Original Article

Bone mineral density in adults in Taiwan: results of the Nutrition and Health Survey in Taiwan 2005-2008 (NAHSIT 2005-2008)

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Osteoporosis is one of the most prevalent global health problems in the elderly. A nationwide representative sample of 1121 adult subjects, aged 19 years and older, were scanned by a dual-energy X-ray absorptiometry in the third survey year of Nutrition and Health Survey in Taiwan 2005-2008. There was an apparent gender difference in the trend of bone mineral density (BMD) with age. In males, the decrease in BMD with age at lumbar spine and at femoral neck were statistically significant in those younger than 50 years, whereas the decrease in BMD at forearm was significant only in those aged 50 years and older (β= -0.005, p<0.0001). In females there was a significant negative correlation between BMD at femoral neck and age (β= -0.004, p<0.0001). In the 236 subjects aged 50 years and older, the prevalence rates of osteoporosis were 4.3% at lumbar spine, 12.0% at femoral neck, and 11.6% at forearm in males, and 12.6% at lumbar spine, 18.1% at femoral neck, and 25.0% at forearm in females, respectively. The prevalence rates of osteoporosis at any site were 23.9% in males and 38.3% in females, respectively. The prevalence rates of low bone mass at lumbar spine, femoral neck, and forearm were 28.8%, 57.5%, and 22.7% in males and 34.7%, 45.9%, and 26.1% in females, respectively. Effective measures to maintain bone health and/or to reduce excessive bone loss may be important in the prevention of osteoporotic fractures in Taiwanese adults.

Key Words: NAHSIT, bone mineral density, osteoporosis, lumbar spine, femoral neck

INTRODUCTION

The elderly population in Taiwan has been expanding rapidly in recent years as a result of the development in economy, social welfare, and medical care systems. The percentage of elderly population aged 65 years and older has reached 10.4% in 2008, and is estimated to exceed 20% by 2025.[1,2] Many of the aging-related diseases thus have become important public health issues in the country. Osteoporosis is a disease characterized by systemic loss of bone mineral that would result in subsequent increase in the risk of fracture. Although osteoporotic fractures are usually not fatal, the risk of post-fracture mortality due to complication and loss of independence that results from hip fractures may have a huge impact on the life expectancy and/or quality of life of the elderly.

The bone sites that are mostly susceptible to osteoporotic fractures are lumbar spine, hip (femoral neck), and wrist (distal forearm). In over two million cases of fracture recorded in 2005, in the United States, 550,000 cases occurred at the lumbar spine, 400,000 cases at the wrist, and nearly 300,000 cases at the hip, respectively. The annual medical cost for the treatment and long-term care of patients with osteoporotic fractures is estimated to be at least 14 billion dollars.[3] Chie *et al.* have reported in 2004 that based on the National Health Insurance database, the age-adjusted (to U.S. white population in 1989) 5-year incidence rates of hip fracture in 1996-2000 in Taiwanese men is $225/10^5$, which appears to be higher than that in Caucasian Americans ($187/10^5$), whereas the rate in Taiwanese females seems to be slightly lower than that in Caucasian Americans (505 vs $535/10^5$), respectively.[4]

Although there are only a few local reports on bone mineral density assessment in hospital settings in Taiwan, no data on a nationwide representative subjects has been available so far. In the previous Nutrition and Health Survey in the Elderly in Taiwan 1999-2000 (NAHSIT Elderly 1999-2000), bone mass at heel of the elderly subjects in Taiwan was assessed by a portable quantitative ultrasound device.[5] In the latest Nutrition and Health Survey in Taiwan 2005-2008 (NAHSIT 2005-2008), a mobile dual-energy X-ray absorptiometry (DXA) device has been employed to collect bone mineral density measurement

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from a subset of nationally representative subjects, and the data were analyzed and presented in the current study. To our knowledge, this is the first attempt in Taiwan to acquire bone mass data from a nationwide group of subjects for better understanding of bone health, and the prevalence of osteoporosis, in Taiwanese adults.

MATERIALS AND METHODS

Design

Data was collected through the Nutrition and Health Survey in Taiwan 2005-2008, an island-wide survey conducted to investigate the nutrition and health status of the general people aged 0-6 years, and 19 years and older in Taiwan. The 359 townships or city districts in Taiwan were classified into 8 strata according to the characteristics of dietary pattern, geographical location, and population density. These 8 strata were the Hakka areas, the mountain areas, the eastern areas, the Peng-Hu Islands, Northern areas Class I & II districts/townships, Central areas, and Southern areas. The sampling procedure is briefly described as below: within each stratum eight districts/villages were sampled with selection probability proportional to population sizes (PPS). In each of selected districts/villages, two geographical locations were selected by systematic sampling as the first household of a region. The interviewers then constructed a list of household addresses and demographic information of the household members for the next a few neighboring households. Door-to-door visits were carried out to interview a designated number of people in each of the pre-determined age-gender groups. A pseudo-Latin square design was used to control for the effects of season and year, and the details are described elsewhere.[6] The study was approved by reviewers from the Human Subject Research Ethics Committee, Academia Sinica in Taiwan, and informed consent has been signed by each participant or guardian. The survey consisted of questionnaire interviews and physical examinations. Overall a total of 6189 subjects were interviewed, which corresponds to a response rate of 65%. Because the lengthy process in applying the approval of the authorities for building a mobile DXA and for scanning human subjects, measuring bone mass by DXA had not been feasible until the 3rd survey year, and the number of subjects with DXA bone scan was therefore much less. In the present study, the adult participants aged 19 years and older who had complete physical examination data with DXA bone scan were included.

Measurements

Bone mineral content (BMC, in g) and bone mineral density (BMD, in g/cm^2) were measured by a DXA (Prodigy, GE Lunar Health Care, Wisconsin, U.S.A.) at total body, lumbar spine 1-4, femoral neck, and forearm (radius and ulna). All subjects were examined by the same device during the survey. Calibration of the densitometry using a phantom was performed prior to the first scan each day. T-score for BMD was generated based on a data set form the Chinese population. Other anthropometric measurements were taken in physical examination sessions. Height without shoes and body weight was measured to the nearest 0.1 cm and 0.1 kg, respectively, and the weight of clothes were estimated and deducted from the results. Body mass index (BMI, body weight in kg by height in m^2) was calculated.

Statistical analysis

All variables were weighted to represent the adult population in Taiwan. Data on the values of peak young mean BMD are not available in Taiwan at present, therefore the T-scores of BMD were calculated based on the reference data from the Chinese population in China,[7] provided by the manufacturer of the DXA device. Osteoporosis is defined as BMD T-score equal to or lower than -2.5 at lumbar spine, femoral neck, and/or 1/3 radius of the non-dominant forearm in those aged 50 years and older. Regression analyses were performed to evaluate the association between the BMD measurement and the possible related anthropometric factors. All statistical analyses were performed using SAS for Windows version 9.1 and SAS-Callable SUDAAN version 10.0.

RESULTS

The characteristics of the eligible subjects are shown in Table 1. Overall, there were 554 males and 567 females who completed the total body scan.

Table 2 lists the mean BMD at total body and specific sites by gender and age groups. In the age groups younger than 30 years, BMD at lumbar spine was not significantly different between males and females. BMD at forearm (1/3 radius), however, significantly differ between genders in all age groups.

The relationships between age, body weight, and/or height and BMD were examined by linear regression analyses, and the model with the highest coefficient of determination (R^2) was considered the best one for each bone site. As shown in Tables 3 and 4, BMD at all sites were negatively predicted by age and positively predicted by body weight in both genders, whereas height was positively related to BMD only at forearm. In males, 14.3% of

Table 1. Characteristics of the subjects by gender and age groups

	Males				Females			
	n	Weight (kg)	Height (cm)	BMI (kg/m2)	n	Weight (kg)	Height (cm)	BMI (kg/m2)
Age group, yr								
19-	77	65.9±1.7**	171.8±1.4**	22.3±0.5	84	55.0±1.2	158.9±0.8	21.7±0.4
30-	51	74.5±1.4**	172.3±0.6**	25.0±0.5*	68	55.8±1.6	157.7±0.4	22.4±0.6
40-	102	68.5±0.3**	167.6±0.5**	24.4±0.2	97	59.2±1.5	155.2±0.5	24.6±0.6
50-	111	68.8±1.2**	165.8±0.5**	25.0±0.3	120	58.9±0.8	154.8±0.4	24.6±0.2
60-	84	66.6±0.9**	164.9±0.9**	24.4±0.2	98	58.7±1.0	151.9±0.6	25.4±0.5
70-	104	65.5±3.1*	164.3±1.2**	24.1±0.9	84	57.2±1.0	150.3±0.4	25.3±0.5
80+	32	63.4±1.8*	159.7±1.2*	24.8±0.6	16	56.2±1.9	147.2±3.5	25.9±0.7
Total	554	68.9±0.7**	168.8±0.6**	24.1±0.2	567	57.3±0.6	155.8±0.2	23.6±0.2

Significantly different between genders in the same age group *p<0.05, **p<0.0001

Table 2. Age-specific bone mineral density at total body, the posterior-anterior lumbar spine (L1-L4), and 1/3 forearm by gender

	Males						Females					
	n	Total body	n	Spine L1-L4	Femoral neck	Forearm (1/3 Radius)	n	Total body	n	Spine L1-L4	Femoral neck	Forearm (1/3 Rdius)
Age group, yr												
19-	77	1.20±0.02*	31	1.13±0.04	0.99±0.04*	0.94±0.01*	84	1.13±0.01	28	1.09±0.02	0.88±0.02	0.84±0.01
30-	51	1.19±0.01	18	1.08±0.02*	0.90±0.02	0.97±0.02**	68	1.18±0.03	30	1.15±0.01	0.93±0.01	0.87±0.02
40-	102	1.13±0.03	31	0.97±0.03*	0.82±0.02*	0.93±0.01*	97	1.18±0.04	40	1.13±0.01	0.93±0.01	0.86±0.01
50-	111	1.14±0.02*	40	1.00±0.03	0.85±0.01	0.95±0.004*	120	1.08±0.01	39	0.98±0.03	0.82±0.03	0.81±0.03
60-	84	1.15±0.02**	38	1.01±0.03*	0.82±0.01	0.92±0.01**	98	0.99±0.04	35	0.87±0.02	0.76±0.03	0.70±0.01
70-	104	1.12±0.03*	36	1.00±0.04*	0.81±0.02*	0.83±0.02**	84	0.97±0.03	29	0.87±0.03	0.68±0.02	0.61±0.02
80+	32	1.21±0.06*	14	1.14±0.05*	0.73±0.02*	0.81±0.03*	16	0.92±0.03	5	0.84±0.04	0.58±0.04	0.55±0.05
Total	554	1.17±0.01*	208	1.05±0.02	0.88±0.02	0.93±0.01**	567	1.11±0.01	206	1.05±0.01	0.86±0.01	0.82±0.01

Significantly different between genders in the same age group *p<0.05, **p<0.0001

Table 3. Regression of anthropometric variables on BMD at total body, lumbar spine (L1-L4), femoral neck and forearm in males† (β)

Variable site	Age (yr)	Body weight (kg)	Height (cm)	Intercept	R^2
Total Body	-0.001*			1.223	0.026
	-0.001*	0.004**		0.941	0.143‡
	-0.001*		0.004	0.595	0.050
LS1-4	-0.002*			1.148	0.056
	-0.002*	0.003*		0.961	0.089
	-0.002*		-0.0004	1.223	0.056
	-0.003**	0.004*	-0.004	1.556	0.100‡
Femoral Neck	-0.004*			1.072	0.207
	-0.004**	0.004*		0.811	0.290
	-0.003*		0.004	0.306	0.235
	-0.004**	0.004*	0.001	0.643	0.292‡
Forearm	-0.003*			1.049	0.212
	-0.002*	0.003*		0.795	0.238
	-0.001*		0.004*	0.301	0.161
	-0.002*	0.003*	0.002	0.556	0.244‡

†BMD, bone mineral density in g/cm^2. Forearm BMD is BMD at 1/3 radius.

‡Model with the best coefficient of determination generated by the regression of combining age and/or body weight and/or height on BMD.

* p<0.05; ** p<0.0001

Table 4. Regression of anthropometric variables on BMD at total body, lumbar spine (L1-L4), femoral neck and forearm in females† (β)

Variable site	Age (ys)	Body weight (kg)	Height (cm)	Intercept	R^2
Total Body	-0.004**			1.274	0.182
	-0.004**	0.004*		1.062	0.267
	-0.003*		0.001	1.056	0.181
	-0.004*	0.004*	-0.002	1.350	0.272‡
LS1-4	-0.005**			1.295	0.293
	-0.006**	0.003*		1.108	0.351
	-0.006**		-0.001	1.425	0.294
	-0.007**	0.004*	-0.005*	1.848	0.373‡
Femoral Neck	-0.004**			1.064	0.244
	-0.005**	0.004**		0.843	0.358
	-0.004**		0.003	0.620	0.256
	-0.005**	0.004**	-0.001	1.035	0.360‡
Forearm	-0.004**			0.999	0.286
	-0.005**	0.004**		0.805	0.397
	-0.004**		0.004*	0.325	0.319
	-0.004**	0.003**	0.001	0.645	0.398‡

†BMD, bone mineral density in g/cm^2. Forearm BMD is BMD at 1/3 radius.

‡Model with the best coefficient of determination generated by the regression of combining age and/or body weight and/or height on BMD.

* p<0.05; ** p<0.0001

the variation in total body BMD can be explained by the variation in age as well as body weight, whereas the best models to predict the BMD at spine L1-L4, femoral neck, and forearm are the combination of age, body weight, and height, such that by which 10.0%, 29.2%, and 24.4% of variation in BMD are accounted for, respectively. In females, the combination of age, body weight, and height account for 27.2%, 37.3%, 36.0% and 39.8% of the variation in BMD at total body, spine L1-L4, femoral neck, and forearm, respectively.

The relation of BMD to age at total body and specific sites are illustrated in Figures 1-4. In males, BMD at all sites is negatively related to age in a linear manner. In contrast, the negative relationship between age and BMD appeared to be a non-linear pattern in females, and the coefficients of determination (R^2) of the non-linear regression models are larger than those of the simple linear models of age on BMD at all sites (Table 3).

The distribution of BMD T-scores below -1 at specific sites is shown in Table 5 for the subjects aged 50 years and older. According to the diagnosis criteria for osteoporosis by WHO, the percentages of BMD T-score equal to or lower than -2.5 (definition for osteoporosis) in males and females are 4.3% and 12.6% at spine L1-L4, 12.0% and 18.1% at femoral neck, and 11.6% and 25.0% at forearm, respectively. The percentages of females with "low bone mass", ie, BMD T-score below -1 but greater than -2.5, are 34.7%, 45.9%, and 26.1% at lumbar spine, femoral neck, and forearm, respectively. The prevalence rate of low bone mass is 57.5.0% at femoral neck in males. At all sites there are more females than males with BMD T-scores below -2.5.

Table 6. Percentage of subjects with at least one BMD T-score≤-2.5 by gender and age group

Age group	Males	Females
50-	12.5	21.0
60-	18.6	50.3
70-	45.4	63.7
80+	49.6	100.0
Total	23.9	38.3

The prevalence rates of having BMD T-score below -2.5 at any of the three specific sites (spine L1-L4, either side of the femoral neck, and either forearm) are listed in Table 6. In females, the rates were higher than 50% in all age groups 60 years and older, and more than 63% of the women aged 70 years and older had at least one BMD T-score below -2.5 at the specific sites. In men the highest prevalence rate was higher than 45% in those aged 70 years and older. Overall, the rates were 23.9% in males and 38.3% in females, respectively.

The prevalence rates of osteoporosis in the USA and other Asian countries were presented in Table 7. There were discrepancies in the age distribution of subjects, and regions of interest scanned and analyzed among different countries. In general, the prevalence rate of osteoporosis in Taiwanese adults aged 50 years and older were higher than that observed in NHANES 2005-2006, but were relatively lower than those found in the Thais and the Japanese. The prevalence rate of osteoporosis at lumbar spine in Taiwanese males was slightly lower than those of Hong Kong and Korea, whereas the rate in females was higher than that of females in Hong Kong.

Table 5. Percentages of BMD T-score† distribution below -1 at specific sites by gender and age group (%)

	Males						Females					
	LS1-4		Femoral neck		Forearm		LS1-4		Femoral neck		Forearm	
	≤ -2.5	-2.5 - -1	≤ -2.5	-2.5 - -1	≤ -2.5	-2.5 - -1	≤ -2.5	-2.5 - -1	≤ -2.5	-2.5 - -1	≤ -2.5	-2.5 - -1
Age group												
50-	0.2	24.8	4.1	54.6	8.3	13.4	3.6	23.6	7.9	41.8	4.6	18.5
60-	4.8	32.1	16.2	56.2	3.4	22.0	26.9	43.1	17.5	50.3	31.3	47.5
70-	11.1	35.9	15.2	62.0	23.6	38.6	17.3	47.8	40.7	55.1	62.0	16.4
80+	7.2	20.7	33.2	66.7	29.0	37.8	1.2	98.8	98.8	1.2	100.0	0
Overall	4.3	28.8	12.0	57.5	11.6	22.7	12.6	34.7	18.1	45.9	25.0	26.1

†according to the diagnostic criteria by WHO, osteoporosis is defined as T-score equal to or lower than -2.5, and low bone mass (osteopenia) is defined as T-score between -1 and -2.5.

Table 7. Prevalence of osteoporosis in the USA and other Asian countries

Country/Area	Year	Sample size	Study sites and prevalence of osteoporosis
NHANES (USA)[16]	2005-2006	50 years+ adults (874 males and 740 females)	Prevalence at femoral Neck: 2% in males 10% in females
Vietnam[19]	2003	2368 adult females aged 20 years+ (1037 aged older than 50)	Prevalence for females 50+ years: 29.5%
Thailand[20]	2001	1935 females aged 40-80 years	Prevalence for postmenopausal females: 39% at lumbar spine; 30% at femoral neck
Japan[21]	2001	4550 females aged 15-79 years (1522 aged 50+ years)	Prevalence for 50+ years: 27.6% at lumbar spine; 17.0% at femoral neck; 35.4% at 1/3 radius
Hong Kong[22]	2005	Chinese aged 9-94 years (1859 males and 2415 females)	Prevalence for 50+ years: Lumbar spine: 7% in males; 7% in females Femoral neck: 6% in males; 16% in females
Korea[23]	2004-2005	4292 adults aged 20-79 years (50+ years: 1424 males and 1806 females)	Prevalence for 50+ years: Lumbar spine: 6.5% in males; 40.1% in females Femoral neck: 5.9% in males; 12.4% in females

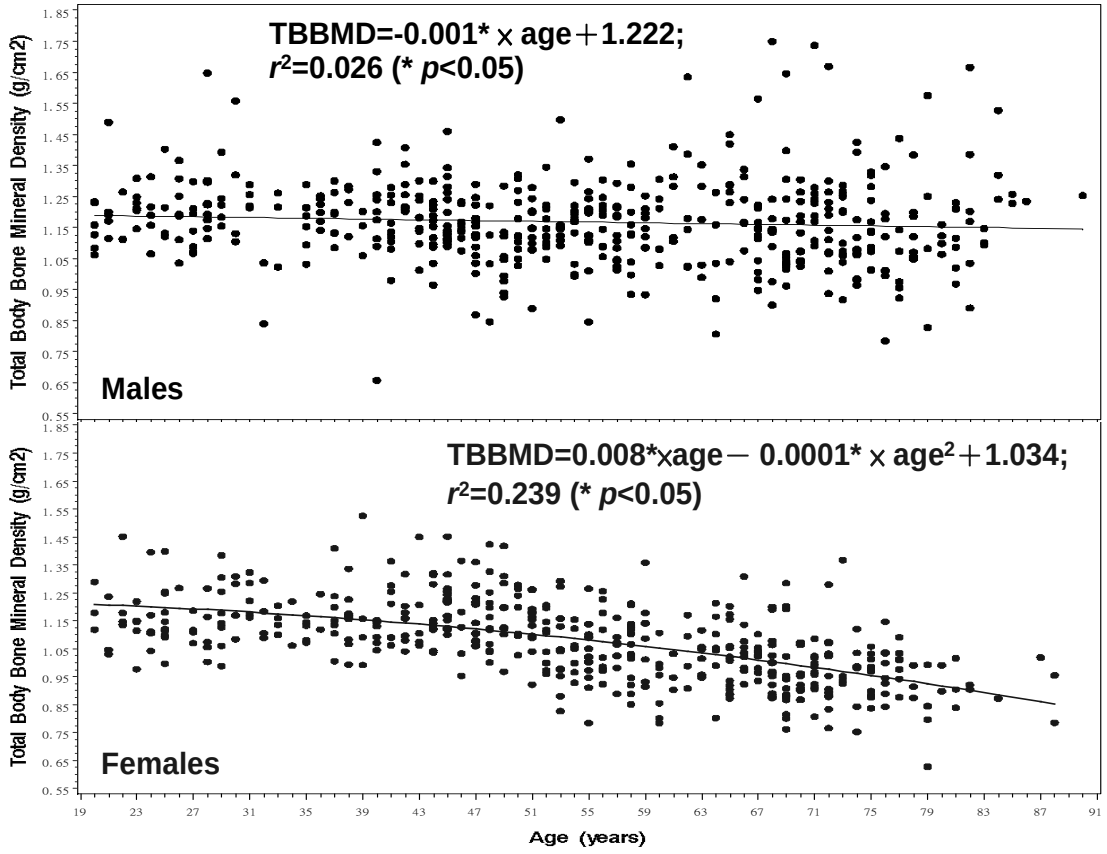

Figure 1. Relation of age to total body BMD

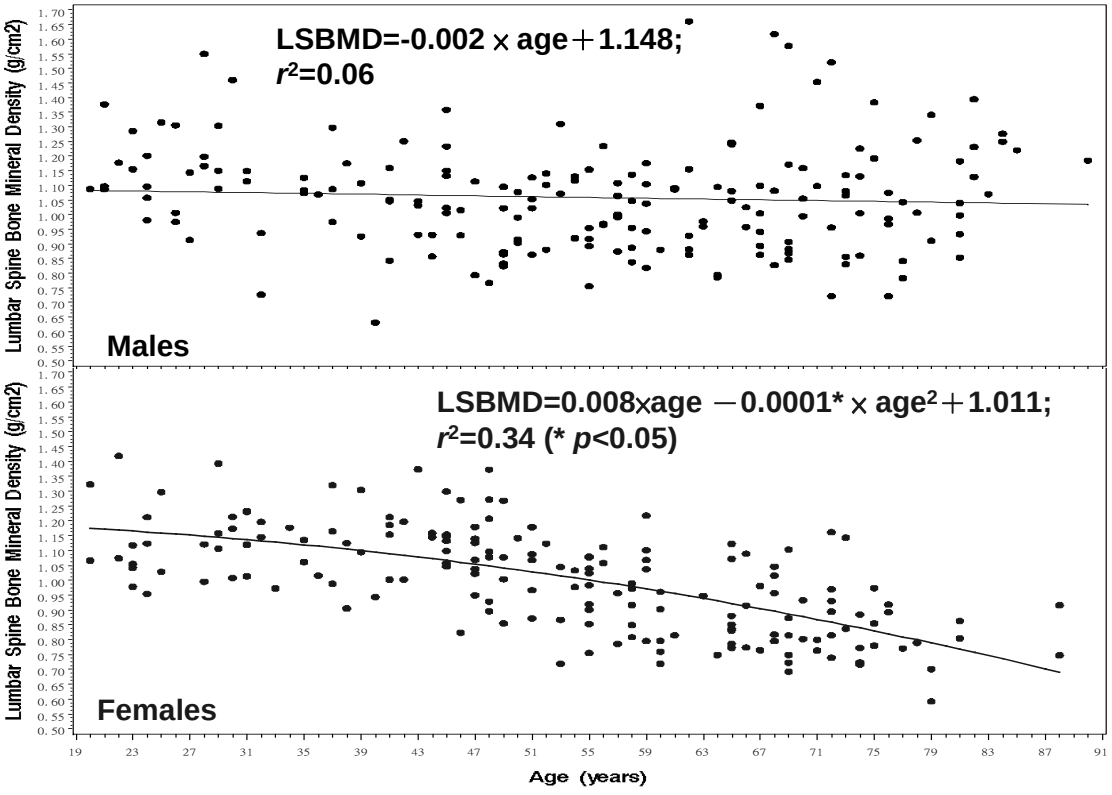

Figure 2. Relation of age to BMD at lumbar spine L1-4

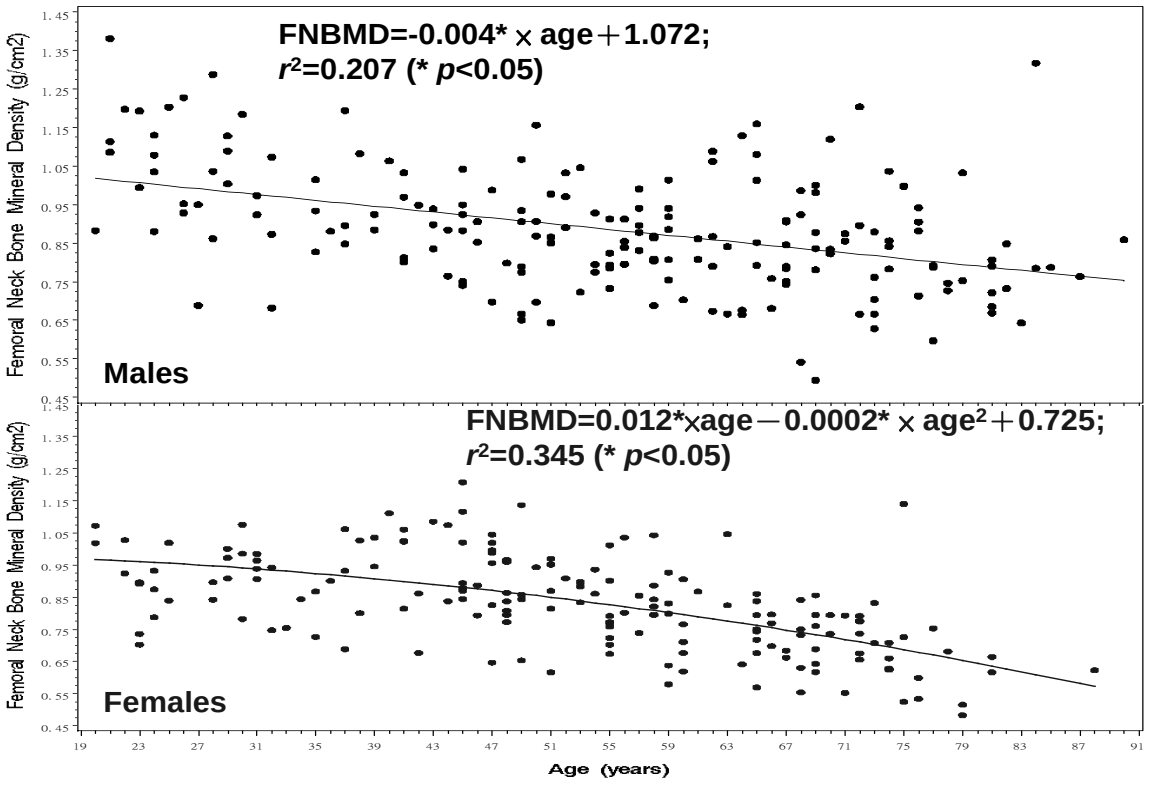

Figure 3. Relation of age to BMD at femoral neck

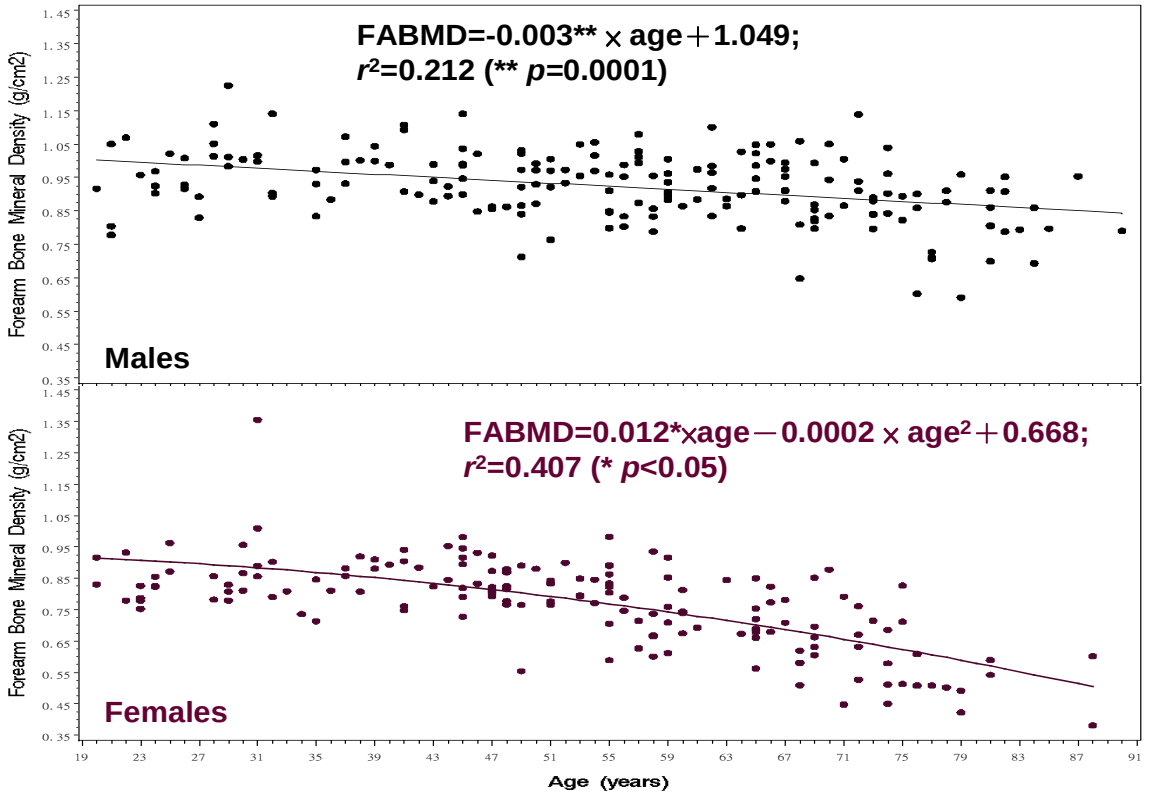

Figure 4. Relation of age to BMD at forearm

DISCUSSION

In this Nutrition and Health Survey 20054-2008, DXA has been employed for the first time in Taiwan to investigate bone health status of a nation-wide sample. The results showed that in subjects aged between 30 to 50 years there was no significant gender difference in total body BMD, yet the mean BMD at lumbar spine and femoral neck were lower in males than in females. Previously in the studies by Tsai *et al.* it has been shown that younger males appear to have larger bone area that the areal bone mineral density generated by DXA scan may thus be lower in males than in females.[8,9] The gender differences in BMD at total body, lumbar spine, and femoral neck were more statistically significant in older subjects may partially be explained by postmenopausal bone loss in females. The true differences in BMD between males and females, however, may not be fully reflected in the current analysis due to the insufficient numbers of subjects in certain gender-age subgroups. For example, there were only 18 males in the 30-39.9 years and only 5 females in the 80+ years subgroups, respectively.

Earlier in 1997, Tsai *et al.* reported that in a sample of 223 males and 604 females living in Taipei, the L2-L4 spine BMDs are 0.98±0.14 and 1.06±0.13 g/cm^2 in males and females younger than 51 years of age, respectively; and are 0.98±0.16 and 0.85±0.16 g/cm^2 in males and females aged 51 years or older, respectively.[8] In the subjects of the current study, the BMD at L2-L4 spine would be 1.20±0.03 and 1.25±0.01 g/cm^2 in males and females younger than 50 years of age, respectively; and 1.20±0.01 and 1.03±0.03 g/cm^2 in males and females older than 50 years, respectively. The results were higher for both genders than those reported by Tsai et al., which may be in part due to the cohort effect. In addition, the subjects in the current analysis were of a representative sample from people residing in different geographical regions in Taiwan that may differ from the residents of Taipei city in many aspects.

The results of regression analyses show that in Taiwanese adults aged 19 years and older, BMD at all sites measured were highly correlated with age and body weight. In females, there appeared to be significantly negative non-linear associations between age and all BMD measurements (Figures 1-4). Height was not a significant explanatory factor for variation in BMD, except at forearm, when age was controlled, and the significance no longer existed when body weight was also adjusted (Tables 3 and 4). Nevertheless, although statistically insignificant, there appeared to be a negative association between height and BMD at lumbar spine in both genders when age was adjusted, .and in females this negative relationship became statistically significant after both age and body weight were considered (Table 4). Age and low body weight are well-known risk factors for low bone mass and osteoporosis, and the relationships between age and BMD are not quite the same in males and in females that may explain, at least in part, the gender difference in the prevalence of osteoporosis. On the other hand, previous findings on the relation of height to BMD are relatively inconsistent. It has been suggested that BMD are higher in taller young females.[10,11] In older women, however, body weight rather than height may be a more important predictor for BMD in addition to hormonal (estrogen) status.[12] In a recent systematic review in 2009, Papaioannou *et al.* reported that height or loss of height are not associated with low bone mass in males aged 50 years and older.[13] Tsai has reported that gender, height, body weight, and age are all related to bone area, and it has been suggested that the true volumetric bone mineral density may be influenced by bone area.[8,14] It may be necessary to analyze in depth whether the relations of height, weight, and/or BMI to BMD vary by age groups and/or genders in our population.

Ethnicity is a known factor influencing bone mass and the risk of osteoporosis as well. It has been shown that African Americans usually have higher BMD and thus lower prevalence rates of osteoporosis and fractures, compared to Caucasians; whereas BMD and the risk of osteoporosis of the Hispanics are in between those of the African Americans and non-Hispanic Caucasians, and BMD in the Chinese appears to be similar or slightly lower than that in non-Hispanic Caucasians.[7,15] Table 8 listed the comparison of the mean femoral neck BMD between subjects aged 50 years and older in our current survey to that observed in NHANES 2005-2006.[16] Except in women aged older than 80 years, the mean femoral neck BMD in every other gender-age group was similar to or somewhat higher than that observed in NHANES 2005-2006. The overall mean femoral neck BMD of subjects 50 years and older was slightly higher than those of the non-Hispanic Caucasians and the Mexican Americans but lower than that of non-Hispanic African Americans.

Table 8. Comparison of femoral neck BMD in subjects 50 years and older between NAHSIT 2004-2008 and NHANES 2005-2006

	Males					Females				
	NAHSIT 2005-2008		NHANES 2005-2006[16]			NAHSIT 2005-2008		NHANES 2005-2006[16]		
	n	Mean±SE		n	Mean±SE	n	Mean±SE		n	Mean±SE
Age group, yr										
50-59	40	0.854±0.014		271	0.833±0.009	39	0.824±0.033		235	0.763±0.012
60-69	38	0.817±0.014		273	0.813±0.009	35	0.758±0.028		241	0.729±0.007
70-79	36	0.804±0.024		203	0.768±0.015	29	0.675±0.021		157	0.664±0.006
80+	14	0.740±0.019		127	0.733±0.013	5	0.577±0.041		107	0.623±0.010
50+ overall	126	0.825±0.012	Non-Hispanic Whites	530	0.803±0.004	108	0.771±0.019	Non-Hispanic Whites	437	0.714±0.005
			Non-Hispanic Blacks	179	0.889±0.013			Non-Hispanic Blacks	146	0.786±0.012
			Mexican Americans	130	0.807±0.011			Mexican Americans	120	0.761±0.015

Nevertheless, the number of subjects in our current survey was fewer than that recruited for NHANES 2005-2006. It would be necessary to recruit more subjects of different age groups in the future surveys for a more precise comparison among the different ethnic groups.

Yang and colleagues have attempted to estimate the prevalence of osteoporosis on a sample from the National Health Insurance database and reported that in 1999-2001, the averaged prevalence rates of osteoporosis in Taiwanese adults aged 50 years and older are 1.63% in men and 11.4% in women, respectively,[17] which appear to be much lower than the findings in the current NAHSIT. The results of an analysis on women dwelling in Taipei by Yang *et al.* showed that based on the WHO diagnostic criteria for DXA BMD scan, the prevalence rates of osteoporosis at lumbar spine and femoral neck increase from 8.25% and 5.24% in women aged 40-49 years to 16.1% and 24% in those aged 80 years and older, respectively, and the overall prevalence rates are 10.1% at lumbar spine and 7.45% at femoral neck, respectively.[18] The prevalence rates are lower than those from other local studies. Nonetheless, the reason that the prevalence of osteoporosis observed in the current NAHSIT is higher than those previously estimated from either the National Health Insurance database or based on DXA testing may be at least in part due to the sampling scheme and number of subjects. In addition, the number of subjects with complete DXA scan at specific sites was much less than those in other countries. It will be necessary to recruit an adequate number of participants for complete DXA scan in future surveys to estimate the prevalence of osteoporosis more precisely, and to better understand the relationship between BMD and fracture risk in our population. However, it is still important for the elderly to be aware of environmental safety to prevent osteoporotic fractures resulted from falling and/or accidental injuries.

AUTHOR DISCLOSURES

Yi-Chin Lin and Wen-Harn Pan, no conflict of interest.

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Original Article

Bone mineral density in adults in Taiwan: results of the Nutrition and Health Survey in Taiwan 2005-2008 (NAHSIT 2005-2008)

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臺灣地區 19 歲以上成人骨密度狀況分析

骨質疏鬆是一種系統性骨質流失的現象，導致骨礦物密度(bone mineral density)降低，骨骼的微細結構遭到破壞而增加發生骨折的危險性，是老年人常見的疾病之一。此次 2005-2008 年的臺灣營養健康家戶調查(NAHSIT)中，在第三調查年度以雙能量 X-光骨密度儀(DXA)對 1121 位 19 歲(含)以上之參與民眾進行骨密度掃描並分析。結果顯示，男女兩性在全身及各部位骨礦物密度之年齡趨勢有差異。男性在 50 歲以前，在腰椎及股骨頸之骨密度隨年齡增長而降低之趨勢較 50 歲以後顯著；而前臂之骨密度則在 50 歲以上者有顯著隨年齡增加而降低的情形。女性方面，股骨頸骨密度明顯隨著年齡越大而降低，至於全身、腰椎及前臂骨密度隨年齡增長而降低的情形在 50 歲以上者較為顯著。此外，參考世界衛生組織所訂定之骨質疏鬆症診斷標準以及國際臨床骨密度儀學會(ISCD)的建議，以 236 位 50 歲以上有腰椎、股骨頸、及前臂三部位骨密度掃描者之資料分析顯示，在上述三部位有骨質疏鬆者分別為腰椎：男性 4.3%、女性 12.6%；股骨頸：男性 12.0%、女性 18.1%；前臂：男性 11.6%、女性 25.0%。有任一部位為骨質疏鬆者，男性有 23.9%、女性為 38.3%。未達骨質疏鬆但已屬「低骨密度(low bone mass)」者，在腰椎有 28.8%的男性及 34.7%的女性、股骨頸部位男性為 57.5%、女性 45.9%；前臂則有 22.7%的男性及 26.1%的女性。骨質疏鬆與年輕時骨量的累積及中老年期骨質流失的速率有關；國人應注意骨骼保健，並預防因跌倒而引發骨質疏鬆性骨折。

關鍵字：骨質疏鬆、骨礦物密度、腰椎、股骨頸、DXA、臺灣營養健康家戶調查