

PREVALENCE OF DENTAL FLUOROSIS IN THE WONJI SHOA SUGAR ESTATE

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ABSTRACT: Wonji Shoa Sugar Estate is a large compound in central Ethiopia known for the high fluoride levels in its drinking water supplies. A defluoridation programme of drinking water in a parallel supply has been going on for the last 35 years. Three samples with a total of 234 children aged 8-12 years from four villages of the estate were examined for dental fluorosis. Mouth prevalence rates of 95.7 %, 92.4 % and 71.8 % were found respectively for Wonji village, Shoa village and villages M and O for all grades of dental fluorosis. The variations in the occurrence and severity of dental fluorosis between the four villages are discussed and the impact of the defluoridation programme is appraised. The poor impact of the defluoridation programme is attributed to low reliability of the defluoridation and inconsequent consumption of defluoridated water.

Key words: Dental Fluorosis; Defluoridation programme; Rift Valley; Ethiopia.

INTRODUCTION

Fluoride is an essential trace mineral that is present in trace amounts in every human tissue but becomes concentrated in bones and teeth.^{1,2} Fluoride in foods and water is easily observed by way of the portal system. From the amount of ingested, about half is retained in bones and teeth and the rest is excreted in urine.^{1,3,4}

Ingestion of excessive fluoride during the period of tooth development causes dental fluorosis. The pathological changes of dental fluorosis involve hypoplasia and/or hypocalcification of the enamel.^{1,5} Hypoplasia which is due to poor formation of the organic matrix of the enamel or missing chunks. Hypocalcification results in lack of luster and is manifest clinically as white, yellow or brown lines or areas (opacities).

Dental fluorosis can occur both in deciduous teeth and in the permanent teeth, the latter being more affected.⁶ The extent of fluoride uptake in different parts of the dentation and skeleton depends upon the amount ingested and absorbed by the organism, the duration of fluoride exposure and the type, the region and the metabolic activity of the tissue concerned. Dental fluorosis is a good indicator of exposure to excessive amounts of fluoride. It can be easily studied by examining the permanent incisors. The critical age of calcification of the enamel of the permanent incisors is 3-4 years. The permanent incisors erupt during age of 7-9 years.⁷

Endemic fluorosis is widely distributed through out the world. Its occurrence has been reported in the USA, China, England, India, South Africa, New Zealand, Sweden, Morocco, and Cuba.⁸ It is wide-spread in the East African Rift Valley, including the Ethiopian Rift Valley due to the high levels of fluoride in water sources.⁹ Wonji Shoa Sugar Estate (WSSE), established in 1954 and located in central Ethiopia within the Rift Valley, has been known to have high levels of fluoride in its water supplies. The community residing in the two factory villages (Wonji and Shoa) and 14 plantation

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villages scattered throughout the estate has depended on well water having high fluoride levels for domestic purposes.

In the two factory villages of WSSE, a defluoridation programme of drinking and cooking water supplies has been going on since 1962. In the plantation villages, a defluoridation programme was launched in 1976 but has been discontinued for the last two years. Raw water has been supplied separately to all factory and plantation villages right from the beginning. So there has been a dual supply of treated and raw water. In some plantation villages, when well water is unavailable from taps, the residents consume water from the nearby river, Awash River.

After the defluoridation programme was started, a survey of dental fluorosis was carried out in 1985 in four villages of the estate. The purpose was to examine the impact of the defluoridation activities on the prevalence of dental fluorosis.⁵ The purpose of the present survey is to estimate the present prevalence of dental fluorosis in the same four villages and make an assessment of the outcome of the defluoridation programme in the light of the earlier studies.

MATERIALS AND METHODS

The target population was all children aged 8-12 years, residing in one of the four villages Wonji, Shoa, Village M or Village O, and having 6 or more permanent anterior teeth erupted. All eligible children learning in Grades 1-3 of the two of the three elementary schools in Wonji villages and one of the two elementary schools in Shoa villages were registered, producing a sample of 70 children for Wonji villages and a sample of 79 children for Shoa village, respectively. For villages M and O all eligible children were registered and a random sample of 85 children was selected.

Each child's guardian was interviewed and every child had examination of the anterior teeth under natural light by one of the investigators. Dental fluorosis for each examined tooth was graded according to the classification criteria of Dean and modified by Møller.^{6,7,10,11,12}

Normal: The enamel is translucent, smooth and presents a glossy appearance.

Very mild: Small paper - white areas on the tooth involving less than 25 % of the surface.

Mild: Opaque areas involving up to 50 % of the surface.

Moderate: The whole of the enamel surface may be affected with chalky white areas or yellowish or brown staining; surface subject to attrition become worn.

Severe: The enamel is grossly defective, opaque, pitted, stained brown and brittle, and may have a corroded appearance.

Data were collected in July 1997. Data were processed using a computer. Prevalence rates of dental fluorosis were calculated in two ways:

- Mouth prevalence rate as the percentage of children having at least one tooth affected.
- Tooth prevalence rate as the percentage of affected teeth.

RESULTS

In total 234 children were included in the survey. Baseline characteristics of the respondents are given in Table 1 and 2.

TABLE 1. Consumption of sweets and sugar cane among study subjects, Wonji, Ethiopia 1997.

Consumption	None		Some times		Frequently	
	No	%	No	%	No	%
Sweets	15	6.4	215	91.9	4	1.7
Sugar cane	7	3.0	97	41.5	130	55.6

The male and female sex ratio level 1:1.2. Most of the respondents (88.5 %) were born in the villages of the state and 94.0 % had lived in the estate during the early childhood (i.e. up to age of 4 years). The average monthly family income was 101-600 Birr for 74.4 % of the children. Most of the children (93.6 %) have been consuming sweets sometimes or frequently and 97.0 % have been consuming sugar cane sometimes or frequently.

The results of the examination of the teeth are summarised in Table 3. The tooth prevalence rates of dental fluorosis for each of the three samples are presented in Table 4. The mouth prevalence rates of dental fluorosis for each sample are given in Table 5. The table shows the mouth prevalence rates of all grades of dental fluorosis (very mild to severe) and also for all grades of dental fluorosis excluding the very mild cases.

For the sample from Wonji villages, only 3 children (4.3 %) has all anterior teeth free from dental fluorosis and all of these children were born outside the estate. From the sample of Shoa village, only 6 children (7.6 %) had all anterior teeth free from dental fluorosis. Among these 6 children, four were born outside the estate. In the sample from village M and O, 24 children (28.25) had all their anterior teeth unaffected with fluorosis. Among these, 22 were born and grown up in the estate.

TABLE 2. Baseline characteristic of respondents

n=234		No	%
Sex			
	Male	106	45.3
	Female	128	54.7
Place of Birth			
	Estate	207	88.5
	Other	27	11.5
Residence (childhood)*			
	Estate	220	94.0
	Other	14	6.0
Present Residence			
	Shoa	79	33.8
	Wonji	70	29.9
	Camp 11	43	18.4
	Camp 12	42	17.9
Average monthly income			
	≤ 100	16	6.8
	101-300	93	39.7
	301-600	81	34.6
	> 600	44	18.8

* Up to age 4

DISCUSSION

The results of this survey showed high prevalence rates of dental fluorosis in the four villages of WSSE studied particularly in Wonji and Shoa villages. The prevalence rates are comparable to those found in previous studies. One study in 1977 showed and 87% mouth prevalence of dental fluorosis among children 5-10 years old.¹² Another study involving 1456 individuals in 14 communities of central part of the Ethiopian Rift Valley found prevalence rates of dental fluorosis ranging between 69% and 98%, the average rate being 84%.¹³

A survey conducted in 1985 in WSSE, and involving the examination of the permanent incisors in 8 years old children found mouth prevalence rates of 64 % for Wonji village, 75 % for Shoa village and 34 % for village M and O.⁵ The corresponding tooth prevalence rates were 49 %, 56 % and 18 % respectively. Among adults 20-25 years old a mouth prevalence rate of 77 % and a tooth prevalence rate of 69 % were found. That survey used a grading of dental fluorosis different from the one that was used in this survey but it can be seen that still there are high rates of dental fluorosis in the estate.

TABLE 3. Results of dental examination among respondents, Wonji, Ethiopia, 1997.

Type of Tooth	Degree of tooth damage (problem), n=234											
	Normal		Very mild		Mild		Moderate		Severe		DMF	
	No	%	No	%	No	%	No	%	No	%	No	%
11	37	15.8	48	20.5	27	11.5	82	35.0	40	17.1	-	-
12	57	24.4	38	16.2	29	12.4	78	33.3	11	4.7	21	9.0
21	41	17.5	47	20.1	28	12.0	78	33.3	39	16.7	1	0.4
22	55	23.5	35	15.0	32	13.7	77	32.9	10	4.3	25	10.7
31	86	36.8	52	22.2	48	20.5	42	17.1	5	2.1	1	0.4
32	86	36.8	51	21.8	49	20.9	40	17.1	4	1.7	4	1.7
41	86	36.8	53	22.6	48	20.5	42	17.9	5	2.1	-	-
42	85	36.3	53	22.6	47	20.1	40	17.1	4	1.7	5	2.1

TABLE 4. Tooth prevalence by place of residence, Wonji, Ethiopia, 1997.

Variable	Place of residence			
	Wonji	Shoa	Camp 11	Camp 12
Tooth examined	560	632	344	336
Tooth with fluorosis	482	512	130	161
Tooth prevalence (%)	86.1	81.0	37.8	47.9

TABLE 5. Mouth prevalence rates of dental fluorosis in three samples from Wonji Shoa Sugar Estate.

Village	Sample size	All grades	All grades excluding very mild cases
Wonji	70	95.7 %	84.3 %
Shoa	79	92.4 %	86.2 %
M & O	85	71.8 %	27.1 %

The fluoride levels in the various water supplies of the estate during the one year period preceding this survey (July 1996 to June 1997), as documented in the record book of the laboratory in Wonji Hospital (the hospital of WSSE) are present in Table 6. In Wonji and

Shoa villages where the defluoridation plants were operational, it can be seen that the levels of fluoride in treated water were at times above the safe level. In villages M and O, which are supplied by water from a common well the defluoridation plants were not functioning and the levels of fluoride in the raw water were similar to those in treated water from Wonji and Shoa villages.

The prevalence rates of dental fluorosis in Wonji and Shoa villages were found to be high despite the availability of treated water. This appears largely to be due to the dual nature of the water supply, with the supply of raw water with high fluoride levels being readily accessible. It is very likely that children in these villages consumed

significant quantities of raw water. Moreover, the level of fluoride in treated water was at times high in villages M and O the prevalence rate of dental fluorosis is lower and most cases of dental fluorosis are very mild. The reason for this is partly because of the low level of fluoride in the raw water supply of the villages and partly because the residents in these two villages too often consumed water from Awash River when tap water from the well was available, as observed during the conduct of this survey.

It can be concluded that the impact of the defluoridation programme on the occurrence of dental fluorosis in the estate is negligible at present. The situation was found to be much better in the areas where the raw water had low fluoride levels and where the residents were additionally consuming river water.

TABLE 6. Fluoride levels in the water supplies of the four villages of WSSF during the period July 1996 to June 1997.

Village	mg F/L treated water	mg F/L raw water
Wonji	< 0.10 - 1.8	6.0 - 12.5
Shoa	0.24 - 4.0	0.37 - 6.0
M and O	-	0.80 - 2.2

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