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FLUORIDE LEVELS OF DRINKING WATER AND DFZNTAL CARIES IN HAZARA AND MIANWALI

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Two hundred and sixteen drinking water samples from various sources in Hazara Division and District Mianwali were tested for fluoride levels.
In Hazara Division, out of 161 water samples, only 4 samples were found to have fluoride levels within acceptable range (0.8-1.5 PPM), remaining samples had fluoride either very low or not at all. The fluoride range was from 0.0 to 0.9 ppm with a mean of 0.11 ppm.
In District Mianwali, 55 drinking water samples were tested, the fluoride content was within normal limits or high, except few samples having less fluoride concentration. The range was 0.3 to 6.5 ppm with mean of 1.46 ppm.
1739 Primary and High School going boys and girls of District Abbottabad,
Haripur and Mianwali were examined for dental caries. In Hazara Division 61 % were found to have mild to severe dental caries while in District Mianwali, it was 4.9% while mottling was 14.6%.

INTRODUCTION

In nature fluoride (F) occurs as sodium fluoride (NaF), and is a common ingredient of rocks. Its fatal dose is 5- 10 g. Traces of fluorspar (CaF_2) occur in bones and tooth enamel. Fluoride is a normal constituent of the human body and is distributed in food stuffs, fish, tea, cereal grains, milk etc. The commonest source of fluoride salt is drinking water, which is 0.5-4.0 mg/day. The estimated safe and adequate dietary intakes of fluoride are 1.5 to 4.0 mg/day for adults.

Inorganic fluoride plays a significant role in the prevention of dental caries. It has a beneficial effect on osteoporosis and other forms of bone demineralization by decreasing pain and improving bone density and calcium balance. It maintains normal hematocrit, fertility and growth. The concentrations of fluoride vary in different parts of the world. 1 ppm of fluoride level is safe and does not affect the health, it reduces the prevalence of dental caries, but if water content is more than 1 ppm, then mottled enamel and other adverse effect on bones are evident[1].

Dean et al (1938) [2] studied an area where the fluoride content of water varied from 0.0 to 2.6 ppm on 700 children aged 12 to 14 years. Decreasing dental caries was observed with increasing concentration of fluoride in water upto 1.5 ppm. Similar studies earned out in U.K. by Weaver (1944) [3] and Forrest (1956) [4] in England show that low levels of fluoride intake are associated with osteoporosis and dental caries.

Hardwick (1958)[5] and Jenkins (1963)[6] have elaborated that the mode of action of fluoride in water is by two ways (i) it increases the resistance of enamel (ii) it reduces the effectiveness of microbiological attack. Many investigators [7 ' 9] suggested that fluoride is deposited in teeth during their formative periods. They further said that it also has an effect on enamel, when the mineralization is complete before eruption as well as after eruption, during the entire life span of the tooth. The fluoride content of enamel increases with fluoride concentration in drinking water. They observed that other trace elements also reduce dental caries. The effect of fluoride on enamel can be tested in vitro: when powdered enamel, Hydroxyapatite ($Ca_3(Po_4)_2$-$Ca(OH)_2$ is treated with a solution of sodium fluoride containing less than 1 ppm, the hydroxyl groups of the hydroxyapatite are

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exchanged for fluoride, which is shown as follows:

$3Ca_3(Po_4)_2Ca(OH)2+2F \rightarrow 3Ca_3(Po_4)2CaF_2H$

Fluoride has an inhibitory effect on the glycolytic mechanism particularly on enzymes, with a resultant reduction in the amount of acid formation from glucose.

Mackay and Black (1916) [10] for the first time discovered in Colorado Springs in USA that the teeth of inhabitants became mottled in areas where fluoride content was higher. Chronic excess intake (26-100 mg/day) produce fluorosis with mottling discoloration and pitting of dental enamel. Large amounts can also affect & impair growth and cause osteosclerosis & exostoses of long bones and joints.

In developed countries, in areas where fluoride level is low, addition of fluoride salt, (1 ppm of the water - fluoridation) is done. This process is cheap, effective and efficient. Today almost half of the United States population drinks water from supplies that have fluoride contents near the original level of 1 ppm either naturally or after addition of fluoride compound.

In Britain, one area (Anglesey) where fluoridation was stopped, five year later Prof. Jones [11] monitored the dental health of children and compared it with a control community. He found that children of 4 years of age had 7.1 % tooth decay, missing or filled teeth while in control area it was 3.0%. Thomas and Karsab [12] recently reported that women who lived in fluoridated area had 30% fewer caries than women living in non- fluoridated areas.

Tariq and Ahmed (1984)[13] reported that in Punjab, Pakistan, 43.5% of drinking water had a fluoride content less than 0.5 ppm, 26.4% of samples were found to be within the acceptable range of 0.5-1.0 ppm, while 2.8% had fluoride level 5.0 to 23.6 ppm. The area of Raiwind, Lahore, is potentially dangerous for dental fluorosis.

Mottling and other diseases caused by increased fluoride concentrations are present in Kasur, Raiwind and District Mianwali.

In the present study, we determined the content of fluoride in drinking water of Hazara Division and Mianwali (Punjab), and its effect on dental caries of school going children.

MATERIALS AND METHODS

216 drinking water samples were collected from Districts Abbottabad, Havelian, Mansehra, Haripur (Hazara) and Mianwali (Punjab). Samples were taken from the main water sources where maximum people were using them for drinking purposes. The distribution of sources and areas is shown in Table-1.

1739 boys and girls were examined from different schools of District Abbottabad, Haripur and Mianwali (Punjab). Their age, sex and positive dental caries were recorded on a proforma.

The water fluoride levels were determined by the Alizarin-Zarconyl method [14] as described by N. Nordmami.

TABLE-1: DISTRIBUTION OF SOURCES AND AREAS OF WATER SAMPLES.

SOURCE	Abbottabad	Havelian	Mansehra	Haripur	Mianwali	TOTAL
1. Taps of Houses & Hotels (Govt. Supplies of Deep Wells & Spring Stores)	14	01	02	06	08	31
2. Deep Wells	10	06	06	14	05	41
3. Shallow Wells	20	07	20	04	06	57
4. Deep Springs	02	Nil	Nil	Nil	Nil	02
5. Shallow Springs	12	04	08	Nil	Nil	24
6. Streams	05	01	02	Nil	Nil	08
7. Hand Pumps	06	01	04	05	34	50
8. Ponds	01	Nil	Nil	Nil	Nil	01
9. Lakes	Nil	Nil	Nil	Nil	02	02
TOTAL	70	20	42	29	55	216

RESULTS & CONCLUSIONS

The fluoride levels of 216 drinking water samples are summarized in Tables 2 - 6 .

TABLE-2: FLUORIDE LEVELS IN DISTRICT ABBOTTABAD

SOURCE	NO. OF SAMPLES	TESTED	FLUORIDE LEVEL RANGE 0.0-0.4	0.50.8	0.9-1.4	1.5-2.4	2.5-10
1. Shallow Wells	20	16	04	Nil	Nil	Nil	Nil
(10 - 20 ft) 2. Taps	14	13	01	Nil	Nil	Nil	Nil
3. Shallow springs	12	12	Nil	Nil	Nil	Nil	Nil
4. Deep Wells	10	10	Nil	Nil	Nil	Nil	Nil
5. Hand Pumps	06	06	Nil	Nil	Nil	Nil	Nil
6. Streams	05	05	Nil	Nil	Nil	Nil	Nil
7. Deep Springs	02	02	Nil	Nil	Nil	Nil	Nil
8. Ponds	01	01	Nil	Nil	Nil	Nil	Nil
TOTAL	70	65	05	Nil	Nil	Nil	Nil

TABLE-3: HAVELIAN

1. Deep Wells	09	09	Nil	Nil	Nil	Nil	Nil
2. Shallow Wells	06	06	Nil	Nil	Nil	Nil	Nil
3. Shallow springs	04	04	Nil	Nil	Nil	Nil	Nil
4. Streams	01	01	Nil	Nil	Nil	Nil	Nil
TOTAL	20	20	Nil	Nil	Nil	Nil	Nil

TABLE-4: MANSEHRA

1. Shallow Wells	20	20	Nil	Nil	Nil	Nil	Nil
2. Shallow springs	10	10	Nil	Nil	Nil	Nil	Nil
3. Hand Pumps	06	06	Nil	Nil	Nil	Nil	Nil
4. Deep Wells	04	04	Nil	Nil	Nil	Nil	Nil
5. Streams	02	02	Nil	Nil	Nil	Nil	Nil
TOTAL	42	42	Nil	Nil	Nil	Nil	Nil

TABLE-5: HARIPUR

1. Deep Wells	16	12	Nil	02	02	Nil	Nil
2. Shallow Wells	09	08	01	Nil	Nil	Nil	Nil
3. Hand Pumps	04	04	Nil	Nil	Nil	Nil	Nil
TOTAL	29	24	01	02	02	Nil	Nil

TABLE-6: MIANWALI

1. Hand Pumps	34	32	04	10	Nil	12	06
2. Taps	08	02	02	Nil	Nil	Nil	Nil
3. Shallow Wells	06	06	Nil	03	Nil	01	02
4. Deep Wells	05	05	01	03	Nil	Nil	01
5. Lakes	02	02	Nil	02	Nil	Nil	Nil
TOTAL	55	47	07	18	Nil	13	09

DISCUSSION

From the present study it was observed that in Hazara Division, there is a severe deficiency of fluoride in drinking waters. A previous study by Ahmed [15] in this area showed that out of 50 samples, only two samples had fluoride levels in normal range and in 38 samples fluoride concentration was nil. Our results are similar to this previous study, in that out of 161 drinking water samples only 4 samples of District Haripur were found to have an acceptable range of fluoride levels. This indicates that in the past

decade no proper measures were adopted for fluoridation of drinking water.

In District Mianwali of Punjab, only 7 samples out of 55 samples (12.7%) had low fluoride levels. This was due to the fact that water samples were taken near the banks of a canal passing through Mianwali. 31 (56%) water samples were in normal fluoride level range, while 9 (16.4%) had increased fluoride levels. It is probably the main reason that the prevalence of dental caries in children of District Mianwali as compared to Abbottabad and Haripur is very low.

In developed countries fluoridation [16] has reduced dental caries to 60 %. In Hazara Division there are low quantities of fluoride in drinking water and high dental caries / decay as compared to areas of Mianwali, where dental decay was only 4.9%.

The low fluoride levels in hilly areas of Hazara Division obviously indicates that this is due to leaching of the soluble fluoride salts from these soils and this may be due to heavy rains. Therefore, the soil water is deficient in fluoride salt. It is recommended that fluoridation should be carried out in this area regularly to prevent dental caries, disfiguration of teeth and to reduce high dental treatment costs, because the cost of fluoridation is pennies per year compared to dental treatment which is in hundreds per year. Application of fluoride in tooth pastes or direct application is considered of inconclusive value, while suitable fluoridation or intake of fluoride in food such as milk or other substitutes is valid and safe.

The age, sex and dental caries status of 1739 children are summarized in Tables 6 - 8 .

TABLE-6: PERCENTAGE OF DENTAL CARIES OF SCHOOL GOING CHILDREN OF DISTRICT ABBOTTABAD

AGE GROUP	TOTAL NOS.	SEX		NO. OF DENTAL CARIES (POSITIVE CASES)	
		MALE	FEMALE		PERCENTAGE
4-5	66	52	14	31	47.0
6-7	279	249	30	198	71.9
8-9	257	231	76	194	75.5
10- 11	118	79	39	79	66.9
12- 13	103	82	21	74	71.8
14- 15	27	21	6	15	55.5
16 +	14	9	5	5	35.7
TOTAL	864	723	141	596	69.0

TABLE-7: PERCENTAGE OF DENTAL CARIES OF SCHOOL GOING CHILDREN OF DISTRICT HARIPUR

4-5	14	14	Nil	7	50.0
6-7	63	50	13	39	61.9
8-9	81	76	6	45	55.5
10- 11	118	96	22	70	59.3
12- 13	153	153	Nil	69	45.1
14-15	93	93	Nil	48	51.6
16 +	25	13	Nil	13	52.0
TOTAL	547	495	41	291	53.2

TABLE-8: PERCENTAGE OF DENTAL CARIES OF SCHOOL GOING CHILDREN OF DISTRICT MIANWALI

4-5	12	12	Nil	Nil	Nil
6-7	41	41	Nil	3	7.3
8-9	128	128	Nil	5	3.9
10-11	70	70	Nil	4	5.7
12- 13	54	54	Nil	3	5.5
14- 15	21	21	Nil	1	4.7
16 +	2	2	Nil	Nil	Nil
TOTAL	328	328	Nil	16	4.9

The mottling of teeth was 16.8% in District Mianwali (Table-9).

TABLE-9: DISTRIBUTION OF MOTTLING IN SCHOOL GOING CHILDREN OF DISTRICT MI AN WALL

	No. of	SEX		POSITIVE MOTTLING	
AGE GROUP	SUBJECTS	MALE	FEMALE	NUMBERS	PERCENTAGE
4-5	12	12	Nil	Nil	Nil
6-7	41	41	Nil	4	9.7
8-9	128	128	Nil	23	18.0
10-11	70	70	Nil	12	17.1
12-13	54	54	Nil	5	9.2
14-15	21	21	Nil	3	14.2
16 +	2	2	Nil	1	50.0
TOTAL	328	328	Nil	48	16.4

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