European Geriatric Medicine 6 (2015) 303–308

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com/en

Research paper

Osteoporosis: Prevalence and risk factors among Taiwanese metropolitan elderly

C.-C. Lin [a,b,c], C.-I. Li [a,c], N.-H. Meng [a,d], C.-S. Liu [a,b,c], C.-H. Lin [a,b], W.-Y. Lin [a,b], C.-K. Chang [d], Y.-D. Lee [e,f], T.-C. Li [g,h,*]

[a] School of Medicine, College of Medicine, China Medical University, Taichung, Taiwan
[b] Department of Family Medicine, China Medical University Hospital, Taichung, Taiwan
[c] Department of Medical Research, China Medical University Hospital, Taichung, Taiwan
[d] Department of Physical Medicine and Rehabilitation, China Medical University Hospital, Taichung, Taiwan
[e] Department of Psychiatry, Medical College, National Cheng-Kung University, Tainan, Taiwan
[f] Bristol-Myers Squibb (Taiwan) Ltd, Global Development & Medical Affairs, Taipei, Taiwan
[g] Graduate Institute of Biostatistics, College of Public Health, China Medical University, Taichung, Taiwan
[h] Institute of Health Care Administration, College of Health Science, Asia University, Taichung, Taiwan

ARTICLE INFO

Article history:
Received 29 January 2015
Accepted 22 March 2015
Available online 23 April 2015

Keywords:
Bone mineral density
Reference norms
Osteoporosis
Elders

ABSTRACT

Purpose: This study estimated the age- and sex-specific prevalence of osteoporosis using dual-energy X-ray absorptiometry (DXA) and determined risk factors of osteoporosis in older Taiwanese metropolitan persons.
Material and methods: Cross-sectional study enrolled total of 711 older persons (294 females and 417 males, aged 65–98 years) in Taichung City during 2009. Bone mineral density at central sites was measured by DXA, whole-body scan performed on each subject lying supine.
Results: Age-standardized prevalence of osteoporosis for women tallied 35.4, 15.0, and 21.1%; for men 15.1, 0.7, and 9.8% at the total hip, lumbar spine, and femoral neck, respectively. After multivariate adjustment, age, gender, body mass index (BMI), weight, and smoking manifested strong linkage with osteoporosis. Odds ratios (95% confidence intervals) were 0.24 (0.15–0.40) for males; 1.86 (1.03–3.35), and 3.24 (1.67–6.28) for 70–74, and >80 years, respectively; 0.12 (0.05–0.29), 0.09 (0.04–0.23), and 0.08 (0.03–0.22) for BMIs of 18.5–24, 24–27, and ≥27 kg/m^2, respectively; 2.66 (1.27–5.56) for smoking; and 2.11 (1.16, 3.84) for frailty status.
Conclusion: Osteoporosis was most common at the total hip and least common at the lumbar spine in both sexes. Programs for osteoporosis screening should aim at older females and/or those with low BMI, frailty or a smoking habit.

1. Introduction

Taiwan has the world's fastest aging population, making osteoporosis and related fractures pose ever-increasing menaces to Taiwanese elderly, since prevalence climbs rapidly with age [1]. Prevalence of osteoporosis is estimated at 49% among women over 50 years of age [2]. In China, about 88 million patients suffer from it [3]. Such fractures are associated with morbidity and mortality, decreased quality of life, as well as higher health care costs [4], yet osteoporosis is often not detected until fracture occurs. Hence, it must be diagnosed as early as possible.

Diagnoses are based on bone mineral density (BMD) and comparison with reference norms. Diagnosis proposed by the World Health Organization (WHO) is calculated by T-score: i.e., BMD of a subject minus the peak BMD (PBMD) divided by standard deviation (SD) of the PBMD (mean BMD of young healthy adults of the same sex and race) [5–7]. A T-score ≤ −2.5 BMD of 2.5 more SDs below peak mass of young, healthy, sex- and race-matched reference population, indicates osteoporosis. Some nations use different PBMD percentile criteria [3,8]; BMD measurements are crucial for diagnosis. BMD measured by dual-energy X-ray absorptiometry (DXA) is the most widely used indicator; DXA of the spine or hip region is the recommended diagnostic tool [9]. No study in Taiwan

* Corresponding author. China Medical University, 91, Hsueh-Shih Road, 40421 Taichung, Taiwan. Tel.: +88 6422 053366, ext 6605; fax: +88 6422 078539.
E-mail address: tcli@mail.cmu.edu.tw (T.-C. Li).

http://dx.doi.org/10.1016/j.eurger.2015.03.011
1878-7649/

has reported BMD reference normative data for any age. In clinical practice, diagnosis is based on manufacturer-supplied PBMD reference values, which may not be fully representative of a specific local population [10–12]. The present study used DXA-acquired BMDs at central skeletal sites (lumbar spine and hip) of a Taiwanese metropolitan community-dwelling older population so as to elicit BMD normative data and information on prevalence among Chinese older persons, using PBMDs of Asian populations in literature, and to determine factors associated with osteoporosis.

2. Materials and methods

2.1. Population and participants

This study used population-based cross-sectional approach. Target population consisted of persons aged 65 or older residing in eight administrative neighbourhoods of Taichung City in June, 2009. This city is located in west-central Taiwan and has a population of over one million, third largest islandwide. A total of 3997 elderly lived in these neighbourhoods during the study period; about 4.58% of Taichung's people were the same age. Sampling frame was the set of all records of individuals obtained from the Bureau of Households.

All eligible individuals were invited to participate. During household visits, we excluded 1764 individuals as ineligible. Overall response rate was 49.0%; study was approved by the Human Research Committee of China Medical University Hospital, with written informed consent obtained from all participants. In all, 855 older persons (402 females and 453 males) aged 65–98 years completed the prerequisite physical examination. After excluding older persons with missing data for height, weight, and BMD, a total of 711 subjects were finally enrolled. Exclusion rate was 16.8%. The detailed methodology has been described elsewhere [13]. This study was approved by the Ethical Review Board of China Medical University Hospital.

2.2. Measurements

2.2.1. Bone mineral density and osteoporosis

BMD (g/cm^2) was rated by DXA system (GE-LUNAR DPX, Lunar Corporation, Madison, WI) at central skeletal sites (hip, lumbar spine, femoral neck, trochanter, and Ward's triangle). This machine was calibrated daily by physical phantom, data analyzed by Lunar enCORE2004 software version 8.60.006 (CV < 1% to measure diverse sites). Whole-body scan was performed on each subject lying supine and osteoporosis defined according to WHO diagnostic criteria: individual with BMD less than 2.5 SDs below young adult mean [5]. Given that there were no young adults in this study, we adopted the BMD reference values of Asian populations of young adults aged 20–39 years from literature. Young adult data from Chinese and Korean populations were all used to define the reference cutoff values. The Chinese and Korean cutoffs were based on predicted BMD at these ages reported by Lynn et al. [1] and Cui et al. [14], respectively.

2.2.2. Anthropometric measurement

Anthropometric measures gleaned from complete physical examination. Weights and heights were measured by autoanthropometer (Super-view, HW-666). Subjects were shoeless and wore light clothing during measurements. BMIs were derived from this formula: weight (in kilograms)/(height)^2 (in meters).

2.3. Definitions of other variables

Data on sociodemographic characteristics (gender, age, educational attainment, marital status, smoking, drinking, physician-diagnosed disease, medication history) were collected during complete physical exam. Educational level was categorized as less than 7 years, 7–12 years, and >12 years. Marital status was divided into currently married or unmarried (single, widowed, divorced, or separated).

Smoking was classified as current, past, or never. Past smokers were those who had smoked at least 100 cigarettes during their lifetime and stopped. Drinking was categorized as current, never, and past. "Never" drinkers were those who self-reported not regularly drinking beer, wine, or hard liquor. Instead of measuring leisure activity, we gauged frailty, as defined by Fried et al. [15]: shrinking, weakness, poor endurance and energy, slowness, as well as low physical activity level. Shrinking was defined as unintentional weight loss ≥ 3 kilograms in the previous year, weakness as grip strength in the lowest quintile at baseline based on subgroups of gender and BMI [15]. Poor endurance and energy were gauged by self-reported exhaustion, as identified by two items from the Center for Epidemiological Studies-Depression Scale [16]. Slowness was measured by slowest quintile of the population based on time needed to walk 15 feet (4.572 m) according to subgroups of gender and standing height [15]. Low physical activity level was tallied by weighted score of self-reported kilocalories expended weekly. Lowest quintile of physical activity in this study was identified for each gender. Those with more than two of these components were considered frail.

2.4. Statistical analysis

Continuous variables were reported as mean ± SD. Categorical variables were reported as percentages (95% confidence intervals, CI). Differences in proportions and means were assessed by χ^2 test or analysis of variance. Prevalence was expressed with a 95% CI. Weighted prevalence via proportionate sampling of age, gender, or both was calculated. Multivariate logistic regression estimated odds ratios (ORs) of osteoporosis for sociodemographic factors, lifestyle and/or self-reported illness. All P values were obtained from two-sided tests. Statistical significance was set at $P < 0.05$. All analyses were performed using SAS version 9.2 (SAS Institute Inc, Cary, NC).

3. Results

Over half of the subjects were male, aged 65–74 years, educational attainment of 7 years or more, and married. Mean height and weight decreased with age among 417 healthy Chinese male elderly; mean BMI decreased up to age 70–74, increased at age 75–79, then decreased again at age ≥ 80 (Table 1). Among 294 females, height and weight generally decreased with age. Average BMI was similar across age groups.

Among males over 65 years old, BMD increased at a rate of 0.003 g/cm^2·year at the lumbar spine, decreased 0.001 g/cm^2·year at the femoral and total hip, decreased 0.002 g/cm^2·year at Ward's

Table 1
Age-stratified anthropometric traits (mean ± standard deviation) of subjects.

Age (years)	Number	Height (cm)	Weight (kg)	BMI (kg/m^2)
Men				
65–69	120	164.2 ± 5.6	65.8 ± 9.5	24.4 ± 3.2
70–74	104	164.2 ± 5.6	65.4 ± 9.1	24.2 ± 2.8
75–79	103	162.4 ± 4.8	64.6 ± 9.6	24.5 ± 3.1
80+	90	162.4 ± 6.2	61.3 ± 9.9	23.2 ± 3.4
Total	417	163.4 ± 5.6	64.4 ± 9.6	24.1 ± 3.2
Women				
65–69	111	153.3 ± 5.8	57.7 ± 9.2	24.5 ± 3.5
70–74	88	152.7 ± 5.7	56.9 ± 7.6	24.4 ± 3.2
75–79	63	152.4 ± 5.8	57.0 ± 9.4	24.6 ± 4.1
80+	32	150.4 ± 5.7	55.4 ± 9.3	24.5 ± 4.1
Total	294	152.6 ± 5.8	57.0 ± 8.8	24.5 ± 3.6