

Low Frequency of Malignancy among Boron-Facility Workers

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ABSTRACT: In this observational study malignant conditions among borate workers are described. Among 1603 males working in ore pits and nearby facilities only 5 cases of malignancy, all surviving, were observed from 1999 to 2002, inclusive. These included Bowen's disease associated with adenocarcinoma, 'brain tumor' and lung carcinoma from Emet, gastric carcinoma from Kırka and bladder carcinoma from Kestelek. Although this was not a formal prevalence study, the rate was found 0.31% versus 0.20% among 1010 with boron- unrelated occupations.

ÖZET: Observasyonel ve kesitsel nitelikli bu çalışmayla Türkiye'nin bütün bor merkezlerindeki ocak ve fabrikalarda çalışan 1603 işçi arasında gözlenen malign tümörler verilmektedir. Kırka'dan adenokarsinomayla asosiy Bowen hastahgi, 'beyin tümörü' ve akciğer kanseri, Kırka'dan mide kanseri ve Kestelek'ten mesane kanseri gözlediklerimiz olup hastaların hepsi yaşamaktalar. Formal bir prevalans çalışması olmamakla beraber %0.31'lik oran bor çalışanı olmayan 1010 kişi arasındaki %0.20'den daha yüksek olmayıp bor maruziyetiyle ilişkisini belgelemeğe yetmez.

1. INTRODUCTION

Despite a large body of works in animals no human data is available on some topics, and this holds true for the carcinogenicity of borate minerals. Boyland and associates (1966) have injected intravaginally 20 BALB/C mice twice a week with 0.1 ml 2 % boric acid tragacanth suspension. One animal has developed squamous tumor of low-grade malignancy. In an other work 50 B6C3Fi mice per group and sex were administered boric acid approximately 70-80 mgB/kgbw in the diet. The histological examinatin showed no significant dose-related increase in neoplasm (NTP, 1987). A similar result has been reached by Dieter (1994). Under the conditions of these studies no evidence of tumorigenicity of boric acid has been reached and it has so been classified as "Group D" carcinogen, indicating that it shows "evidence of non-carcinogenicity" for humans (EPA, 1993).

During the course of study health effects of boron, if any, in a country with the world's largest borate deposits ever discovered. We here present some data, concerning our field observations and indicating that a few subjects indeed among borate workers have developed tumors.

2. EXPERIMENTAL WORK

2.1 Study areas

Study areas have extensively been described in previous articles (Şayh et al., 1998, Şaylı 1998, 2001, 2003). Briefly, these are all 4 centers with large borate deposits plus a processing facility, and Bandırma Borax and Acid Plants. The first four centers are İskele-Osmanca belt of Bigadiç county, Balıkesir; Kestelek village of Mustafa Kemal Paşa county, Bursa; Emet-Hisarçık belt, Kütahya, and Kırka town of Seydigazi county, Eskişehir. There is

no borate deposit in Bandırma, instead crude material brought out from centers is processed here and exported worldwide. Yet one should take into account that the area is on the same geomorphological soils with frequent earthquakes.

Drinking waters from natural sources across the production centers and towns and villages vary from 0.1 to 30 ppm (see Şaylı et al., 1998). They were grouped into three with respect to boron content: those from 0.1 to 2.0 ppm, those up to 10.0 ppm and as iskele street fountains, one with 8-10, and the other with 26-30 ppmB.

2.2 Study population

Two sets of individuals were covered. First set included 2456 subjects, 1906 (77.6 %) males and 550 (22.4 %) females as interviewed between the years 1999-2002, inclusive. An excess of males was because of inclusion miners in essence. Of total 1442 (58.7 %) were of boron-related and the remaining 1010 (41.3 %) of boron-unrelated occupations. Among the former there were 1256 (87.1 %) active and 186 (12.9 %) former workers. Twenty five out of 550 women presently had a boron job whereas 62 were retirees.

Anyone born and living on/near deposits and a facility were regarded exposing to borates environmentally lifetime; for natives from these communities move but little. And anyone from such a territory is exposed both environmentally and occupationally if he (she) has a boron job. And anyone from places far away from deposits is exposed occupationally, if he (she) had this kind of a work. However one should not expect that a clear-cut distinction so far could ever be achieved.

Second set of data covered only borate workers and employers. There were 290 workers and 133 employers from Bigadiç, 559 workers and 102 employers from Bandırma, and 143 workers and 61 employers from Kestelek, totalling 1288, 992 workers and 296 employers.

2.3 Boron exposure

Despite such limitations a classification could have been achieved at approximate terms. Of boron-involved probands some 10 % are exposed to the

element occupationally but 90 % environmentally and/or occupationally as natives. About 16 % of active and former workers fell in the most heavily-exposed subgroup (++++), 38 % heavily (+++), 19 % moderately (++) , 17 % mildly (+) and 10 % slightly or none. Exposure changed from 2 to 34, averaging 12.4 years. Though boron itself was not discriminated, total amount of powder in workplaces did not exceed 10 mg/m³. There were changes from one service to another, but most workers maintained their original appointment. No proband under 2 years of boron work was included.

Boron intake by drinking water can be judged from the information given above; however, boron content of some other beverages is not known. Daily boron intake via alimentary system is unknown either.

2.4 Methods

In this observational study the method was a questionnaire-based inquiry in field. Home and coffee-house visits in villages, and health offices and common buildings in towns were the sites of interview. For borate workers this was carried out at an ore pit and a plant at random. Lastly, health stories have been obtained from the personal files of workers, besides consultation was made with the physicians. No physical or laboratory examination was attempted at all.

2.5 Controls

There was no an adequate control group. And figures pertaining to the general population are not far from critics. However prevalence and incidence rates provided by Balıkesir Health Office were considered. Besides boron-related and unrelated probands Served controls each other to some extent.

3. RESULTS

3.1 Demographic data

The general character of participants was of rural. Some 90 % were natives of boron-rich territories and some 70 % of spouses were born in the same quarter as the proband, intermarriages being as frequent as 17 to 23 %. Needless to say that all

persons were living on/near deposits, mostly in their home places. Age distribution differed between 19 and 92 for males and between 18 and 80 years for females, the means ranging from 40.2 to 56.8 for the former and from 34.5 to 52.7 for the latter, implying a relatively young group of people was under consideration.

The educational state was also of rural type. Most of the elderly and particularly the women had no formal education at all. While male workers had preliminary grades, about 5 % had higher education, including university grades. It is also relevant that most of men and women were engaged in animal husbandry and agriculture following retirement; though females were housekeepers in the main.

3.2 Malignancy

Fives cases were revealed with a neoplasm. One was from Hisarcık county, born there and working at concentrator for 9 years following an 8-years open-field job. He was suffering from arsenic-bound Bowen's disease with squamous-cell carcinoma (Çöl et al., 1999). He displayed albinoid features and his older brother was described died with lung carcinoma.

Second case was a social-affairs employer in Kırka for 15 years, not exposing to borates directly. He was born in Yenigümüş village, Niğde, too far away from deposits. This 36-year old man had total gastrectomy due to carcinoma 6 years ago. Interestingly, his mother has not survived a similar operation for the same condition at age 70. A maternal uncle, dying at 47, had skin tumor. Still a maternal cousin had an intervention because of a mass in his calf. The last three had been lived in their home village.

Two cases were seemingly linked to boron exposure. A 49-year-old farmer from Eğrigöz town, Emet, with a crippling leg due to a wagon accident just on the third day of work in an underground pit was suffering from lung carcinoma. The other one was a retired borate miner who has been operated on a 'brain tumor' 5 years ago.

The fifth and last case was from Kestelek* but his birth place was Ermenek, Konya. He was an employer and had no direct contact with borates. He

has undergone an operation due to bladder carcinoma 7 years ago. It was learned that his sister had mammary carcinoma.

These five examples altogether, even though the one with a brain tumor was not specified, constitute 0.31 percent of 1603 borate workers, all alive at the time of inquiry. On the other hand 2 instances of malignancy among those with a boron-unrelated job were encountered. One of these, a 46-year old farmer from Gemiş village, Kırka, had lung carcinoma. His father-in-law, a blood-relative, suffered likewise. The other one appeared sporadic: a man from Dereköy, Hisarcık also had lung malignancy. These two instances with a rate 0.20% among 1010 probands having a boron-unrelated occupation would be regarded not too different.

Balkesir Health Office provided information for the province that the incidence was 0.32 and the prevalence 2.97 for 10,000 for the year 1998. Although no a statistical test was applied here, it seemed obvious none of the cases with a malignant disease could be related to occupational exposure to borates unless familial as well as other factors are to be taken into account.

As of early 2002, concerning second set of data, no one was reported suffering from a malignant condition among 849 workers and 235 employees of two facilities, Bigadiç and Bandırma. That the low frequency of malignancy in those subjects with chronic exposure to different boron minerals apparently compatible with the suggesting that boron is not a carcinogenic agent in humans at the present levels of amount.

4. DISCUSSION

This presentation mainly focused on workers in a borate region has some bearing in terms of boron exposure. It is to be remembered that the work is not a formal prevalence one nor intends to compare data from different populations and of authors. It has to be further underlined it is the first of its kind from this country. Prevalence and incidence figures of malignancy are far from being complete, and no segmental distribution is available either (Health Statistics, 2000).

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This survey is an observational one, realized in field interviewing two groups of persons: residents of a borate area on the one and borate workers on the other hand. Former group will not be dealt further with because of missing details. The latter may be divided as those exposed to the mineral environmentally and occupationally, but the number of affected is not large enough.

In spite of a small number of cancer cases insufficient for a statement in terms of ecotoxicology, one still would be impressed that environmental and/or occupational exposure to borates does not associate with an increased frequency of malignancy. Tumor types appeared not unusual either but not sufficient to compare. Five men, one being equivocal, out of 1603 subjects with a boron-related occupation was suffering from a malignant disease at the time of inquiry. Importantly however, the case with Bowen's disease and that from boron-distant region presented a frank genetic susceptibility. The one with lung carcinoma, seemingly without familial history, had a contact with borates only 3 days. And the last one with a bladder tumor also suggested familial disposition in pathogenesis.

The rate of these stands at about 0.3% - an occurrence hardly indicative of a high incidence of tumors among those having a boron-related job. Besides no case was in record among 1084 individuals, 849 workers and 235 employers of Bigadiç and Bandırma pits and plants suffering from malignancy.

Findings and individual stories presented here would support the conclusion that familial liability is of prime importance in addition to other agents in tumorigenesis even under continuous exposure to borates - a result compatible with that from animal experiments (Boyland et al, 1966, NTP, 1987, Dieter, 1994). And although preliminary the presentation of field observations appears merit for consideration that it reveals that boron exposure per se is not associated with an increased frequency of malignant diseases among miners, and supports the statement of EPA (1993).

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