

Fluoride abundance in drinking water and related health hazards: A case study from Khashki area, Nowshera district, N.W.F.P.

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ABSTRACT: Fluorides in food or drinking water have drastic effects on human health. High concentrations of fluorine in drinking water causes a disease called fluorosis. Geochemical study of groundwater and soil samples from the Khashki area in Nowshera District, N.W.F.P., (wherefrom frequent cases of fluorosis are related), was carried out in February to June 1994. The results show high concentration of fluorides (0.00 to 41.2 ppm) in the groundwater samples from the studied area which confirms fluoride toxicity. Necessary measures are required to be adopted to minimize the effect of this environmental deterioration.

INTRODUCTION

Several studies have shown that excessive fluoride intake is as damaging to health as no fluoride intake (Bernstein et al., 1960; Maier, 1971; Pindborg, 1970; Steinberg et al., 1955; Weaterell & Wiedmann, 1959). As drinking water is the main source of fluoride supply, it is absolutely imperative that its level of concentration be regularly monitored. The absence of fluorides in drinking water cause a disease called "Osteoporosis" in which bones and teeth degenerates (Bernstein et al., 1960). On the other hand, while the presence of fluorides up to 1.5 ppm results in dental fluorosis which is characterized by lusterless white mottling on the surface of teeth. The mottled area may become stained yellow or brown (Pindborg, 1970). Similarly, if this level exceeds 5 ppm, skeletal fluorosis can occur. According to Steinberg et al. (1955), water fluoride level above 8 ppm results in an increased X-ray density of trabecular bone (mesh work of interconnecting bone spicules) in

the lumber spine, pelvis and elsewhere. In addition, calcification of ligaments (a band of fibers connecting bones, serving to support and strengthen joints) also occurs. Histologically, fluorotic bone presents a very mixed picture in the X-ray chart. There may be a great increase in new bone formation as well as increase in the width and number of osteoid (organic matrix of bone) borders. Crippling skeletal fluorosis occurs when the water supply contains 10 ppm fluoride (Weaterell & Wiedmann, 1959).

This study was undertaken in response to reports of fluorine toxicity hazards, particularly skeletal fluorosis, from a village, Khashki, situated 50 kms north west of Peshawar and 5 kms west of Nowshera (Fig. 1). Similar reports have also been received from adjoining areas.

PRESENT INVESTIGATION

A large number of cases of dental and skeletal fluorosis were reported from the Khashki and

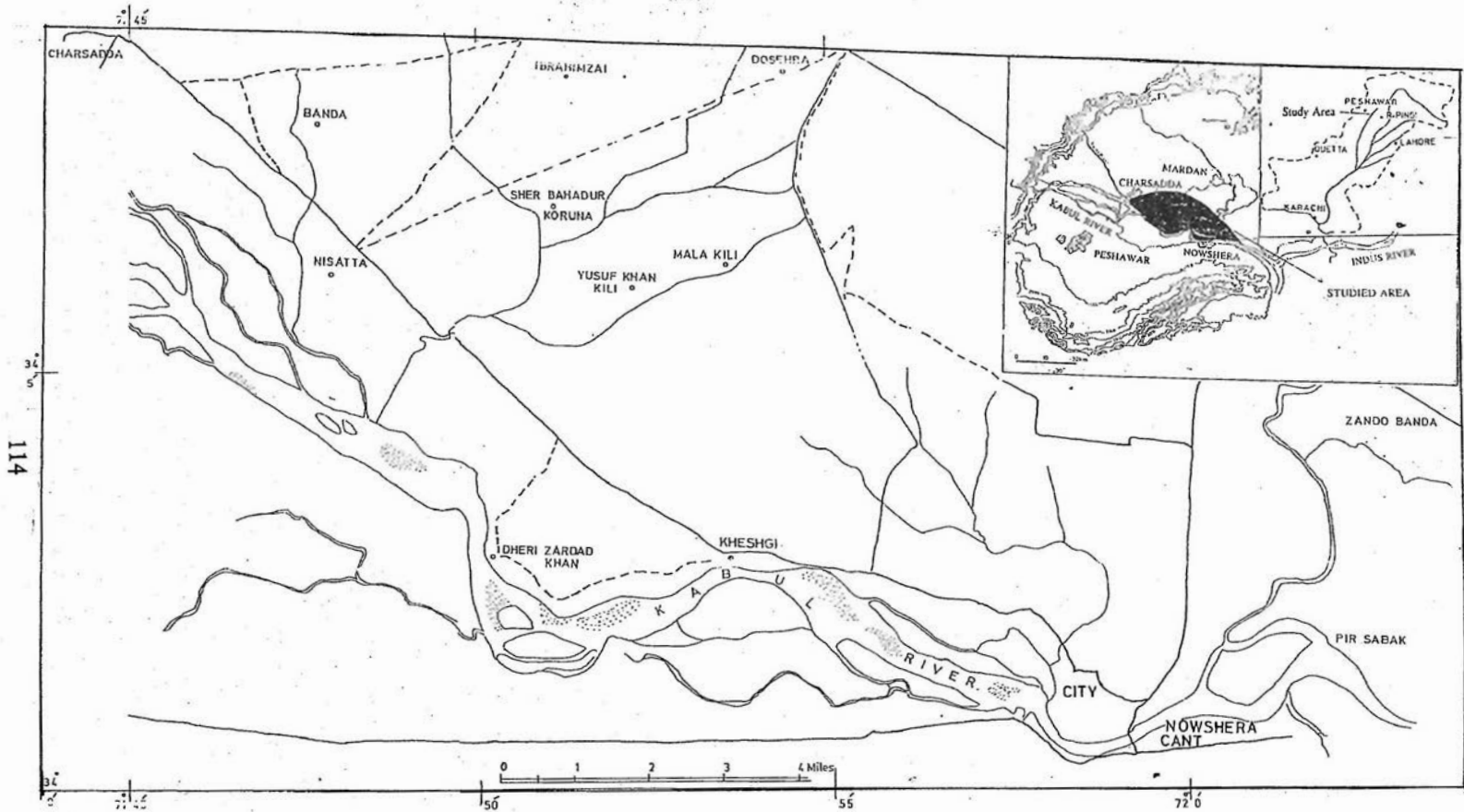


Fig. 1. Index map of Kheski and surrounding areas.

surrounding areas in Nowshera district in 1990 and afterwards. The first case was of a 60 years old lady. She was admitted in Medical A-Unit of Hayat Shaheed Teaching Hospital (HSTH), Peshawar in 1990. She had general body aches and weakness and had complained of pain specially in the ribs and spine. She was weighing 110 pounds, pulse was 80 per minute and had blood pressure 180/80. Lymph Nodes were not palpable. General medical check up did not show any abnormality except for crepitation (a dry cracking sound of sensation) in left lower chest. Teeth were of muddy appearance. Further investigations revealed normal blood count, urea, sugar and electrolytes. Urine analysis was also normal. However, the chest X-ray revealed thickening and sclerotic changes in the bones arousing suspicion of fluorosis/carcinoma, a breast cancer. Breast examination was normal and bone scan excluded the possibility of malignant disease. It was surprising to note that when other members of her family and village mates were examined in detail, they also showed symptoms of early fluorosis.

The case was brought to the notice of the Department of Geology, University of Peshawar, in January 1994, which for the systematic study of this health hazard prepared the following project schedule:

1. Collection of soil and groundwater samples from Khashki and surrounding areas according to a defined grid pattern.
2. Analysis of the samples for major and trace elements, especially for fluorides and other contaminants, using Atomic Absorption Spectrophotometer, Photospectrometer, pH meter, Conductivity meter, Dissolved Oxygen Meter, X-Ray Diffraction (XRD) etc.
3. Identification of the source of contaminants (minerals, rocks or any other material).

4. Understanding of the geochemical process(es) through which the toxic elements are released from its source into the groundwater.
5. Proposing remedial measures to eliminate/minimize the effect of this environmental deterioration.

The present work is concerned with the preliminary results of the first two steps of the project. Geological and geochemical study of the remaining parts of the project schedule is in progress. Complete report of the fluorides toxicity hazard will be published when details of step 3 and 4 of the project are available.

Initially samples of drinking water were collected from wells (shallow levels) and tube wells (deeper levels). A total of 450 km² area was divided into 10 sections as shown in figure 1. Within each section, water samples (average 2 to 5 samples, collected at the interval of 500 meters) were analyzed in detail. Average compositions from each site in the studied area are listed in table 1 and compared graphically in figure 2 with maximum contaminant level of WHO (1970) and USEPA (1986). It is evident that the fluoride content is 10 times greater than the maximum

TABLE. 1. AVERAGE FLUORIDE CONTENT (MG/L) OF KHESHKI AND SURROUNDING AREAS

1.	Khashki	20.18
2.	Dheri Zardad Khan	10.5
3.	Nissata	25
4.	Charsadda	0
5.	North of Khashki	23.5
6.	Doshara	0
7.	Nowshera City	23.5
8.	Rasilpur	7.25
9.	Zando Banda	23.7
10.	Pir Sabak	0

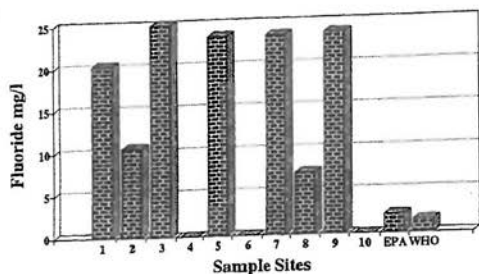


Fig. 2. Comparison of fluoride in groundwater of the Kheski and surrounding areas with USEPA & WHO, Maximum Contaminant Level values; Block 1 = Kheski area, Block 2 = Dheri Zardad Khan, Block 3 = Nissata, Block 4 = Charsadda, Block 5 = North of Kheski, Block 6 = Doshara, Block 7 = Nowshera City, Block 8 = Risalpur, Block 9 = Zando Banda, Block 10 = Pir Sabak.

contaminate level in most of the analyzed samples from the studied area. It is particularly highest in the north east of Kheski village. However, the western (Charsaddsa), northern (Doshara) and eastern (Pir Sabak) limits of the area have no fluoride in the drinking water.

CONCLUSION AND RECOMMENDATIONS

1. Cases of dental and skeletal fluorosis are frequently reported from the Kheski and surrounding areas in Nowshera district, N.W.F.P.
2. As this bone disease is the result of the high concentration of fluoride in drinking water, a ground water survey was carried out and samples were analyzed for both major and trace elements, specifically for the contaminants, including, fluoride, chloride, ammonia, nitrate, sulfate.

3. The chemical analysis show high concentration of fluoride which confirms fluoride toxicity hazard in the studied area.
4. It is very important to adopt certain remedial measure to save the inhabitants of the area from this environmental deterioration. Further work is in progress.

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