Original Article

Salty food preference is associated with osteoporosis among Chinese men

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Background and Objectives: The main purpose of this study was to evaluate the associations between salty food preference and osteoporosis (OP) in general Chinese men. **Methods and Study Design:** We conducted a large-scale, community-based, cross-sectional study to estimate the associations by using self-report questionnaire to evaluate the salty food preference. The total of 1,092 men was available to data analysis in this study. Multiple regression models controlling for confounding factors to include salty food preference variables were employed to explore the relationships for OP. **Results:** We found negative correlations between preference for salty food and T-score (p=0.006). Multiple regression analysis showed that the preference for salty food was significantly positively associated with OP (p<0.05 for all). The men with preference for salty food habits had a higher prevalence of OP. **Conclusion:** The findings indicated that salty food preference was independently and significantly associated with OP. The prevalence of OP was more frequent in Chinese men preferring salty food habits.

Key Words: salty food preference, osteoporosis, Chinese men, association, large scale

INTRODUCTION

Osteoporosis (OP) is characterized by a decrease in bone mass and density, which can lead to an increased risk of fracture.[1] In osteoporosis, the bone mineral density (BMD) is reduced, bone micro-architecture deteriorates, and the amount and variety of proteins in bone are altered. OP is now a serious global public health problem that is responsible for millions of fractures annually, mostly involving the lumbar vertebrae, hip, and wrist.[2] Fragility fractures of ribs are also common in men. Osteoporotic fracture is associated with increased mortality, concomitant morbidity, and reduced quality of life.[3] China is experiencing a growing osteoporosis pandemic, due to a rapidly developing economy and a large, aging population.[4]

Many osteoporosis risk factors have been identified. Personal behaviors changes such as diet, exercise, and preventing falls can reduce the risk of osteoporotic fractures.[5,6] These benefits are also realized by those with previous osteoporosis-related fractures and medications. Specially, dietary habits play an important role in the prevention of OP and osteoporotic fractures.[5,7,8] Previous studies described that a salty food preference can increase the risk of common diseases, such as hypertension (HTN).[9] Studies conducted on animals show that a high salt intake causes not only severe HTN, but also bone reduction in rats.[10] Epidemiological studies indicate that change in bone mineral density is inversely related to sodium intake, and that both dietary calcium and urinary sodium excretion are significant determinants of the change in bone mass.[11,12] On the contrary, evidence indicates that reducing the sodium intake of young, healthy people with adequate calcium intake does not affect the markers of bone metabolism.[13] There are no consistent conclusions concerning the salt intake association with osteoporosis.[14]

It was appropriate and convenient to conduct a large-scale study to evaluate risk factors for common diseases by using self-reported questionnaire methods. Fortunately, evidence demonstrates that a subjective self-report questionnaire for a salty food preference can precisely reflect the salty intake.[15-17] Generally, previous studies on osteoporosis have been conducted in three special gender groups: men, premenopausal women, and postmenopausal women. Gender is a major factor that influences the balance of hormones and metabolism related to osteoporosis.[1,2] In addition, more studies have been conducted on women than men. To the best of our knowledge, little is known of the associations between salt intake and OP in the Chinese population. The main purpose of the study was to evaluate the extent to which salty food preference was associated with OP among the Chinese men population by using self-reported questionnaire methods applied to a large-scale sample.

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METHODS

Study population

We performed a risk-factor survey for OP using a random sample of the Chinese population. Participants were recruited from rural and urban communities in Shanghai. Survey participants aged 30-80 years were included in this study. More than 3,000 participants (both men and women) were invited to a screening visit between 2012 and 2015. Some participants with chronic diseases and conditions that might potentially affect bone mass, structure, or metabolism were excluded. Briefly, the exclusion criteria were as follows: a history of 1) serious residual effects of cerebral vascular disease; 2) serious chronic renal disease (Glomerular filtration rate - GFR<30 mL/min/1.73m^2); 3) serious chronic liver disease or alcoholism; 4) significant chronic lung disease; 5) corticosteroid therapy at pharmacologic levels; 6) evidence of other metabolic or inherited bone disease, such as hyper- or hypoparathyroidism, Paget disease, osteomalacia, or osteogenesis imperfecta; 7) recent (within the past year) major gastrointestinal disease, such as peptic ulcer, malabsorption, chronic ulcerative colitis, regional enteritis, or significant chronic diarrhea; 8) Cushing syndrome; 9) hyperthyroidism; and 10) any neurologic or musculoskeletal condition that would be a non-genetic cause of low bone mass. A total of 1,092 men with complete records were available to data analysis in this study.

Written consent was obtained from all patients before the study, which was performed in accordance with the ethical standards in the Declaration of Helsinki, and approved by the Medicine Ethical Committee of the Shanghai Tongji Hospital (Clinical trials gov. number: NCT024 51397).

Measures and data collection

All study subjects underwent complete clinical baseline characteristics evaluation, which included a physical examination and response to a structured, nurse-assisted, self-administrated questionnaire to collect information on age, gender, residential region, visit date, family history, Personal behaviors, dietary habits, physical activity level during leisure time, use of vitamins and medications, smoking, alcohol consumption, and self-reported medical history. Body weight and height were measured according to a standard protocol.

Definition

Smoking and alcohol consumption were categorized as never, current (smoking or consuming alcohol regularly in the past 6 months), or ever (cessation of smoking or alcohol consumption for more than 6 months). Regular exercise was defined as any kind of physical activity 3 or more times per week. Education was commonly divided into four stages: preschool, primary school, secondary school, and college. Dietary habits, including consumption of healthy foods (vegetables, potato, beans, and fruits) were evaluated by a semi-quantitative food frequency questionnaire (group 1: seldom, group 2: once or twice per week, group 3: once per 2 days, and group 4: every day). Self-reported medical history was categorized as "no" or "yes." HTN was defined as blood pressure ≥140/90 mmHg, or a history of hypertension medication. Diabetes mellitus (DM) was defined by oral glucose tolerance test (OGTT) and either HbAlc ≥6.5% or the use of insulin or hypoglycemic medications.

To determine salty food preference, the participants were asked, "Do you prefer salty foods?" The possible answers were: "no," "sometimes," or "yes," and the answers were taken as a subjective assessment. To answer the question, the participants were required to decide two issues based on their impressions: 1) whether or not the consumed foods were actually salty; and 2) the frequency with which they consumed salty foods.

The study outcomes

The bone mineral density (BMD g/cm^2) was measured at calcaneus by standardized quantitative ultrasound (QUS, Hologic Inc., Bedford, MA, USA) utilizing T-scores based on WHO criteria,[18] which were obtained from the automated equipment. T-score refers to the ratio between patient's BMD and that of young adult population of same sex and ethnicity. T-score of >-1 was taken as normal, between -1 and -2.5 osteopenic and <-2.5 as osteoporotic. Daily calibration was performed during the entire study period by a trained technician. The coefficients of variation of the accuracy of the QUS measurement were 0.9%. The QUS technology is less expensive, portable and also has the advantage of not using ionising radiation, so it is safer than dual energy X-ray absorptiometry (DEXA).

Statistical analysis

Continuous variables were analyzed to determine whether they followed normal distributions, using the Kolmogorov-Smirnov test. Variables that were not normally distributed were log-transformed to approximate a normal distribution for analysis. Results are described as mean ± SD or median, unless stated otherwise. Differences in variables among subjects grouped by salty food preference were determined by an unpaired *t*-test. Between groups, differences in properties were detected by χ^2 analysis. Univariate regression analysis was performed to determine variables associated with outcomes (T-score or OP), and to estimate confounding factors possibly disturbing the relation of salty food preference to outcomes (T-score or OP). Multivariable regression (MR) was performed to control potential confounding factors and determine the independent contribution of variables to outcomes (T-score or OP). Results were analyzed using the Statistical Package for Social Sciences for Windows, version 16.0 (SPSS, Chicago, IL, USA). Tests were two-sided, and a *p*-value of <0.05 was considered significant. Odds ratios (OR) with 95% confidence intervals (CI) were calculated for the relative risk of salty food preference with the outcome of OP.

RESULTS

Clinical characteristics of subjects

The clinical baseline characteristics of the 1,092 Chinese men subjects are listed in Table 1. The mean age was 64.1 years in the total sample. The mean height and weight were 168 cm and 68.0 kg, respectively, in the total sample. The prevalence of HTN, coronary artery disease (CAD), DM, gout, and rheumatoid arthritis (RA) were 45.8%, 10.3%, 9.73%, 3.56%, and 3.43%, respectively, in the total sample. The proportions of subjects having current smoking and alcohol habits were 36.4% and 30.6%, respectively, in the total sample. There were significant differences in smoking habits among the salty food preference groups (*p*-value=0.004). The vitamin D supplement used in the total sample had low frequency (2.66%). A high proportion of participants with advanced education (27.4%) was reported in the total sample. An average T-score of -1.23 was reported in the total sample. The prevalence of OP was 8.79% in our study sample. There were significant differences in oil intake and T-score among the salty food preference groups (*p*-value=0.005 and 0.007 for the two variables). There were no significant differences in other parameters among the three groups (*p*-value >0.05 for all).

Univariate analysis for T-score and OP

Univariate linear regression models were developed to include demographical information, medical history, and Personal behaviors to estimate the association of various clinical factors and T-score (Table 2). The variables age, exercise, education, and salty food preference were significantly associated with the T-score. The comparison of T-scores among salty food preference groups (with no, sometimes, and yes categories) revealed that the mean T-score was -1.16, -1.19, and -1.36 in the three groups, respectively (Figure 1A). There are significant differences among the three groups (*p*-value=0.007). In addition, the comparison of T-scores between the no or sometimes preferences for salty food groups and the preference for salty food group showed that the mean T-score was -1.17 and -1.36 in the two groups, respectively (Figure 1B). There are significant differences between the two groups (*p*-value=0.002). Univariate analysis demonstrated a negative correlation between salty food preference and T-score.

Univariate logistic analyses were performed to evaluate associations with OP. The results indicate that age, RA, alcohol intake, exercise, education, and salty food preference were significantly associated with OP (*p*-value <0.05 for all, Table 3). The comparison of prevalence of OP among salty food preference groups (with no, sometimes, and yes categories) reported that the prevalence of OP was 7.51%, 7.91%, and 11.4 in the three groups, respectively (Figure 2B). There were no significant differences among the three groups (*p*-value=0.142). However, the results of comparison of prevalence of OP between the no or sometimes preferences for salty food groups and the preference for salty food group indicate that the prevalence of OP is 7.67% and 11.5% in the two groups, respectively (Figure 2B). There are significant differences between the two groups (*p*-value=0.048). Univariate analysis demonstrates a positive correlation between salty food preference and OP.

Multiple variable analysis for T-score and OP

Multivariate linear regression models were developed to

Table 1. Baseline characteristics of subjects

Variable	Total sample	Salty foods preference			*p* value
		No	Sometimes	Yes	
Demographic parameter					
N	1,092	453	316	323	-
Age (year)	64.1±9.77	64.4±9.75	64.1±9.66	63.8±9.94	0.691
Height (cm)	168±5.61	168±6.34	169±6.18	168±4.58	0.856
Weight (kg)	68.0±11.9	67.0±16.1	67.9±8.11	68.9±9.17	0.777
Medical history, %					
HTN	494 (45.8)	193 (42.9)	147 (47.3)	154 (48.4)	0.260
CAD	108 (10.3)	44 (10.0)	28 (9.33)	36 (11.6)	0.641
DM	104 (9.73)	46 (10.3)	30 (9.77)	28 (8.92)	0.825
Gout	38 (3.56)	14 (3.18)	9 (2.91)	15 (4.7)	0.412
RA	37 (3.43)	14 (3.13)	8 (2.56)	15 (4.72)	0.298
Personal behaviors, %					
Smoking	397 (36.4)	152 (33.6)	104 (32.9)	141 (43.4)	0.004
Alcohol intake	333 (30.6)	122 (26.9)	104 (33.1)	107 (33.2)	0.088
Exercise	705 (64.6)	286 (63.1)	210 (66.5)	209 (64.7)	0.637
Education pre	299 (27.4)	142 (31.4)	84 (26.6)	73 (22.6)	0.078
Dietary habits					
Potato, %	37 (3.39)	16 (3.53)	10 (3.17)	11 (3.41)	0.947
Oil gram	20.2±10.1	19.1±9.33	20.5±10.8	21.5±10.4	0.005
Vitamin D, %	29 (2.66)	10 (2.21)	11 (3.48)	8 (2.48)	0.542
Fish, %	328 (30.0)	137 (30.2)	87 (27.5)	104 (32.2)	0.434
Meat, %	531 (48.6)	204 (45.0)	148 (46.8)	179 (55.4)	0.013
Egg, %	645 (59.1)	274 (60.5)	181 (57.3)	190 (58.8)	0.669
Milk, %	625 (57.2)	277 (61.2)	189 (59.8)	159 (49.2)	0.002
Vegetables, %	993 (90.9)	420 (92.7)	284 (89.9)	289 (89.5)	0.222
Sea food, %	79 (7.23)	38 (8.39)	24 (7.59)	17 (5.26)	0.243
Fruit, %	843 (77.2)	363 (80.1)	247 (78.2)	233 (72.1)	0.029
Outcomes					
T-score	-1.23±0.91	-1.16±0.90	-1.19±0.96	-1.36±0.87	0.007
OP, %	96 (8.79)	34 (7.51)	25 (7.91)	37 (11.5)	0.142

HTN: hypertension; CAD: coronary artery disease; DM: diabetes mellitus; RA: rheumatoid arthritis.

Table 2. Univariate linear regression analysis for associations among variables and T score

Variables	β	SE	p value	95% CI for β
Age	-0.009	0.003	0.002	-0.014 - -0.003
Height	-0.002	0.016	0.911	-0.034 - 0.030
Weight	0.008	0.008	0.279	-0.007 - 0.023
HTN	0.087	0.056	0.117	-0.022 - 0.196
CAD	-0.085	0.092	0.359	-0.266 - 0.096
DM	0.060	0.095	0.523	-0.125 - 0.246
Gout	0.076	0.151	0.613	-0.220 - 0.373
RA	-0.248	0.153	0.105	-0.547 - 0.052
Smoking	-0.044	0.057	0.441	-0.157 - 0.068
Alcohol intake	-0.048	0.060	0.420	-0.166 - 0.069
Exercise	0.060	0.024	0.049	1.00 - 0.121
Education	0.104	0.027	<0.001	0.052 - 0.156
Potato	-0.012	0.073	0.873	-0.156 - 0.132
Oil	-0.004	0.003	0.194	-0.009 - 0.002
Vitamin D	0.026	0.172	0.881	-0.311 - 0.363
Fish	0.084	0.038	0.025	0.011 - 0.158
Meat	-0.095	0.055	0.085	-0.203 - 0.013
Egg	-0.016	0.056	0.771	-0.127 - 0.094
Milk	0.018	0.056	0.744	-0.091 - 0.128
Vegetables	-0.065	0.096	0.496	-0.254 - 0.123
Sea food	0.171	0.106	0.109	-0.038 - 0.379
Fruit	0.031	0.066	0.635	-0.098 - 0.160
Salty foods preference	-0.098	0.033	0.003	-0.163 - -0.033

HTN: hypertension; CAD: coronary artery disease; DM: diabetes mellitus; RA: rheumatoid arthritis.

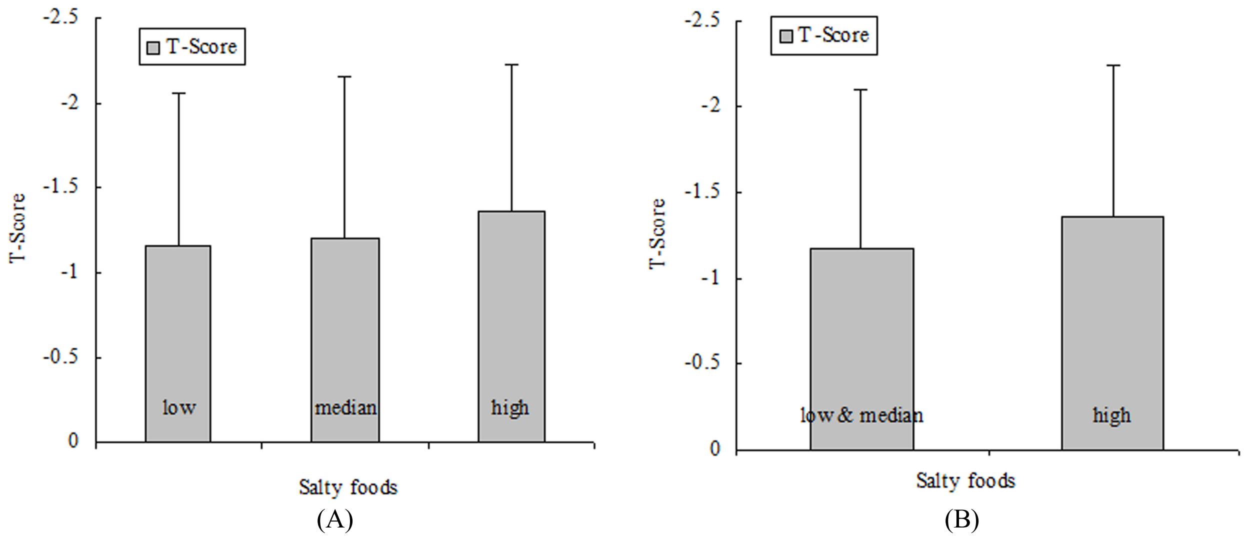

Figure 1. Comparison of T score among groups according to salty foods preference. (A) The results of comparison of T-score among three groups according to salty foods preference. The mean T-score was -1.16, -1.19 and -1.36 in low, the three groups, respectively. There were significantly differences among the three groups (p=0.007). (B) The results of comparison of T-score between two groups according to salty foods preference. The mean T-score was -1.17 and -1.36 in the two groups, respectively. There were significantly differences between the two groups (p=0.002).

include salty food preference (with trinary or binary categories) and the outcome of T-score. After adjustment for relevant potential confounding factors, the multivariate linear regression model detected significant associations (β=-0.094, p-value=0.011, 95% CI: -0.168 to -0.020 for salty food preference with trinary categories; and β=-0.183, p-value=0.009, 95% CI: -0.326 to -0.040 for binary categories, Table 4).

Multivariate logistic regression models were employed to evaluate the association between salty food preference and the OP outcome. After adjustment for relevant potential confounding factors, the multivariate logistic regression model detected significant associations (p-value= 0.039 for salty food preference with trinary categories; and p-value=0.048 for binary categories, Table 5). In participants with salty food preferences, the OR for OP was 1.57 (95% CI: 1.01-2.43).

DISCUSSION

A large-scale, community-based, cross-sectional study was conducted to estimate the associations between salty food preference and OP in Chinese men. The prevalence of common diseases, such as DM, CAD, and HTN, was consistent with the results of nationwide epidemiological studies, and our sample was an adequate representation of the Chinese men population. A subjective, self-reported

Table 3. Univariate logistic regression analysis for associations among variables and osteoporosis

Variable	*β*	SE	*p* value	OR	95% CI
Age	0.072	0.013	<0.01	1.07	1.05 - 1.10
Height	-0.156	0.097	0.065	0.856	0.735 - 0.996
Weight	-0.052	0.048	0.279	0.950	0.865 -1.04
HTN	-0.023	0.216	0.915	0.977	0.640 - 1.49
CAD	0.388	0.318	0.222	1.47	0.791 - 2.75
DM	0.097	0.351	0.784	1.10	0.553 - 2.19
Gout	-1.31	1.02	0.198	0.269	0.037 - 1.98
RA	1.11	0.415	0.008	3.03	1.34 - 6.82
Smoking	-0.245	0.143	0.066	0.783	0.616 - 1.07
Alcohol intake	-0.344	0.134	0.010	0.709	0.545 - 0.921
Excise	-0.274	0.137	0.045	0.760	0.582 - 0.994
Education	-0.223	0.102	0.028	0.800	0.655 - 0.977
Potato	-0.295	0.310	0.340	0.744	0.406 - 1.37
Oil	0.003	0.010	0.810	1.00	0.982 - 1.02
Vitamin D	0.800	0.504	0.112	2.23	0.829 - 5.97
Fish	-0.402	0.160	0.012	0.669	0.489 - 0.915
Meat	-0.262	0.216	0.225	0.770	0.504 - 1.18
Egg	0.306	0.224	0.172	1.36	0.875 - 2.11
Milk	0.049	0.217	0.820	1.05	0.687 - 1.61
Vegetables	0.886	0.522	0.090	2.43	0.872 - 6.75
Sea food	0.569	0.344	0.098	1.77	0.900 - 3.47
Fruit	0.269	0.272	0.323	1.31	0.768 - 2.23
Salty foods preference	0.294	0.122	0.048	1.34	1.00 - 1.68

HTN: hypertension; CAD: coronary artery disease; DM: diabetes mellitus; RA: rheumatoid arthritis.

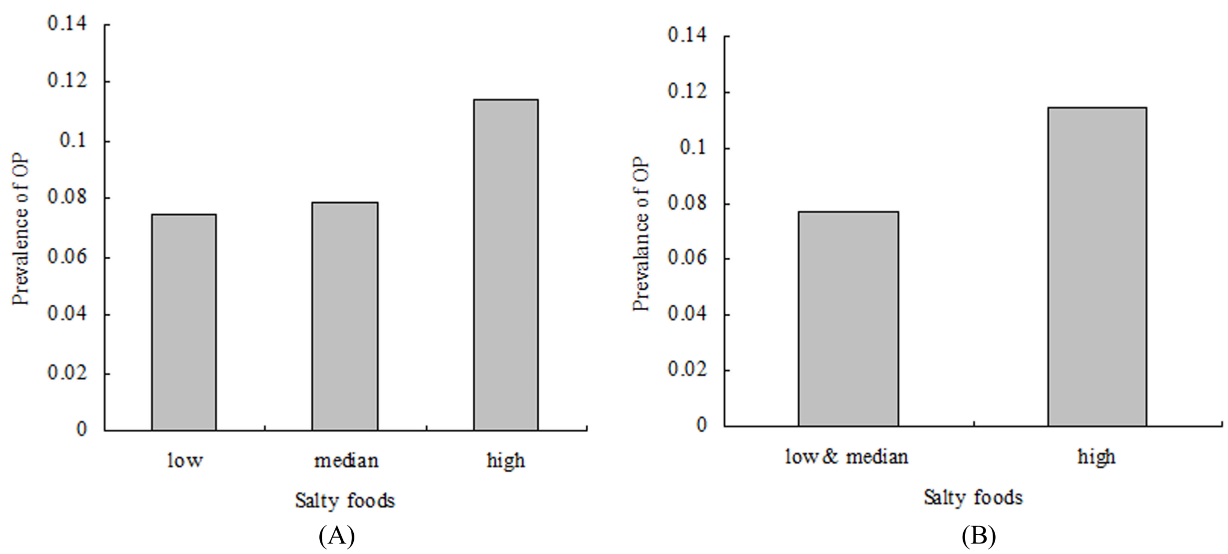

Figure 2. Comparison of prevalence of osteoporosis among groups according to salty foods preference. (A) The results of comparison of prevalence of osteoporosis among three groups according to salty foods preference. The prevalence of osteoporosis was 7.51%, 7.91% and 11.4 in the three groups, respectively. There were no significantly differences among the three groups (*p*=0.142). (B) The results of comparison of T score between two groups according to salty foods preference. The prevalence of osteoporosis was 7.67% and 11.46% in the two groups, respectively. There were significantly differences between the two groups (*p*=0.048).

questionnaire to estimate salt intake was suitable for this large-scale study because of its convenience in collecting independent variables. Importantly, in the general Chinese men population, we first performed an association analysis between salty food preference and OP. In this study, BMD was evaluated by using QUS that has many advantages in assessing osteoporosis. The modality is small, no ionizing radiation is involved, measurements can be made quickly and easily, and the cost of the device is low compared with DXA and quantitative computed tomography devices. Physicians must better understand the effect of modifiable risk factors on outcomes. This is partly because we can control modifiable risk factors to efficiently reduce the overall risk of the outcome. In this study, we focused on evaluating the association between salty food and OP in Chinese men, so that we employed multiple variable regression analysis controlling for confounding factors such as variables of dietary habits. We also selected the variables significant association with outcomes in clinical practice or biological investigations. For example, fruit and its own BP effects were associated with potassium and phytonutrients to influence the bone metabolism.

In this study, our finding was that salty food preference

Table 4. Multivariate linear regression analysis for the associations between salty foods preference and T score

Model	Variable	β	SE	p value	95% CI for β
Model 1	Salty foods preference	-0.094	0.038	0.011	-0.168 - -0.020
Model 2	Salty foods preference	-0.183	0.073	0.009	-0.326 - -0.040

Model 1: Salty foods preference with trinary variables; Model 2: Salty foods preference with binary variables; both models adjusted for age, smoking, alcohol intake, education, exercise, fish, milk, vegetables, sea food, fruit and medical history.

Table 5. Multivariate logistic regression analysis for associations between salty foods preference and osteoporosis

Model	Variable	β	SE	p value	OR	95% CI
Model 1	Salty foods preference	0.289	0.141	0.039	1.34	1.01 - 1.76
Model 2	Salty foods preference	0.448	0.225	0.048	1.57	1.01 - 2.43

Model 1: Salty foods preference with trinary variables; Model 2: Salty foods preference with binary variables; both models adjusted for age, smoking, alcohol intake, education, exercise, fish, milk, vegetables, sea food, fruit and medical history.

was strongly, independently, and significantly associated with OP in Chinese men. Results of univariate and multiple variable analysis provided evidence to support this finding (p-value <0.001 for all analyses). These results were consistent with other studies in which salty intake was linked to lower BMD and OP[11,16] (salt intake 1-2). Jones et al conducted a population-based, cross-sectional study to explore the relationship between salt intake and bone resorption or bone mass in a sample of healthy Hobart residents.[13] A population of 154 participants was available for association analysis, which suggests that salt intake is associated with markers of bone resorption in a population-based sample of men and women. It appears likely to be a risk factor for OP (salt intake 1). Teucher et al performed a randomized trial with a crossover design, consisting of four successive 5-week periods of controlled dietary intervention to investigate the effects of salt on calcium metabolism and the potential impact on bone health.[12] This study demonstrated that salt is responsible for a significant change in bone calcium balance when consumed as part of a high calcium diet (salt intake 1). On the other hand, Natri et al conducted a randomized clinical trial with successive 7-week periods of controlled dietary intervention to evaluate whether reducing sodium intake decreased urinary calcium excretion and had a beneficial influence on bone metabolism in young healthy subjects.[13] This study provided evidence that reducing the sodium intake of young, healthy people with adequate calcium intake over a 7-week period does not affect the markers of bone metabolism. Burger et al reviewed the scientific literature on OP for studies addressing the relation between salt intake and calcium balance, and bone resorption and BMD, which indicate that the relationship between salt intake and OP is still controversial.[14] Briefly, our finding provided strong evidence that salty food preference has a positive correlation and association with OP in Chinese men.

Basic medical studies provide evidence of the mechanism underlying salt intake leading to bone loss. Jamie et al. explore whether bone marrow-derived mononuclear cell (BM-MNC) angiogenic function was impaired by an elevated dietary sodium intake in Sprague-Dawley rats. This study suggests that BM-MNC transplantation can restore skeletal muscle angiogenesis and that a high-salt diet impairs the angiogenic competency of BM-MNCs, due to suppression of the renin-angiotensin system, causing increased apoptosis.[19] Iwasa et al evaluated the effect of high salt intake on the mandibular bone in Dahl-Iwai salt-sensitive rates, which indicates that high salt intake causes not only severe HTN, but also mandibular bone reduction in rats.[10] Mona et al performed an animal study to determine the effect of the polyunsaturated fatty acid omega-3 on bone changes imposed by salt loading, highlighting the role of the kidney as a potential mechanism involved in this effect in Men Wistar rats.[20] The study concluded that omega-3 prevents the disturbed bone status imposed by salt loading. This osteoprotective effect was possibly mediated by attenuation of alterations in Ca^{2+} and Pi, and improvement of renal function and arterial blood pressure. Evidence indicates that salt supplementation over the short-term increases the rate of bone resorption in rats.[21] Generally, high sodium intake increases urinary calcium excretion and may thus result in a negative calcium balance and bone loss. Our study and epidemiological studies demonstrate that salty food preference or salty intake is positively correlated with OP. The independent and significant association between preference for salty food and the outcome was explained and proved by basic medical studies. In this study, we did not take into account that salty food preference makes a greater contribution to OP than some other factors. A large-scale, case-controlled study or cohort study incorporating a more rigorous method of evaluating salt intake will be conducted in the future to determine salty intake to predict OP.

Several limitations of this study warrant comment. This study does not cover age groups other than 30-90 years. The study data, based on a cross-sectional study for association analysis, also requires a larger sample size and more geographic representations. Third, a subjective self-reported questionnaire was used to estimate salt intake for convenience in a large-scale cross-sectional study. However, the association results in this study need to be verified by future follow-up studies using objective measures to evaluate actual salt intake. Finally, it is important to emphasise that our study was conducted on Chinese men, and our findings may not be relevant to people of other ethnicities.

In conclusion, our findings indicated that salty food preference was independently and significantly associated with OP. The prevalence of OP was more frequent in Chinese men preferring salty food. This study suggests that a change in preference for salty intake might be beneficial in the prevention of OP in Chinese men.

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AUTHOR DISCLOSURES
None declared.

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Ethical approval
All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Original Article

Salty food preference is associated with osteoporosis among Chinese men

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中国男性饮食咸淡嗜好与骨质疏松有关

背景与目的：评估中国男性饮食咸淡嗜好和骨质疏松症（OP）之间的关联。**方法与研究设计：**我们以社区自然人群为基础进行了大规模的横断面调查，采用问卷调查的方法评估饮食咸淡嗜好与 OP 的关联性，对 1092 名成年男性的相关资料进行了数据分析，通过多元回归模型控制混杂因素，其中咸淡的饮食嗜好变量被用来探索与 OP 的关系。**结果：**偏咸的饮食嗜好和骨密度检验 T 值之间呈显著负相关（p=0.006）。多元回归分析表明，偏咸的饮食嗜好与 OP 显著正相关（p<0.05）。偏咸饮食男性 OP 的患病率较高。**结论：**研究结果表明：偏咸饮食与 OP 显著正相关。

关键词：偏咸饮食嗜好、骨质疏松、中国男性、相关性、大样本