Relationship between Tea drinking and Bone Mineral Density in Iranian population

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Abstract

Background: Tea is the most commonly consumed beverage by Iranian adults after water, and while previous studies have examined the negative effects of coffee-based caffeine on Bone Mineral Density (BMD), the relationship between the consumption of tea and BMD has not been clearly explored. The aim of this study was to investigate the relationship between habitual tea drinking and BMD in the adult Iranian population.

Methods: BMD was measured at the lumbar spine and hip, in 830 men and women living in Tehran, all aged between 20 and 76 yr old. The degree of tea consumption was assessed by questionnaire, and subjects were categorized as either tea drinkers (more than 5 cups of tea per day) or non–tea drinkers (equal or less than 5 cups of tea per day).

Results: After adjusting for age and body mass index, it was found that female tea drinkers had a small (4.2%), but significantly higher BMD in the hip ($P= 0.01$).

Conclusions: This may suggest a potentially positive effect for habitual tea drinking on the BMD of those women with an inadequate consumption of calcium and vitamin D.

Keywords: *Bone mineral density, Osteoporosis, Tea, Vitamin D, Calcium, Iran*

Introduction

Bone mineral density (BMD) is the key variable for evaluating osteoporosis and the risk of subsequent bone fracture. Consumption of a diet rich in calcium and vitamin D is the best way to maintain an adequate bone mass density. Previous studies have examined the negative effects of coffee-associated caffeine on BMD, but the relationship between tea and BMD had not been sufficiently explained (1). Tea is the second most commonly consumed beverage in the world after water (2). Results from the Mediterranean Osteoporosis (MEDOS) study showed that tea drinking was associated with 30 percent reduction in the risk of hip fractures in both women (3) and men (4) over 50 yr of age, with the suggestion that this may be due to components such as phytoestrogens and fluoride, which may influence BMD (1, 5).

Since there is a high prevalence of osteoporosis in Iran, and since Iranians regularly consume tea, the aim of this study was to investigate the relationship between bone mineral density and tea consumption.

Materials and Methods

One thousand two hundred subjects aged between 20 to 76 yr were randomly selected from 50 clusters in Tehran, capital of Iran to take part in the study. Exclusion criteria were any disease, condition or using drug that influence on bone metabolism. Inclusion and exclusion criteria were described previously by IMOS study (6).

Ten ml of blood was taken from each subject at their home in the period late December to February in 2002. The serum was separated immediately using a portable centrifuge and dispatched to the EMRC for immediate freezing. Serum

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25-hydroxyvitamin D3 was measured by radioim-munoassay using an IDS kit (Immunodiagnostic Systems Limited, UK); parathyroid hormone was measured by immunoradiometric assay using a DiaSorin kit (DiaSorin Inc, Still-water, USA). Subjects attended at the EMRC in Shariati Hospital in Tehran where a clinical examination was performed that measured height, weight, bone deformity (in particular lumbar spine deformity), and muscular sensitivity. A bone density evaluation of the lumbar spine and hip (averaged from femoral neck, greater trochanter, and Ward's triangle) was carried out using the DXA method. If the subjects had within five days been exposed to any radiation or calcium metabolism drugs, the BMD was postponed for at least 5 d. All subjects completed a questionnaire examining ethnicity, disease history, drug consumption, physical activity, and exposure to sunlight. An estimation of their calcium and vitamin D intake was based on a 2 d record of food consumption. Subjects were asked separate questions about the regularity of their tea and coffee consumption, and were categorized as either consuming five or more cups of tea daily, or less than five cups of tea daily (respectively case and control groups). Statistical analysis was done by using SPSS (v 11.5), and results expressed as mean +/- standard deviation. The two-tailed student *t*-test was used to determine significant differences, and for the comparison of frequencies the Chi square test was used.

Results

Totally 830 healthy subjects (39.2% men, 60.8% women) were studied. Table-1 shows the data for the subjects studied. 10.9% of the men and 17.8% of the women studied consumed more than 5 cups of tea daily. Female tea drinkers had lower frequencies of osteoporosis (5.6%) and osteopenia (24.5%) compared with non-tea drinkers (12.1% and 36.5% respectively). There were, however, no significant differences in prevalence of osteoporosis and osteopenia in the male subjects. For men, bone mineral density in the hip and spine was identical between tea and non-tea drinkers. For women, bone mineral density was 4.54% higher in the spine (N/S, $P= 0.07$) and 4.2% higher in the hip ($P= 0.01$) in tea drinkers compared with non-tea drinkers. This significant difference in the bone mineral density of the hip of female tea drinkers can be seen in Figure-1 (showing changes in bone mineral density of the hip in correlation with the number of cups of tea consumed per day).

The percentage of men with a smoking habit (22.5%) was higher than women (5.8%) while most of the other characteristics (mean age, BMI, daily calcium and vitamin D intake, and BMI) were similar between both men and women, and tea drinkers and non-drinkers. Serum levels of vitamin D, calcium, and parathyroid hormone was also very similar between both men and women, and tea drinkers and non-drinkers.

Table 1: Characteristics of participants based on tea intake

	Women			Men		
Daily tea intake	**≤ 5 cup**	**>5 cup**	***P****	**≤ 5 cup**	**>5 cup**	***P***
Age (year)[+]	45.2±14.5	44.3±14.6	0.7	44.01±11.8	40.98±10.2	0.07
[‡] BMI	26.1±4.2	26.9±3.98	0.2	27.6±5.4	29.2±5.5	0.048
Daily vitamin D intake[§]	54.4±48.5	64.8±64.6	0.026	48.3±45.2	40.85±40.4	0.4
Daily calcium intake[**]	572.5±390	650.6±334	0.17	548.3±321	608.3±306	0.19
Serum vitamin D[††]	30.9±30.1	30.04±25.5	0.9	52.8±37.5	34.96±34.3	0.7
Serum Ca[‡‡]	9.6±0.6	9.7±0.5	0.4	9.5±0.6	9.6±0.6	0.5
PTH[§§]	26.6±15.5	27.1±12.9	0.8	31.75±20.4	31.3±21.2	0.8
Physical activity[***]	15.8	9.4	0.16	6.75	3.7	0.31
Smoking[†††]	20.7	32	0.057	5.7	7.1	0.42
Bone density in spine[‡‡‡]	1.2±0.2	1.2±0.2	0.5	1.1±0.2	1.15	0.07
Bone density in hip[§§§]	1.01±0.1	1.01±0.1	0.7	0.95±0.1	0.99±0.11	0.01

*P value, †mean±sd, ‡ Kg/m^2, § IU, **mg, ††nmol/li, ‡‡mg/li, §§pg/li, ***> twice to week, ††† frequency in each group, ‡‡‡ L2-L4 (g/cm^2), §§§Hip (g/cm^2)
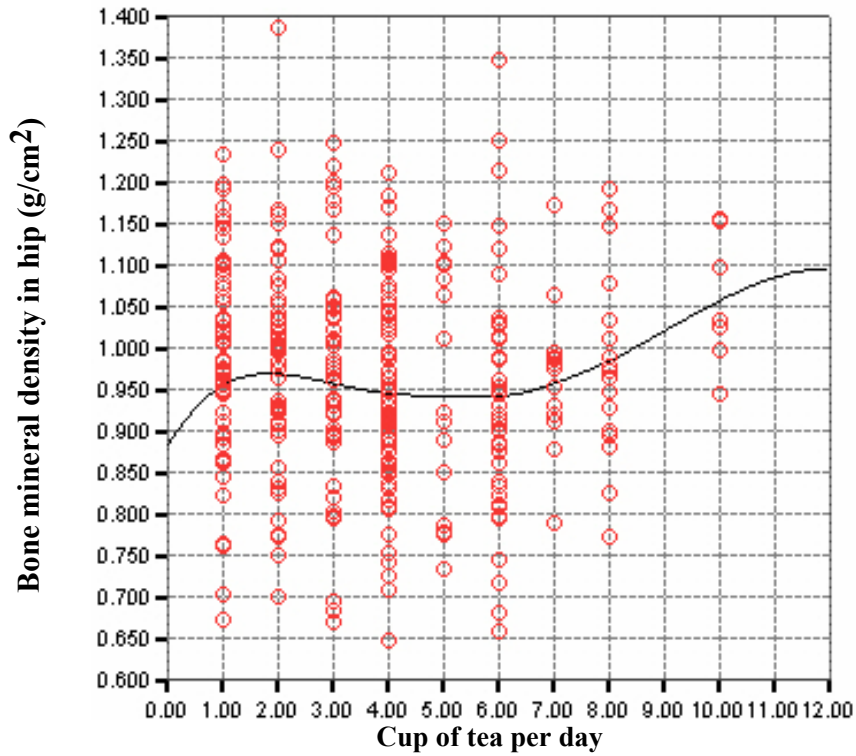
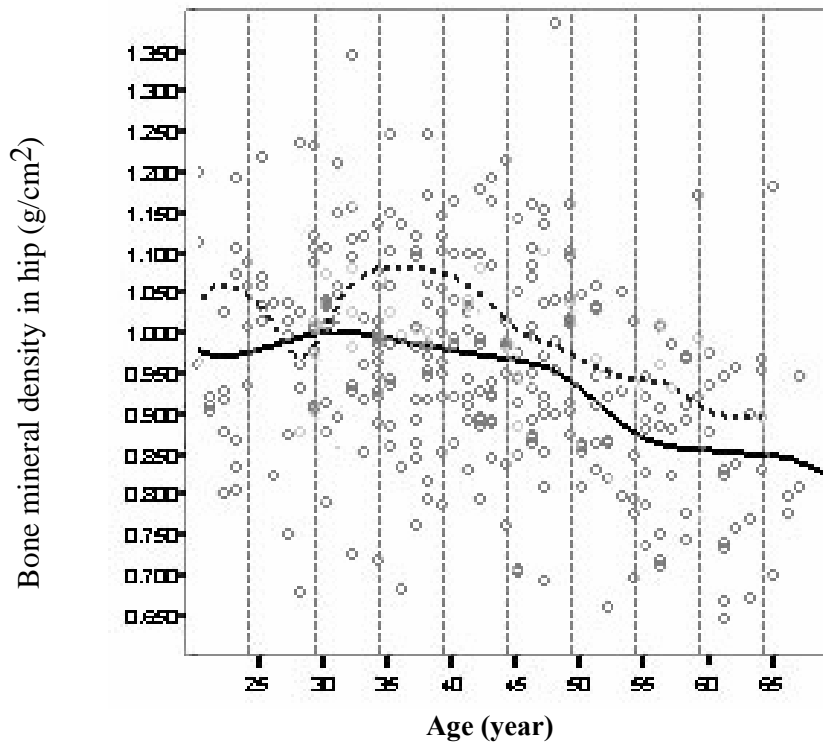**Fig. 1:** Changes in bone mineral density in hip in correlation with tea drinking

Fig. 2: changes in bone mineral density in hip with age in correlation with tea drinking

More than 5 cup of tea per day

Less than 6 cup of tea per day

Discussion

Caffeine containing beverages vary in the pattern of micronutrients they contain coffee and tea have been shown to have different effects on health and physiological processes. The studies on caffeine intake and BMD were conducted in populations where coffee drinking predominated, and although caffeine is also found in tea, the relationship between tea drinking and BMD is not clear (1).

Several studies found that tea intake was positively related with increased BMD in the hip and spine and/ or total body bone mineral density among postmenopausal women in Canada (7), in the United States (8), and in the United Kingdom (1) and more recently among Asian older men and women (2). Report that tea intake was positively associated with BMD in the lumbar spine and femoral neck of postmenopausal women (7). Results in the present study are consistent with these studies, showing a positive relationship between tea consumption and BMD in the hip, and are likely to reflect an improvement in the bone mineral density of those women with an inadequate intake of calcium and vitamin D.

Some studies have shown an inverse association between caffeine intake and BMD in older women (9-11), also a weak inverse association between BMD and tea intake in pre- and postmenopausal women has been shown (12).

The difference in the results of these studies is most likely due to differences in the setting and participant's characteristics, since along with genetic factors, environmental factors, lifestyle, and diet play an important role in bone density variation. In communities where tea is the most common beverage after water like this population study, have reported positive effects on bone mineral density for tea drinkers, but in the communities where coffee and its derivatives are consumed more than tea, results have been controversial. In the cases that had an adequate dietary intake of calcium and vitamin D, the effect of tea on bone density was not significant.

Indeed the differences in menopausal status and skeletal sites measured may contribute to the discrepancies in research findings.

Tea is a major source of isoflavonoids (2), which have been shown to have several biological actions, including a weak estrogenic effect (13, 14). Japanese women have higher isoflavonoid consumption than North American and European women, and also reduced clinical symptoms during the menopause, which has been attributed to the higher dietary consumption of isoflavonoid and its weak estrogen-like effect (15). Tea drinking in Japanese women from Tokyo was also associated with a higher bone mass density in elderly women (16). Hsing et al. reported that subjects with a habitual tea consumption of 6 to 10 yr showed a higher lumbar spine BMD, and that those with a consumption of more than 10 years showed the highest BMD of all subjects studied (2). Hegarty et al. reported a significantly higher mean BMD at the lumbar spine, greater trochanter, and ward's triangle, in tea drinkers compared to non-tea drinkers, and a higher (but non-significant) BMD at the femoral neck (1). Furthermore, tea is a major dietary source of fluoride. Fluoride is a very potent and highly bone-specific anabolic substance (16). However, the role of fluoride in fracture prevention is still in debate.

Following the menopause in women there is a reduction in the production of sex hormones, (in particular estrogen), resulting in an acceleration of the rate of bone loss. For men this process of bone loss occurs much more slowly, and over a longer period of time. As a result, it is easier to see the positive effect of tea drinking on bone metabolism in women. Female tea drinkers had a 5% higher mean BMD at various sites compared to non-tea drinkers, reducing the risk of fracture by 10 to 20% (1). Phytoestrogen content of tea may possibly express positive effect of tea drinking on BMD especially in postmenopausal women, although the weak estrogenic effects of tea do not have noticeable effect on BMD in premenopausal women who have

normal levels of endogenous estrogen (12).

In conclusion we have shown that there is a significantly higher BMD in the hips of those women that drink more than 5 cups of tea per day, as well as a reduced prevalence of osteoporosis and osteopenia. These observations are in accordance with previous studies, and suggest that tea drinking may be protective against osteoporosis in older women.

Acknowledgements

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