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CLINICAL EPIDEMIOLOGY OF OSTEOPOROSIS AMONG ELDERLY FISHING AND AGRICULTURAL POPULATION IN TAIPEI, TAIWAN

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ABSTRACT

Purpose

This article is aimed to evaluate through quantification the prevalence and related aspects of osteoporosis among the aging people working in the fishing and agricultural areas in Taipei, Taiwan.

Methods

The population (n=4360) aged 65 years and above and who were admitted to a teaching hospital for a physical examination in 2010 were involved in this study. Osteoporosis is defined as bone mineral density (BMD) of 2.5 standard deviation (SD) or more under the young adult mean value (−2.5 SD or inferior).

Results

The population presented an over-occurrence of osteoporosis, scoring 34.4%, and exposed a statistically important rise with cumulative age (P<0.001). Female population displayed a higher incidence than male population (48.1% vs. 26.4%; P<0.001). The age-specific frequency of osteoporosis in 65–74 years, 75–84 years, and ≥85 years was 27.7, 40.0, and 56.7%, respectively. The multinomial logistic regression showed that age (odds ratio [OR]=1.07, 95% confidence interval [CI]: 1.06–1.09), body height (OR=0.98, 95% CI: 0.97–0.99), body weight (OR=0.97, 95% CI: 0.95–099), waist circumference (OR=1.02, 95% CI: 1.00–1.03), total cholesterol (OR=1.01, 95% CI: 1.00–1.02), uric acid (OR=0.90, 95% CI: 0.85–0.95), and regular habits of meat intake (OR=1.47, 95% CI:1.19–1.75) were statistically significantly associated with osteoporosis.

Conclusion
Numerous medical aspects were individualistically specified, relating the occurrence of osteoporosis in the elderly among the population involved in fishing and agriculture.

Key Words: *agricultural and fishing population; elderly; osteoporosis; prevalence*

INTRODUCTION

Nowadays, osteoporosis is one of the most common diseases among the elderly worldwide.[1] People with osteoporosis may not be aware that their bones are getting weaker since it is a silent disease.[2] Not until the patients suffer from fractures in their hips, spines, wrists, or other bones do they know that their own health condition is deteriorating.[3] Patients with osteoporosis not only face painful experiences but also have greater risk of serious disability or even death.[4] In addition, the clinical care of this chronic disease costs lots of money, efforts, and medical resources.[5] As the number of elderly population grows continuously, osteoporosis may cause an increasing burden on society and healthcare systems. Therefore, it is important to have appropriate strategies to assess the state of health.

Osteoporosis is determined by several risk factors. Higher blood glucose concentration is one of the common symptoms of osteoporosis among female patients.[6,7] Previous studies also indicated a positive relationship between higher uric acid levels and higher spine bone mineral density (BMD) in men and in peri- and postmenopausal women.[8,9] Low body weight is considered as another important risk factor for osteoporosis in healthy 40–60-year-old women.[10] In addition to some health conditions, daily intake habits and personal life style are also associated with the morbidity of osteoporosis. An intake of dairy products and fruits may decrease the risk of osteoporosis in postmenopausal women.[11] Smoking also contributed to fracture among postmenopausal women.[12]

These consequences give us some indicators to evaluate the probability of suffering from fractures due to osteoporosis; however, most of these researches apply only to postmenopausal women. It is possible to observe from factors related to preventive medicine perspective; it is not only vital to be aware of the contextual morbidity of osteoporosis locally but also to sightsee the whole range of demographic and biological indicators that could be linked with osteoporosis. Due to some ambiguity around the frequency and the related threat, aspects of osteoporosis expose gender dissimilarity among elderly work-related subjects. Therefore, to recognize the commonness of and related elements of osteoporosis, this research was conducted. In an effort to discover the potential for condition-related gender variance, it was measured such that dissimilarity might emphasize significant repercussions for comprehending the general pathogenesis of osteoporosis among the elderly agricultural and fishing population in Taipei, Taiwan.

METHODS

Data Resource and Data Collection

A total of 4360 healthy occupational adults in agricultural and fishing professional fields, aged 65 years and over, were involved in this cross-sectional study. They willingly assisted to one teaching hospital in Northern Taiwan for a yearly physical examination between January 1, 2010 and December 31, 2010. All actions and patients' data were accomplished in agreement with the procedures of the institutional ethics committee and followed the guidelines of the Declaration of Helsinki.

The medical histories and measurements of the participants were obtained by well-trained nurses. Personal and family histories of hypertension,

type 2 diabetes, cardiovascular diseases, and other chronic diseases were obtained by a structured health interview questionnaire. The study participants were asked to take off the shoes and any other belongings that could possibly add extra weight when they were weighed. Body mass index (BMI) was evaluated according to heights and weights. In addition, the waist perimeter was stated at the level of the iliac procedures and the umbilicus with a lax tape quantity to guesstimate abdominal obesity.

For each person, blood pressure was measured twice in the sitting position, with an intermission of 15 min between the measurements, by the average earnings of sphygmomanometer of suitable measurement, after a break period for 30 min. Patients undergoing antihypertensive therapy were examined to measure hypertension.

Fasting blood samples were strained via venipuncture from the study participants by medical nurses. Overnight-fasting serum and plasma samples (from whole blood preserved with Ethylenediaminetetraacetic acid (EDTA) and NaF) were retained ice-covered (−20°C) until they are prepared for examination. BMD was examined by dual energy X-ray absorptiometry (DXA). Osteopenia was defined as BMD being between 1 and 2.5 standard deviation (SD) below the young adult mean value. Likewise, osteoporosis was defined as BMD being 2.5 SD or more below the young adult mean value.[13] Metabolic syndrome was identified according to The US National Cholesterol Education Programme Adult Treatment Panel III (NCEP ATP III) standards, that is, at least three of the subsequent five constraints should be extant: abdominal obesity (waist circumference>90 cm for males), hypertension (systolic blood pressure [SBP] >130 mm Hg and/or diastolic blood pressure [DBP] >85 mm Hg) or history of antihypertensive practice, hypertriglyceridemia (≥150 mg/dL) or incidence of action for this condition, low high density lipoprotein cholesterol (HDL-C) (<40 mg/dL in males) or existence of treatment for this condition, and high fasting plasma glucose (>100 mg/dL) or incidence of finding of type 2 diabetes.[14,15]

Statistical Analysis

Statistical analysis was achieved via SPSS for Windows (SPSS version 18.0; Chicago, IL, USA). One-way analysis of variance (ANOVA) system was approved to evaluate alterations in the mean rate of constant variables. The χ^2-trend test was utilized to regulate important variances in quantities among definite variables. Multinomial logistic regression is the addition for the (binary) logistic deterioration when the categorical dependent outcome has more than two stages.[16] This technique was also accomplished to deliver a number of measurements for each of the two contrasts of osteoporosis and to inspect the individuality of features related to the frequency of osteoporosis. A P-value of <0.05 was reflected to characterize a statistically noteworthy dissimilarity among the examined population.

RESULTS

Table 1 shows the sex- and age-specific prevalence of osteopenia and osteoporosis among the elderly study participants. The results indicated the prevalence of osteopenia and osteoporosis for the study population to be 37.8% and 34.4%, respectively. Under the circumstance of osteoporosis, the prevalence for women proved to be higher than for men (48.1% vs. 26.4%, P<0.001 for χ^2 test). From the Cochran–Armitage trend test, the prevalence of osteoporosis showed a statistically significant increase with increasing subjects' age by means of the χ^2 trend test (P<0.001).

Table 2 shows the demographic and biochemical features of the contributors who were and were not screened with abnormal BMD. In addition to age (P<0.001), height (P<0.001), weight (P<0.001), BMI (P<0.001), waist circumference

TABLE 1 The Sex- and Age-Specific Prevalence of Osteoporosis among the Elderly Agricultural and Fishing Screened Subjects (n=4360)

Variable	Osteoporosis						
	Total	Subtotal		Osteopenia		Osteoporosis	
	Screened	Prevalence		Prevalence		Prevalence	
	No.	No.	(%)	No.	(%)	No.	(%)
Sex							
Men	2758	1804	65.4	1076	39.0	728	26.4
Women	1602	1343	83.8	572	35.7	771	48.1
P-value for χ^2-test	<0.001						
Age							
65–74	2433	1639	67.4	964	39.6	675	27.7
75–84	1604	1229	76.6	588	36.7	641	40.0
≥85	323	279	86.4	96	29.7	183	56.7
P-value for Cochran-Armitage trend test	<0.001						
Total	4360	3147	72.2	1648	37.8	1499	34.4

TABLE 2 Comparisons of Demographic and Biochemical Characteristics of Osteoporosis among the Elderly Agricultural and Fishing Screened Population Subjects (n=4360)

Variables	General (n=4360)	Normal	Osteopenia	Osteoprosis	P-value for F-test
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
Age (year)	74.38±6.60	72.93±6.01	73.92±6.30	76.08±7.00	<0.001
Height (cm)	156.99±8.49	158.83±7.42	157.41±8.20	155.05±9.19	<0.001
Weight (kg)	62.00±10.83	64.51±10.49	62.28±10.52	59.67±10.95	<0.001
BMI (kg/m^2)	25.19±3.76	25.54±3.48	25.14±3.60	24.96±4.10	<0.001
Waist circumference (cm)	86.75±10.05	88.06±9.76	86.72±9.70	85.71±10.52	<0.001
Blood sugar (mg/dL)	100.56±27.80	102.39±30.91	100.35±27.45	99.31±25.37	0.02
SBP (mm Hg)	137.48±22.34	137.49±22.79	137.08±22.02	137.92±22.33	0.57
DBP (mm Hg)	78.72±12.25	79.53±12.12	78.73±12.45	78.05±12.09	0.01
Total cholesterol (mg/dL)	200.70±35.74	197.76±34.33	201.69±35.97	201.98±36.49	0.003
Triglycerides (mg/dL)	132.07±86.10	134.47±89.12	134.02±94.87	137.99±72.27	0.08
HDL-C (mg/dL)	54.15±15.05	55.37±14.42	54.15±15.06	52.58±15.38	<0.001
Uric acid (mg/dL)	6.12±1.56	6.33±1.53	6.10±1.52	5.98±1.60	<0.001

BMI = body mass index; DBP = diastolic blood pressure; HDL-C = high density lipoprotein cholesterol; SBP = systolic blood pressure; SD = standard deviation.

(P<0.001), blood sugar (P=0.02), DBP (P=0.01), total cholesterol (P=0.003), HDL-C (P<0.001), and uric acid (P<0.001) were significantly different between normal, osteopenia, and osteoporosis subgroups.

The effects of independent associated risk factors on osteopenia and osteoporosis were studied using the multinomial logistic regression system. As shown in Table 3, in addition to alteration of be wildering features, age

TABLE 3 Multinomial Logistic Regression on the Risk Factors Associated with Osteoporosis Disease among the Elderly Fishing and Agricultural Population (n= 4360)

Variables	Odds ratio	95% Confidence interval	P-value
Osteopenia versus normal			
Age (year)	1.03	1.01–1.04	<0.001
Height (cm)	1.00	0.98–1.01	0.67
Weight (kg)	0.98	0.97–1.00	0.03
Waist circumference (cm)	1.01	1.00–1.03	0.02
Sugar (mg/dL)	1.00	0.99–1.01	0.17
DBP (mm Hg)	1.00	0.99–1.01	0.43
Total cholesterol (mg/dL)	1.01	1.00–1.02	0.002
HDL-C (mg/dL)	1.00	0.99–1.01	0.47
Uric acid (mg/dL)	0.93	0.88–0.98	0.004
Smoke (yes vs. no)	1.06	0.86–1.25	0.68
Alcohol drinking (yes vs. no)	1.13	0.85–1.40	0.49
Betel nut (yes vs. no)	1.01	0.55–1.48	0.68
Milk (yes vs. no)	0.98	0.82–1.14	0.68
Meat (yes vs. no)	1.23	1.04–1.49	0.02
Osteoporosis versus normal			
Age (year)	1.07	1.06–1.09	<0.001
Height (cm)	0.98	0.97–0.99	0.005
Weight (kg)	0.97	0.95–0.99	<0.001
Waist circumference (cm)	1.02	1.00–1.03	0.02
Sugar (mg/dL)	1.00	0.99–1.01	0.12
DBP (mm Hg)	1.00	0.99–1.01	0.96
Total cholesterol (mg/dL)	1.01	1.00–1.02	0.003
HDL-C (mg/dL)	1.01	0.99–1.02	0.10
Uric acid (mg/dL)	0.90	0.85–0.95	<0.001
Smoke (yes vs. no)	1.22	0.97–1.46	0.09
Alcohol drinking (yes vs. no)	1.15	0.84–1.46	0.48
Betel nut (yes vs. no)	1.32	0.60–2.05	0.75
Milk (yes vs. no)	0.95	0.78–1.11	0.43
Meat (yes vs. no)	1.47	1.19–1.75	<0.001

(odds ratio [OR]=1.03, 95% confidence interval [CI]: 1.01–1.04), weight (OR=0.98, 95% CI: 0.97–1.00), waist circumference (OR=1.01, 95% CI: 1.00–1.03), total cholesterol (OR=1.01, 95% CI: 1.00–1.02), uric acid (OR=0.93, 95% CI: 0.88–0.98), and regular habits of meat intake (OR=1.23, 95% CI: 1.04–1.49) appeared to be statistically significantly related to osteopenia. Age (OR=1.07, 95% CI: 1.06–1.09), height (OR=0.98, 95% CI: 0.97–0.99), weight

(OR=0.97, 95% CI: 0.95–0.99), waist circumference (OR=1.02, 95% CI: 1.00–1.03), total cholesterol (OR=1.01, 95% CI: 1.00–1.02), uric acid (OR=0.90, 95% CI: 0.85–0.95), and regular habits of meat intake (OR=1.47, 95% CI: 1.29–1.75) appeared to be statistically significantly related to osteoporosis.

DISCUSSION

Table 4 presents the prevalence of osteopenia and osteoporosis in various types of study populations.[17–21] The prevalence of osteoporosis ranges from 19.5 to 34.5%, and the prevalence of osteopenia ranges from 37.8 to 51.6%. There is only a subtle difference between the prevalence of osteoporosis and osteopenia in our research when compared with other studies. In addition to diagnostic criteria, this disparity is largely due to the different sources of study subjects.

Age is a well-known risk factor for osteoporosis. An elderly person has a greater probability of having osteopenia and osteoporosis as bone mass decreases with age, that is, osteoporosis can be considered an aging process.[22] As a result, old age could be a predictor of high osteoporosis probability clinically.

Height is recognized as one of the risk factors for osteoporosis in several types of research.[23–27] In our analysis, the results revealed that the average height of the patients with osteoporosis was significantly lower than the non-osteoporosis group. Compared with other research in which the study group focused on people of middle age, high body height is the risk factor for osteoporosis.[28,29] The height loss is common in the elderly population. The occurrence of height loss is owing to the curvature of the spine, narrowing of intervertebral discs, and vertebral fractures.[30] However, further studies with larger sample sizes are needed to confirm this interference.

Total cholesterol concentration is linked to some diseases. It can lead to cardiovascular diseases. It is injurious to bone structure and is

TABLE 4 Prevalence of Osteoporosis in Various Populations

Author	Study year	Screened number	Study age	Setting	Prevalence of osteoporosis and osteopenia (%)	Associated factors
D'Amelio et al.[17]	2013	995	45–92 years	Italy	Osteoporosis: 33.67% Osteopenia: 46.63%	Age, weight, postmenopausal period
Jeon et al.[18]	2014	375	Postmenopausal women	Korea	Osteoporosis: 19.5% Osteopenia: 45.9%	Age, smoke, parental fracture, previous fracture, secondary osteoporosis
Lo[19]	2015	1507	Postmenopausal women	Hong Kong	Osteoporosis: 25.7% Osteopenia: 51.6%	Calcium intake, exercise, sun exposure, age, body mass index, parental history of osteoporosis or hip fracture, duration of menopause
Lim et al.[20]	2015	1433	Postmenopausal women	Korea	Osteoporosis: 34.5% Osteopenia: 50.4%	Calcium intake
Domingues et al.[21]	2015	29	23–83 years	Brazil	Osteoporosis: 20.7% Osteopenia: 37.9%	Age, bone mineral density of the femoral neck without hip osteoarthritis
Lee et al. (Present study)	2016	4360	≥65 years	Taiwan	Osteoporosis: 34.4% Osteopenia: 37.8%	Age, height, total cholesterol, HDL-C, uric acid, smoke, meat

HDL-C = high density lipoprotein cholesterol.

correlated with bone turnover, which may predict osteoporosis.[31,32] In this study, higher total cholesterol concentration is proven to be related to the high prevalence of osteopenia and osteoporosis. In addition, HDL-C is widely regarded as good cholesterol because it protects against the development of atherosclerosis disease.[33] However, when it comes to the relevance to osteoporosis, it yielded conflicting results. Some paper did not observe the association between HDL-C and osteoporosis,[34] but some researches revealed that elevated levels of serum HDL-C had a higher probability of forming osteoporosis than the low HDL-C levels in Chinese postmenopausal women.[35] In this study, the association between HDL-C, osteoporosis, and osteopenia is statistically significant.

Uric acid is the end product of purine metabolism. When the intake of purines increases or the body has problems in metabolism, high level of serum uric acid may lead to gout. However, it is a protective factor for osteopenia and osteoporosis. The results in this study showed that higher uric acid levels were linearly associated with higher lumbar spine BMD, and it is protective for bone loss in peri- and postmenopausal women.[8,36] The possible reason may be due to the antioxidant ability of uric acid. Nevertheless, the mechanism of the association between uric acid and BMD still needs clarification.

Smoking habits showed only a borderline significance to osteoporosis in this study. Previous studies indicated that smoking could lead to DNA damage and oxidative stress, further leading to many diseases such as various cancers and cardiovascular diseases.[37,38] Likewise, smoking inhibits bone formation and increases bone resorption, which decreases BMD and causes osteoporosis.[39]

After adjustment for confounding factors, our findings suggest that regular meat intakeis one of the risk factors of osteoporosis. Daily intake also has a great impact on the bone density.[40]Meat is considered an important component of a balanced diet, and it helps in body growth as it contains nutrients, such as protein, fatty acid, iron, vitamin B, and zinc.[41] As for the interaction between meat intake and osteoporosis, the results are not all positive. Some research observe less frequent prevalence of osteoporosis in Chinese postmenopausal women preferring meat food habits.[42] Some conclude that having a large proportion of animal meat has the possibility to cause adverse effects on bone metabolism.

Methodological Considerations

An important major inadequacy in this study was the possible range bias due to only one aging-populace curtained in Taiwan. The prospective influence on the frequency estimated and the study-observed osteoporosis and osteopenia-connected threat aspects was unavoidable.Given the relative big model scope, nevertheless, we still retained enough numerical control to evaluate efficiently the existence of any sex dissimilarities between the numerous accompanying threat aspects of osteoporosis successive to alteration for difficult dynamics. Furthermore, we would not be able to reflect long-term exposure to various demographic or biochemical aspects or factors as our measurements were conducted only at a single point in time and, by clear inference, which might be an important influencer of osteoporosis. Finally, with our study design, it was difficult to determine the effects of changes in biochemical levels over time after the development of osteoporosis. By conducting a number of prospective longitudinal analogous studies, the solution to such a quandary could best be accomplished, and the results would also complement the cross-sectional findings of this study.

CONCLUSION

Numerous medical influences independently were designated affecting the commonness of osteoporosis in aging among the fishing and

agricultural populace. Further studies are needed not only to evaluate the temporal sequence of events that typically lead to osteoporosis but also to assess how gender-related differences are related to osteoporosis among the elderly population.

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CONFLICTS OF INTEREST

The authors have no proprietary interest in any aspect of this study. The authors certify that, within the past 5 years and in the foreseeable future, all affiliations or financial involvement with any organization or entity with a financial interest in, or financial conflict with, the subject matter or materials discussed in this manuscript are fully disclosed (e.g. employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, and royalties).

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