Epidemiology of Osteoporosis in Taiwan

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Osteoporosis and osteoporotic fractures are major global epidemiological problems. Among the ethnic groups, Asian and Caucasians are generally considered races at high risk for involutional osteoporosis [1]. Taiwan, a subtropical island in Southeast Asia, is inhabited by 21 million people, mostly of Chinese descent. Its elderly citizens (aged 65 years or more) currently comprise 7.9% of the population, but the proportion is increasing rapidly. Because of its geographic and environmental background, and moderate degree of industrialization, the epidemiology of osteoporosis in Taiwan may be different from that of the Western world or the other parts of China. This paper reviews the prevalence of vertebral fractures and status of bone mass – mainly bone mineral density (BMD) measured with dual-energy X-ray absorptiometry (DXA) – and risk factors of low BMD in Taiwan.

Epidemiology of Osteoporotic Fractures

The prevalence of vertebral fractures defined by the morphometric criteria is relatively high in elderly Taiwanese. The adjusted prevalence rate for elderly women living in the cities of Taiwan is 18% and that of the elderly men 12% [2]. The annual incidence of hip fracture for Taiwanese men and women older than 65 years of age, based on the counts of applications for insurance reimbursement, was 203/10^5 in 1996 (unpublished data). This rate seems to be lower than that for the white population in Europe or North America [3]. The estimated total cost, both direct and indirect, was US$120 million in 1993 for hip fractures of the elderly Taiwanese [4]. The cost of osteoporosis is expected to increase rapidly in the coming years as the population grows older.

Bone Mass Measurement in Taiwan

Instruments for measuring bone mass are quite common in Taiwan. More than 200 sets are available in 1997. About half of these are DXA machines for hip and spine, and the others are ultrasonic or forearm machines. BMD measured with DXA instruments made by the major manufacturers shows that Taiwanese have similar values to European or American white populations at lumbar spine [5,6] and lower values at the hip region [5–7]. The lower BMD values at the proximal femur seem to be at least partly due to the smaller body size [8] of Taiwanese people. Taiwanese men show smaller decrements of BMD than women, especially at the lumbar spine [6]. Studying the geometry at the proximal femurs, we found an increased diameter of the femoral neck with aging in men, but not in women; and increased projectional area of the trochanteric region with aging in women, but not in men [9]. This apparent difference in the age-related changes in proximal femoral geometry may have contributed to the different propensity for hip fractures in the two genders.

Risk Factors for Low BMD

Low BMD values predict higher risks of osteoporotic fractures [10]. Thus, risk factors for low BMD may represent risks for osteoporotic fractures. Previous studies from various medical centers in Taiwan showed that aging and menopause are the most important factors in low BMD in women at all sites, measured with DXA or dual-photon absorptiometry (DPA) [5,6,9]. However, because of the prevalent degenerative changes, spinal BMD showed only a small or no change with aging in men [6]. The proximal femur was seldom affected by degenerative arthritis and showed a similar decrease in BMD with aging in both genders [6].

Body weight has been reported to be one of the important determinants of BMD at various sites [5,6,8,9,11]. For Taiwanese women aged 60 years, those who weigh 60 kg show 10% higher BMD at the lumbar spine and femoral neck than do those who weigh 40 kg.
Height, on the other hand, has a smaller influence on BMD values, taller women having significantly higher BMD values only at the femoral neck [6,9].

Rapid bone turnover rate, as reflected by elevated levels of biochemical markers of bone metabolism, has been shown to be associated with faster bone loss and lower BMD in postmenopausal women [12,13]. In Taiwanese postmenopausal women and men aged 20–80 years, higher bone turnover rate was found to be associated with lower BMD [6]. Interestingly, we found that in men, both resorption and formation markers decrease with age, in contrast to the increase of bone turnover rate in postmenopausal women [6]. We hypothesize that the gradual bone loss in aging men is mostly a result of decreased bone formation whereas the bone loss in postmenopausal women is a result of excessive bone resorption. Bone metabolism seems to be in negative balance with each remodelling cycle in the elderly of both genders. Faster bone loss and lower BMD can thus be a consequence of rapid bone turnover in both genders.

The mechanisms of rapid turnover in some individuals have been shown to be genetically determined [14] and the vitamin D receptor gene has been proposed to be largely responsible [14]. However, the role of vitamin D receptor gene polymorphism has been controversial [15,16] in Caucasian populations. In Taiwanese men and premenopausal women, we found that the polymorphisms usually reported to be associated with lower BMD and higher bone turnover rate (i.e., B, A, and t genotypes) are rare. Furthermore, the BMD levels and bone marker values are similar among groups of men and women with different genotypes/haplotypes [17]. Estrogen receptor gene polymorphisms have been shown to be associated with differences in BMD levels of Japanese [18]. However, we did not find differences or even trends of differences in BMD and bone markers of men and women of various ages, menopausal or not, with different estrogen receptor genotypes (unpublished data).

Vitamin D deficiency may cause secondary hyperparathyroidism, and lower BMD in postmenopausal women [19]. Urban women in Taiwan generally have adequate vitamin D stores. In a group of 262 peri- and postmenopausal women aged 40–72 years, we did not find higher bone turnover or lower BMD in those belonging to the lowest tertile of vitamin D stores as represented by the serum 25-hydroxyvitamin D levels [20]. Calcium intake has been limited for Chinese because of the prevalent lactase deficiency, but the consumption of milk and daily ingestion of elemental calcium has increased in the recent years. In 1981, the daily calcium intake was estimated to be around 400 mg for adult men and women of all ages [21]. In a recent survey, we found the mean daily calcium intake had increased to 640 mg/day (SD 240 mg) for 465 ambulatory women aged 40–70 years in urban Taipei. Most of the increase is from either milk consumption or supplement of calcium/vitamin D tablets [22]. We did not find significant association between daily calcium intake and BMD or bone turnover rate in this study.

Fluorosis is not a problem in Taiwan. However, in a survey in Taichung County, those who were consuming water containing more than 0.6 mg/l of fluoride showed slightly higher BMD values than those who were consuming less fluoride in their drinking water [23].

**Conclusion**

Osteoporosis is common in Chinese men and women living in Taiwan. Although the incidence of hip fracture seems to be lower in this region, the prevalence of vertebral fractures is high and similar in Taiwan to the rates in northern Europe or North America. Taiwanese have relatively low calcium intake, but the vitamin D stores seems to be generally adequate. In this region, elevated bone turnover markers are shown to be associated with lower BMD values in men and postmenopausal women. Vitamin D receptor gene and estrogen receptor gene polymorphisms were not found to be related to BMD or bone marker values. Because a larger proportion of population will be affected by osteoporosis as the population ages, Taiwanese need some sensitive and specific means to guide the effective control program for osteoporotic fractures. Although the mechanism of rapid turnover in certain individuals is not yet clear, bone markers and BMD may be useful to identify those who are at higher risk and need special attention.

**References**