whereas the BMD at the femoral neck was lowest in the housewife group and the next was the farmer group ($p < 0.05$). The BMD was highest in the group of office workers. AlJohara's study M AlQuaiz et al. (2014) reported that in the group of women over 40 years of age with low BMD, up to 90% were housewives (OR = 2.96, 95% CI = 2.06-33.08) [20]. This difference might be due to the different labor structures between countries. The results of our study showed that BMD of urban women was higher than that of women living in rural areas ($p<0.05$). Similarly, Wenjia Gu and colleagues (2007) recorded that BMD in urban women was significantly higher than that of rural women ($p<0.001$) [21]. This could be explained by the higher quality of life in urban areas. Our research showed that BMD was lowest among the illiterate women, followed by the group with primary education level and the highest level was an upper secondary school ($p<0.05$). Similarly, AlJohara M AlQuaiz et al (2014) noted that the group of women over 40 years of age with lower education levels consisting of primary education and illiterate accounted for the highest proportion. In particular, illiteracy, primary, secondary and tertiary education were 29.2%, 42%, 18.9% and 9.9%, respectively (OR = 2.13; 2.68; 2.27 and 1.00) [20]. The reason for this similarity is that both studies had a large enough sample size to investigate and used the same research subjects as well as DEXA method measured at the position of the lumbar spine and femoral neck. Since then, low levels of education and health care awareness had been found to be a precursor for lower rates of BMD and a higher risk of osteoporosis. Therefore, in the work of prophylaxis, promoting awareness, especially for women, has been playing an indispensable role.

The strengths of our study are that it is one of the first studies of reference values for BMD of the lumbar vertebral and femur area and its relative factors in the healthy Vietnamese female population. Furthermore, based on the WHO recommendations, the appropriately selected age group and the reasonably associated factors were in good agreement with data on the prevalence of fracture in Vietnam. Lastly, our study used the results from the DEXA method which is known to be precise and widely used in Vietnam and all around the world due to its high sensitivity and specificity as compared to other techniques. However, our study still had some limitations. Firstly, the cross-sectional data can only showcase an approximation of actual mean BMD varies through the period. By measuring the BMD in both two popular and clinically important sites – lumbar spine and femoral neck, we expected to be able to showcase a more accurate BMD status of the subjects. Secondly, the study subjects were not randomly sampled from all geographic regions in Vietnam. All of the women in our study are from one region in Vietnam only – Mekong Delta, which can not ensure the representativeness of the reference data and reduce the effects of potential biases that could adjust the estimates. In term of this, we established a pure clear inclusion and exclusion criteria as well as extended size of samples up to 168 subjects in order to enhance the representativeness of our reference data. However, we should have conducted a detailed questionnaire to access the food intake of the participants, especially their calcium and vitamin D intake, which can have a significant impact on the BMD values. Consequently, this issue should be considered when doing further studies about BMD. Thirdly, because of the cross-sectional design and limited numbers of subjects in each subgroup, we could not accurately evaluate the association between changes in BMD and its relative factors. Therefore, further large-scale research should be conducted to enhance the accuracy of BMD values and thoroughly investigate the relationship between osteoporosis and its relative risks as determined in our study. Finally, all the factors analyzed in our study were not modifiable, which was not ideal for the work of prophylaxis. Thus, there is an urgent need for conducting further research to investigate the correlation between BMD and modifiable factors in those women such as lifestyle, tobacco and alcohol consumption or hormone replacement therapy using. Further longitudinal studies are also suggested to thoroughly evaluate the use of BMD as a marker for fracture risks.

CONCLUSION

The mean BMD at the lumbar spine and the femoral neck, which had a negative correlation with age, TESM, number of giving births and positive correlation with height, weight and BMI ($p<0.05$), were rather high as compared to other populations. The data presented in our study has substantially added in quantity and quality, to the qualified dataset of BMD in order to provide physicians with the valuable reference standards for the management of osteoporosis in Vietnam. This study also highlighted the importance of education, health care awareness and nutrition in long-term prophylaxis. Moreover, the database is expected to act as a precursor to enhance the accuracy of osteoporotic fractures predicting tools such as FRAX® and Gravan for this population. With this result, we optimistically expect to be able to turn healthy women over 40 years of age in Mekong Delta into beneficiaries for our national systematic osteoporosis tracking program.

CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose.

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