

Bone mineral density in Hong Kong and Taiwan Chinese women: a comparative study

EMC Lau, KS Tsai, J Woo, NF Chan, PC Leung, L Lim

The bone mineral density of 575 healthy premenopausal and postmenopausal Chinese women living in Hong Kong and Taiwan was measured by dual X-ray densitometry. After adjusting for age, height and body weight, the bone mineral density for premenopausal and postmenopausal Chinese women living in Hong Kong was found to be not significantly different from that of women living in Taiwan. The variation in bone mineral density with age was very similar in postmenopausal women in both countries. Body weight was a significant predictor of bone mineral density at the hip and spine in both Hong Kong and Taiwan Chinese women, while height was a significant predictor of bone mineral density only in postmenopausal Taiwan Chinese women.

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Introduction

Osteoporosis and hip fracture are important public health problems in Chinese populations. In 1989, the age-adjusted incidence of hip fracture in Hong Kong Chinese was 35 per 100 000 in men and 77 per 100 000 in women.¹ The bone mineral density (BMD) of Chinese women in Taiwan has been measured by dual-photon absorptiometry, and the results were comparable to the BMD values found in Korean and Japanese populations.^{2,3} However, the BMD of Chinese, as measured by dual X-ray densitometry, has not been reported. We measured the BMD of Chinese women living in Hong Kong and Taiwan by dual energy X-ray absorptiometry (DEXA), the results of which are

reported here. The rate and pattern of bone loss with age in the two populations was also compared.

Materials and methods

Study populations

In Hong Kong, the study population was recruited from Shatin, a satellite town. Three groups of women were studied—premenopausal, peri/postmenopausal and elderly women. The first group comprised volunteers from nurses in a large public hospital in Hong Kong, with all subjects under 40 years of age. The perimenopausal and postmenopausal women studied comprised subjects aged between 40 to 60 years, who were registered with a group general practice. The elderly group consisted of subjects living in a housing block for the elderly, with all subjects aged 60 years or more.

In Taiwan, the study subjects were randomly selected from a list provided by the population registry for Taipei city. Study subjects from both countries were free of metabolic diseases. None were on steroids or diuretics at the time of the study. Postmenopausal status was defined as cessation of menstrual flow for one year or more.

Bone mineral densities and other measurements

Bone mineral density at the spine (L2 to L4 level) and the hip (at three sites—femoral neck, intertrochanteric

The Chinese University of Hong Kong, Shatin, Hong Kong:
Department of Community and Family Medicine, Lek Yuen Health Centre

EMC Lau, MD, MFPHM
NF Chan, MB, BS, FRACGP

Department of Medicine
J Woo, MB, ChB, FRCP

Department of Orthopaedics and Traumatology
PC Leung, MB, BS, FRCP

Department of Laboratory Medicine, National Taiwan University Hospital, Taipei, Taiwan

KS Tsai, MD

Centre of Clinical Epidemiology and Biostatistics, University of Newcastle, Australia

L Lim, BSc, PhD

Correspondence to: Dr EMC Lau

area, and the Ward's triangle) was measured by dual X-ray densitometry. Norland machines (NR26 model) were used in both populations and identical readings were obtained from a spine phantom from both machines. Standing height was measured without shoes, to the nearest centimetre. Body weight was measured with subjects dressed in light summer clothing.

Statistical methods

Data was analysed using the statistical package SPSS. Analysis of covariance (ANCOVA) was performed to test if the BMD differed between Hong Kong Chinese and Taiwan Chinese while adjusting for weight, height and age. This technique tests the equality of adjusted group means when covariates are specified. The slopes of the covariates are tested for equality (parallelism) among groups. Multiple regression was used to investigate how bone mineral densities varied with age, height, and body weight in the two populations, and to study whether the bone mineral densities were significantly different between the two populations after

adjusting for age, height and body weight.

Results

In Hong Kong, 37 nurses volunteered for the study. The response rate in the perimenopausal group was 78% (107 were premenopausal, 47 were postmenopausal), and the response rate for elderly women was 81% (resulting in 161 subjects).

The means and standard deviations for age, height, body weight, and BMD in Hong Kong and Taiwan women are presented in Table 1. There was no significant difference in BMD at the hip or spine between Hong Kong and Taiwan women (except at the Ward's triangle), after adjustments were made for age, height and body weight. The BMD of Hong Kong and Taiwan women in each decade of life is presented in Fig 1. While bone loss at the spine began at 40 years of age in both Hong Kong and Taiwan Chinese, a sharp decline in BMD occurred after the menopause in

Table 1. Bone mineral density, body weight and height in Hong Kong Chinese and Taiwan Chinese women (mean and standard deviations)

	Bone mineral density (g/cm ²)					Body weight (kg)	Body height (cm)
	L2-L4	Femoral neck	Intertrochanteric area	Ward's triangle			
Premenopausal group							
Hong Kong (n = 144)	0.96 (0.12)	0.80 (0.10)	0.68 (0.09)	0.81 (0.13)	56.0 (9.0)	153.5 (5.7)	
Taiwan (n = 67)	1.08* (0.11)	0.83 (0.12)	0.68 (0.10)	0.73* (0.12)	54.4 (9.1)	156.7 (5.6)	
Postmenopausal group							
Hong Kong (n = 208)	0.70 (0.16)	0.55 (0.12)	0.47 (0.12)	0.49 (0.15)	53.8 (10.9)	149.3 (6.4)	
Taiwan (n = 156)	0.97 (0.16)	0.71 (0.13)	0.60 (0.11)	0.60* (0.14)	55.0 (7.3)	155.2 (5.5)	

* p < 0.01 between Taiwan and Hong Kong measurements by ANCOVA (adjusting for age, body weight and height)

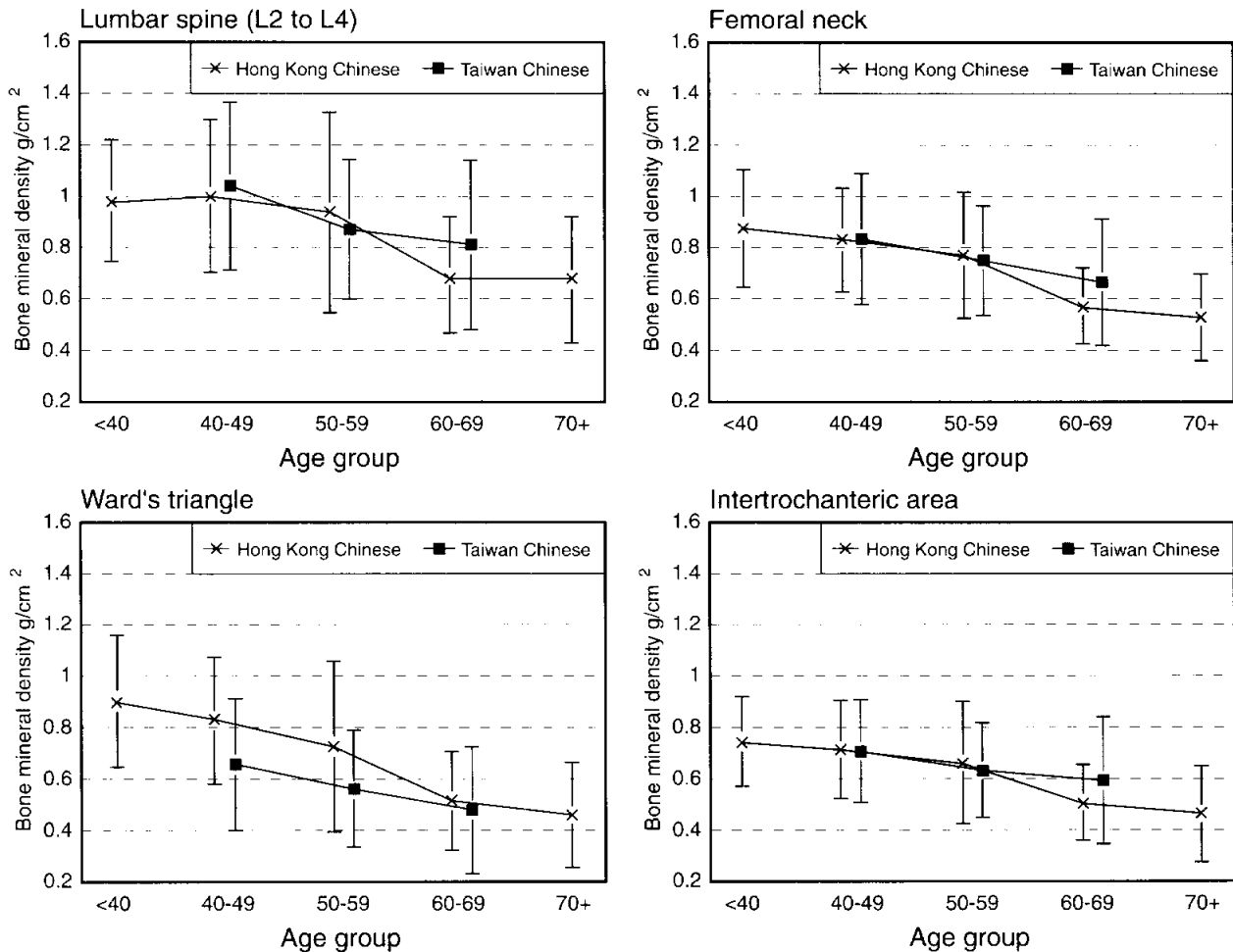


Fig 1. Bone mineral density (mean and 95% confidence interval) of Hong Kong and Taiwan Chinese by decade

Hong Kong Chinese, but this did not occur in Taiwan Chinese. In Hong Kong Chinese, bone loss at the hip began before age 40, with the most rapid decline in BMD occurring between 60 to 69 years. As in the spine, the BMD at the hip among Taiwan Chinese decreased steadily from age 40 onwards, with no sharp decline between 60 to 69 years.

The regression coefficients of BMD on age, height and body weight in Hong Kong and Taiwan women are shown in Table 2. The residuals of all the multiple regression models followed an approximately normal distribution. There was significant hip bone loss but not spinal, with increasing age among premenopausal Hong Kong Chinese women, while the reverse was observed in Taiwan Chinese women. The average rates of bone loss at both the hip and spine, as measured by regression coefficients, were very similar in both Hong Kong and Taiwan Chinese postmenopausal women. Body weight was a significant predictor of BMD at both the hip and spine in Hong Kong and Taiwan Chinese, while height was a significant predictor of BMD

only in postmenopausal Taiwan Chinese women.

Discussion

This is the first study which compares the pattern of bone loss and BMD in two different Chinese populations. Although the methods of recruiting study subjects were different in Hong Kong and Taiwan, there is no obvious selection bias in either sample. The BMD of Chinese women living in Hong Kong and Taiwan was found to be very similar in our study. The apparent difference in BMD at the Ward's triangle could have resulted from a difference in the technique of BMD measurement. Although the BMD of Japanese and Taiwan Chinese were found to be lower than in Caucasians in two previous studies, no attempt was made for such comparisons here, as BMD was measured by different techniques in various studies, which may lead to systematic bias and spurious differences in BMD.³

Given the limitation that the change in BMD was

Table 2. The results of multiple regression for bone mineral densities (g/cm²) on age, height and body weight

Site	Country/ menopausal group	Regression coefficients (x10 ⁻³)			R ²
		Age (yr)	Height (cm)	Body weight (kg)	
Spine	Hong Kong/ premenopausal	1.7	2.7	2.9*	0.10
	Hong Kong/ postmenopausal	-7.6***	0.45	5.4***	0.44
	Taiwan/ premenopausal	-8.9**	6.0	5.5*	0.27
	Taiwan/ postmenopausal	-8.8***	4.9*	5.5***	0.23
Femoral neck	Hong Kong/ premenopausal	-2.0*	2.1	3.6**	0.13
	Hong Kong/ postmenopausal	-7.9***	1.5	3.4***	0.64
	Taiwan/ premenopausal	-3.4	3.0	7.8***	0.30
	Taiwan/ postmenopausal	-9.2***	4.3**	5.0***	0.35
Intertro- chanteric area	Hong Kong/ premenopausal	-2.1*	-1.0	4.3***	0.14
	Hong Kong/ postmenopausal	-6.4***	-5.3	4.9***	0.61
	Taiwan/ premenopausal	-3.1	1.5	6.9***	0.38
	Taiwan/ postmenopausal	-6.1***	2.5	5.8***	0.31
Ward's triangle	Hong Kong/ premenopausal	-4.6***	-0.97	6.2***	0.17
	Hong Kong/ postmenopausal	-10***	0.62	3.3***	0.58
	Taiwan/ premenopausal	-5.4	2.9	5.9**	0.22
	Taiwan/ postmenopausal	-11***	4.5**	3.2**	0.33

* p < 0.05
** p < 0.01
*** p < 0.001
R² represents the total amount of variance explained by the model

not derived from follow-up measurements of study subjects, a comparison of the pattern of bone loss in the two study populations is attempted. While there was significant bone loss at the hip but not at the spine among premenopausal Hong Kong Chinese women, the reverse was observed in Taiwan Chinese women. The average rates of bone loss among postmenopausal women, as measured by the regression coefficients, were very similar in the two populations. In the West, different patterns of bone loss at the spine have been observed in studies involving Caucasians. In some studies, a linear diminution of the lumbar BMD starting at the age of 20 or 35 years has been observed.⁴⁻⁸ This was similar to the observed trend in Taiwan Chinese. However, BMD has been found to be stable in some Caucasian populations until menopause, in line with our findings in Hong Kong Chinese.⁹⁻¹³ An accelerated bone loss at the hip, starting just before menopause has been found in three studies involving Caucasians. This was similar to our findings for the Taiwan Chinese.^{8,9,14} Most other Western investigators have suggested a linear diminution of the femoral BMD since early adulthood, as we have found in Hong Kong Chinese.^{5,12,13}

As expected, body weight was a determinant of BMD at the hip and spine in both premenopausal and postmenopausal Chinese women. In addition, height was found to be a significant predictor of BMD in postmenopausal Taiwan Chinese women. Although it is possible that height may be a predictor of BMD, a more plausible explanation is that Taiwanese women who were more osteoporotic lost more height with ageing.

We have demonstrated that the BMD of premenopausal and postmenopausal Chinese women living in Hong Kong and Taiwan are similar, while the pattern of bone loss is different in the two populations. Body weight was a significant predictor of BMD at the hip and spine in both Chinese populations, while height was significant only in postmenopausal Taiwan Chinese women. In the future, longitudinal and comparative studies in different Chinese populations, using standard protocols for BMD measurements, may

generate important knowledge on the mechanisms of bone loss.

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