Maturitas 89 (2016) 16–21

Contents lists available at ScienceDirect

Maturitas

journal homepage: www.elsevier.com/locate/maturitas

Aging and bone health in Singaporean Chinese pre-menopausal and postmenopausal women

Victor Hng Hang Goh*, William George Hart

Curtin Medical School, Faculty of Health Sciences, Bldg 400, Curtin University, Kent Street, Bentley, WA 6102, Australia

ARTICLE INFO

Article history:
Received 12 January 2016
Received in revised form 4 April 2016
Accepted 6 April 2016

Keywords:
Physical exercise
Age
Bone mineral density
Percent body fat
Singaporean Chinese women

ABSTRACT

Objective: The study evaluated relationships between menopausal statuses, hormone replacement therapy (HRT), body mass index (BMI), percent body fat (PBF), and exercise with osteoporosis and bone mineral density (BMD) in Singaporean women.
Study design: This is a cross-sectional study.
Main outcome measures: The spine BMD, and femoral neck BMD as well as the prevalence of osteoporosis are the main outcome measures studied.
Results: Age, BMI, PBF and exercise intensity were independently associated with spine and femoral neck BMD. Women with higher BMI and lower PBF had higher BMD and lower prevalence of osteoporosis. Postmenopausal women without HRT had lower BMD and higher prevalence of osteoporosis while those on HRT had similar BMD and prevalence of osteoporosis as premenopausal women.
Conclusion: This study shows that BMI and PBF are powerful predictors of BMD. Osteoporosis is site-specific in the Singapore population, being higher in the femoral neck than in the lumbar spine. The bone status after menopause may not be worse than that dictated by age alone and both ERT and E/PRT could sustain the BMD to levels corresponding to those of women a decade younger. A strategy to improve bone health should include dieting and physical exercise program that focuses on selectively reducing fat mass and increasing lean mass.

1. Introduction

In postmenopausal women, estrogen is a major factor in the pathogenesis of postmenopausal osteoporosis as the effects of declining estrogen levels in female skeletal health is well established in both human and animal models [1,2]. In addition to age and menopausal status, several other factors including weight bearing exercises and bodyweight are known to be associated to osteoporosis [3,4]. The varying associations of these factors in different populations may contribute to the wide range of prevalence of osteoporosis, from 10% to more than 50% for women above 50y old in different countries [5].

With a rapidly aging population, osteoporosis is becoming a major public health threat to the elderly, especially women [6]. As with the rest of the world, osteoporosis-associated hip and vertebral fracture rates have been rising in most Asian countries [7,8]. Early preventive measures are required to address this huge health problem.

Osteoporosis is also known as a silent disease, and its pathological changes remain unnoticed until a fracture occurs or when a bone scan is carried out [9]. Furthermore, osteoporosis apart from being age-related is gender-, bone site- and population-specific [10]. Therefore, the present study sought to evaluate in a sample of healthy community dwelling Singaporean Chinese women, the prevalence of osteoporosis, and how age, menopausal status, bodyweight, obesity and engagement in regular physical exercise are associated with the prevalence of osteoporosis and bone mineral density (BMD). A better understanding of the interrelationships of these factors on BMD will assist in the formulation of appropriate recommendations for aging women to delay or reduce the prevalence of osteoporosis. In addition, the study afforded the opportunity to compare the BMD of Singaporean with those for other Asian and American populations.

* Corresponding author.
E-mail addresses: victor.goh@curtin.edu.au, victorhgoh@gmail.com (V.H.H. Goh).

http://dx.doi.org/10.1016/j.maturitas.2016.04.004
0378-5122/

2. Subjects, materials and methods

2.1. Subjects

This study was approved by the Institutional Review Board of the National University Hospital, Singapore and each volunteer gave her written informed consent. One thousand three hundred and twenty-six Singaporean Chinese women, aged between 29y and 71y, were included in the analyses. These were community-dwelling healthy individuals with no known history of major medical illnesses such as cancer, hypertension, thyroid dysfunction, diabetes, or cardiovascular events nor major sleep disorders including sleep apnea. None of the subjects had a history of major joint surgery, or bone fracture. None had been clinically diagnosed as having any form of osteoporosis. Subjects were not paid for participation. They represented the diverse spectrum of people in Singapore, ranging from those with low to high levels of education, working and non-working, and those in various types of occupations [11]. Their profiles were typical of Singapore, which is a highly urbanized city-state with no rural population.

2.2. Questionnaire

Each subject answered a self-administered and investigator-guided questionnaire to collect demographic, previous medical history and lifestyle factors. The questionnaire also allowed participants to record their physical exercise and/or sport as a lifestyle habit for each week. Only engagement in the physical exercise and/or sport for at least six months was considered a lifestyle habit. Participants recorded either no exercise or up to 4 different types of exercise/sport in which they were engaged in per week. For each exercise/sport type, they stated the duration and frequency per week. For example, a participant could record walking for 30 min 5 times a week and playing tennis for 60 min once a week.

2.3. Exercise/sport intensity

In order to normalize the different types of exercise/sport into a single common score, exercise intensity was calculated using the Metabolic Equivalent of Task (MET) of each exercise/sport type. A score was then calculated to denote the intensity of exercise/sport per week in MET minutes (METmin) by taking into account the duration of each exercise/sport episode and the frequency of the exercise/sport per week in accordance with the exercise guidelines [12]. For example, a participant reported that she walked for 30 min 5 times a week, played tennis for 60 min twice a week and did line dancing for 60 min once a week. Walking is assigned a MET of 3; tennis, a MET of 7; and line dancing, a MET of 5. Her total exercise/sport activities intensity per week was therefore 1590 METmin $[(3 \times 30 \times 5) + (7 \times 60 \times 2) + (5 \times 60 \times 1)]$.

2.4. Age groups (AgeGp)

For comparisons, all women were divided into four age groups: AgeGp1: ≤40y; AgeGp2: 41-50y; AgeGp3: 51-60y; and AgeGp4: >60y.

2.5. Menopausal groups (MenoGp)

All women who were still having their menstrual periods were classified as premenopausal women. All women were had ceased their menstrual periods for at least a year were classified as postmenopausal women. All women were also divided into five groups: MenoGp1: all premenopausal women; MenoGp2: postmenopausal women not on any hormone replacement therapy; MenoGp3: postmenopausal women on estrogen only replacement therapy (ERT) for at least the past year (mainly on 0.625 mg Premarin (Pfizer, NY) ; MenoGp4: postmenopausal women who were on estrogen only replacement therapy (ERT) for at least the past year (mainly on progynova, (2 mg estradiol valerate, Schering AG, Berlin); and MenoGp5: postmenopausal women on estrogen/progestin hormone replacement therapy (E/PRT) for at least the past year (mainly Prempak C (0.625 mg Conjugated estrogen and 0.15 mg norgestrel, Pfizer Ltd., NY) and only two subjects were on Climen (2 mg of estradiol valerate and 1 mg cyproterone acetate, Schering AG, Berlin).

2.6. Body mass index

As suggested in previous work, BMI is a good index of bodyweight normalized for height, but not of body fat [13]. The BMI was computed by taking bodyweight in kilograms divided by the square of height in meters.

2.7. Bone scan: and osteoporotic groups

Each subject underwent a whole body scan, a lumber spinal scan at the L2-L4, and a scan of the hip (representing the femoral neck, shaft, and trochanter) using DXA (DPX-L, Lunar Radiation, Madison, WI, USA; software version 1.3z). The DXA scan was used for clinical management and has routinely been calibrated with the phantom. Total percent body fats (PBF), lumbar spine bone mineral density (SBMD) (average BMD of L2-L4) and femoral neck bone mineral density (FnBMD) were computed automatically by the DXA scanner. The T-scores for SBMD and FnBMD were computed with reference to the young reference values established for the local population using the DXA scanner. According to the WHO guidelines, a T-score >-1.00 is normal, while T-scores of <-2.50 are considered as osteoporosis [18]. Hence, the following 4 groups were classified as SOstGp1 (normal spinal BMD) and FnOstGp1 (normal femoral neck BMD) when the spine and femoral neck T-scores were >-1.00, SOstGp2 (osteoporosis of spine) and FnOstGp2 (osteoporosis of femoral neck) where the spine and femoral neck T-scores were <-2.50.

2.8. Statistical analysis

Statistical analyses were performed using SPSS for windows version 19.0. Basic descriptive statistics, as well as multivariate linear comparison of means using the General Linear Model coupled with the Bonferroni as the Post-Hoc test for multiple comparisons for the bone parameters of SBMD, FnBMD, age, BMI, percent body fat, exercise and menopause groups were calculated. Where appropriate, the exercise intensity (METmin), BMI, and PBF and age were analyzed as covariates in the comparison groups. Linear regression analyses were carried out separately for SBMD and FnBMD using the stepwise method with age, METmin, PBF, and BMI and weighted for Menopause status. Cross-tab and Fisher Exact tests were used to assess the prevalence of spine and femoral neck osteoporosis in the different age, BMI, percent body fat, exercise intensity and menopause groups.

3. Results

Table 1 shows that both spine and femoral neck BMD were independently and negatively associated with age with FnBMD apparently more associated with age than SBMD (Table 1). Body mass index was highly and positively correlated with both SBMD and FnBMD, while percent body fat was highly but negatively correlated with both SBMD and FnBMD (Table 1). Exercise intensity (METmin) was positively associated only with FnBMD but not with SBMD (Table 1).