

On the Prevalence of Osteoarthritis and Osteoporosis in f skele Town of Bigadiç County, Balıkesir, of Country's Borate Regions: 1 Postmenopausal Osteoporosis

U. Şayh,
Fatih University Hospital, Ankara,

M. Korkmaz,
Balıkesir University Boron Research Center, Balıkesir

B. S. Şayh,
Ankara University Medical Faculty (retired), Ankara
Balıkesir University Boron Research Center, Balıkesir

ABSTRACT: In order to understand if increased amount of boron intake environmentally prevents postmenopausal osteoporosis we compared bone mineral density measurements of 98 women aged 49 to 75 years from İskele Town of Bigadiç County of province Balıkesir. The town is situated on borate deposits and drinking water of street fountains contains 10-30 ppm boron, still in use. Lunal DEXA® procedure revealed 50 % of women had normal density, 27.6 % osteopenia and 22.4 % osteoporosis. Findings seem to indicate a yet-undefined factor would be required for the prevention of condition.

ÖZET: Araştırmaya Türkiye'nin geniş bor minerali yataklarıyla bor üretim tesislerinin bulunduğu İskele beldesinde doğup yaşamlarını orada geçiren 49-75 yaşlı 98 kadın dahil edilmiştir. Hepsisi menopoz döneminde olup 57'si bor işçiliği yapmış emekliler. Demografik ayrıntılara ek olarak Lunal DEXA® yöntemiyle kemik mineral yoğunlukları ölçülmüş, % 50 normal değerlere karşılık % 27.6'sı osteopenik, % 22.4'ü osteoporotik bulunmuştur. Bulgular osteoporozun önlenmesinde başka bir faktörün daha katkısı olacağını düşündürür anlamdadır.

1. INTRODUCTION

Elementary boron is an established essential micronutrient for plants for normal growth and an optimal crop; though it is herbicide at high doses (WHO, 1995; ECETOC 1995). It exerts deleterious effects at chronic excessive amounts in experimental animals, the testes being targeted are atrophied eventually (Chapin and Ku, 1994). Moreover, it has some adverse developmental effects (Heindel et al., 1994) while no an adverse effect is observed at doses known NOAEL (Anonymous, 1995). Importantly however is the fact that the mechanisms of action neither in plants nor in animals are yet clarified despite several proposals and hypotheses (Blevins and Lukaszewski, 1994). In experiments made by HUnt and Nielsen (1981) it has been shown that boron supplementation stimulated growth of chicken grown in Vitamin D3 - deficient diet. This

encouraged further work followed by a series of investigations proving that boron plays a regulatory role in macromineral metabolism. In a clinical assay by Nielsen et al. (1987) boron supplementation 3 mg/day/diet resulted in decrease of urinary excretion of Ca and Mg, and increase of serum ionized Ca, 17 β-estradiol and testosterone in postmenopausal women. This work led to the suggestion that osteoporosis, one of the main health problems of menopausal females as well all elderly, can be prevented, and symptoms of osteoarthritis be alleviated by boron administration (Newnham, 1994). Despite such speculations however no a field study was ever made. We here present our own approach whether the prevalence of osteoporosis is affected in menopausal women from a boron-rich territory.

2. EXPERIMENTAL WORK

2.1. Study area

İskele Town of Bigadiç County of province Balıkesir was the study area. This small town presented as a 'natural human boron laboratory' (Şaylı et al., 2003) is situated on large colemanite and ulexite deposits, surrounded by green pine woods. There are 4 open active pits, several underground ones being closed by 1990's. It is of importance to note that borders of an open ore pit are the walls of some dwellings in town. There is also a processing facility 5 km away.

Drinking water of İskele is of remark too. There are several street fountains, supplied until recently the whole need of the town. In of the fountains boron content is 8-10, in the other 26-30 ppm, this latter being the highest among other borate centers of Country (see Şaylı et al., 1998). Inhabitants told that boron concentration of a well in the heart of bazaar was 90 ppm, not in use any longer. For a few years drinking water with an amount 1 ppm is pumped out to houses while street supplementation is maintained.

2.2 Study population

There lives little over 2000 individuals - all natives without much movement elsewhere. According to health office in İskele there are approximately 200 females over 50 years of age. Between 1950 and 1975 many of these have worked in pits in washing out and picking up the ore. This so created a borate town with borate families in the course of time. One of the features of note is the high frequency of intermarriages, running around 20% as is the case for the whole vicinity. Just one half of those women, 98 in number, participated in the work.

2.3 Methods

Participants were contacted and consent was obtained. They were first interviewed and Questionnaire - based demographic details obtained. Then they were taken to Balıkesir where bone mineral density measurements have been carried out in a private health center. For this Lunar DEXA® procedure was applied and whole-body measurements were evaluated by WHO criteria.

Other parameters of relevance with the states of both osteopenia and osteoporosis were the age, birth place, living place, job, body mass index, age at menopause, time after menopause, hysterectomy, hormone replacement therapy, bone fracture, pregnancy and births, and some habits - all these have been dealt with other articles (Çöl et al., 1999; Şaylı et al., 2004).

Statistical evaluation was carried out using SPSS window's software package. Percent distribution of subgroups was tested with χ^2 , and comparison of two independent subgroups with Student's t test, and that of medians of more than two independent subgroups with unidirectional variance analysis.

2.4 Boron analysis

Blood and urine analyses were carried out in order to estimate boron intake of participant women. Samples were taken from 11 individuals, 8 males and 3 females, from the same community, and analysed by inductively-coupled plasma mass spectrometry in laboratories in California, U.S.A. (courtesy of Dr. B.D. Culver from UIC, Irvine). Urine values changed from 1.96 to 6.70, the mean being 4.09 ppmB. Creatinine-adjusted values differed between 0.89 and 5.58 with a mean 2.72 $\mu\text{gB}/\text{mgCr}$. Blood levels were 0.024 to 0.108, and the mean 0.062 $\mu\text{gB}/\text{g}$. Boron content of urine of 3 females, İskele house-keeper natives aged 29, 63 and 69 years, were 4.0, 4.7 and 6.7 ppmB/l, respectively.

We estimated boron intake without discrimination of any means as approximately 11 mg/day (Velioglu et al., 1999). This matter however needs further refinement.

2.5 Controls

Two sets of controls were used. One came from Balıkesir, consisting of 100 menopausal women living in this city. Bone mineral density assessment was made in the same medical center as İskele probands. Second set derived from referrals to Fatih University Hospital and to Dr. Zekai Tahir Burak Women's Hospital in Ankara. This subgroup covered 108 menopausal females from different parts of country.

3. RESULTS

3.1 Some demographic details

Since most data have already been reported previously by Çöl et al. in 1999, and recently by Şaylı et al. (2004), only few items will be considered here.

Age distribution of İskele subgroup changed from 49 to 75, the mean being 59.7 years. They all but one were from the area, born and living lifetime in this once-a-small village without much movement elsewhere. About 70 % of whom had no school education whereas the remaining only preliminary grades, indicating a suburban population. While marriage of 74 was continuing there were 21 widows and 3 separated subjects amongst. One of the remarkable findings was that 59 women had a borate job in pits to wash out and to pick up the ore. The time spent at this work varied from 8.5 to 24 with a mean 12.8 years. Evidently they all now are retired. Yet some have been engaged in agriculture and animal husbandry.

3.2 Densitometric findings

Table 1 shows total-body bone mineral-density measurements of 98 probands from İskele. While 49 females, just one half of the sample, had normal bone mineral density, 27 were reported with osteopenia and the remaining 22 with osteoporosis, 50.0, 27.6 and 2.4 %, respectively. Neither the time spent in a borate pit nor to live in boron-rich soils seemed to be significant so far as the prevalence of condition is concerned ($\chi^2 = 10.7$, $p = 0.0048$). No significance was observed either between second and third subclasses of instances having a borate job ($F = L07$, $p = 0.35$). Eleven women out of 98 described bone fracture, some been occurred in infancy. The age at menopause was 47.6 years for normals, 45.5 for osteopenics, and 43.1 for osteoporotics with a significant difference relating to first and third subcategories.

Table 1. Bone mineral density measures of probands.

BMD	No.	%
Normal	49	50.0
Osteopenic	27	27.6
<u>Osteoporotic</u>	22	22.4
Total	98	100.0

In Table 2 bone mineral density values of control cases are presented. There were 36 (36 %) cases with normal densitometry among 100 females from Balıkesir, 50 (50 %) with osteopenia and 14 (14 %) with osteoporosis. Age range of these postmenopausal subjects was between 53 and 83, the mean being 66.2 years. All were from Balıkesir and its vicinity, and almost all were living in the same city for years. In Ankara subpopulation of 108 persons 41 were normal, 34 osteopenic and 33 osteoporotic, the rates being 37.9, 31.5 and 30.5 %, respectively. It is clear that this subcategory of menopausal women was heterogeneous with respect to both birth and living places, and living standards as well.

Comparison of figures from the three subclasses of aged females seemed to lead to a conclusion that increased amounts of environmental boron exposure (or intake) does not associate with a lower frequency of osteopenia and osteoporosis in postmenopausal women. Early boron exposure at job on the other hand, tough open to critics, had too no an apparent effect on bone mineral density.

Table 2. Bone mineral density measures of control women.

BMD	Balıkesir		Ankara	
	No.	%	No.	%
Normal	36	36	41	37.9
Osteopenic	50	50	34	31.5
Osteoporotic	14	14	33	30.5
Total	100	100	108	100.0

4. DISCUSSION

This work appears to have some bearing on a present-day subject and the population under discussion. The presentation represented just one half of a population under the risk of developing osteoporosis. They all but one were born and living in a boron-rich territory with elevated levels of boron in drinking water; that about 60 % had once a borate job that required direct handling of, and thus direct exposure to the mineral; that for a whole life they consumed elevated amounts of boron perhaps excepting last few years. Additionally, many were kept themselves busy after retirement with engagement of agriculture and animal husbandry. Most of them had as many children as they liked or

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could do in those days where family planning was not so widely accepted. One further would take into account that economic state of the community in general was rather good.

Approximately one fourth of those were reported having osteopenia and another one fourth osteoporosis. Osteopenics were higher but osteoporotics lower among Balıkesir controls than iskele probands. Contrary osteoporotics were higher among Ankara controls than İskele probands; although the number of persons treated so far was not too large.

At the present stage of knowledge the fundamentals of this discrepancy are not clear. One would argue that technical differences as well differences of interpretation would account for.

In accordance with a substantial body of evidence (Nielsen, 1998) one would expect that osteoporotics should be at lower frequency among those with chronic boron exposure. This expectation seemed not to be met with. To be born and to live and to work in a boron-rich environment would not be *per se* an advantage to spare osteoporosis. Alternatively, there can be another as yet-undefined factor for the prevention of some bone disturbances in addition to boron supplementation.

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