FLUORIDE AND FLUOROSIS IN THE SUDAN

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SUMMARY: In Sudan the Nile River provide water for agriculture and industry, and for the majority of Sudanese households. Where Nile water is unavailable, sub-surface water reservoirs are tapped. No comprehensive study has ever been made on the fluoride contents of Sudanese ground water. Dental fluorosis is, however, found in certain areas of the country, especially in the Northern and Western provinces. In the present study water samples were collected from 55 wells in various provinces in the northern part of Sudan. The fluoride concentration of the waters ranged from 0.08 to 3.55 mg-F/L. The overall average fluoride concentration was 0.34 mg-F/L. Dental fluorosis was studied in two villages in the Khartoum area, Treit el Biga (TeB) and Abu Groon (AG). The fluoride contents of the village wells were 0.25 and 2.5 mg-F/L, respectively. All the examined children in AG had dental fluorosis, with Dean's scores ranging from 1 to 4. The Community index was 2.44. The prevalence and degree of dental fluorosis in high-fluoride AG was comparable to what has previously been reported from areas with a similar fluoride concentration. Dental fluorosis was seen in 91 percent of the children in low-fluoride TeB. The TeB community index was 1.40. The fact that 91 percent of the examined children developed dental fluorosis in TeB; an area with lower than average fluoride concentration in the drinking water, is alarming, and requires further studies.

Key words: Fluorosis, fluoride, Sudan, Dean's Index.

INTRODUCTION

As the local yearly precipitation is low, the Nile rivers are the main source of water in the Sudan. According to recent reports[1], the fluoride contents of Nile waters fluctuate between 0.2 and 0.4 mg-F/L. Emslie (1966), however, indicated that fluoride values as high as 1.0 mg-F/L may be recorded, especially when the Nile water is low[2].

Most Sudanese communities outside the Nile valley depend on ground water. As compared with the local surface water, ground water is, on an average, richer in fluoride[3]. Anecdotal information on fluoride containing ground water is available, but no comprehensive study of the fluoride contents of Sudanese ground water has ever been made. Dental fluorosis was reported already 30-40 years ago among children in certain areas, especially in Northern and Western Sudan[2]. To our knowledge, skeletal fluorosis has not been reported in the Sudan.

The aim of the present study was twofold:

- To assess the fluoride contents of water from selected groups of deep wells in Central, Northern and Eastern Sudan, and
- To study the prevalence of dental fluorosis in a low-fluoride and a high-fluoride village in the Khartoum area.

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MATERIAL AND METHODS

Fifty five individual water samples were collected from deep wells in the Gezira area (21 wells); Kordufan area (13 wells); Northern area (4 wells); Red Sea area (5 wells); and Khartoum area (12 wells).

Water samples were taken directly from faucets/pumps and filled into 30 ml Sarstedt polypropylene bottles, fitted with tight lids. The samples were brought to Norway by courier, and the water was analysed for fluoride at the Inst. of dental research, University of Bergen. Fluoride selective electrodes were used for the analysis, according to standard procedures[4].

Dental fluorosis was studied in two villages, Treit el Biga (TeB) and Abu Groon (AG). The villages, situated within a distance of 50 km from Khartoum, were of similar size and had comparable socio-economic conditions. Both communities were supplied with water from boreholes drilled into the bedrock (Nubian sandstone) 15-20 years ago. The Treit el Biga water contained 0.25 mg-F/L while the fluoride contents of the Abu Groon well were ten times higher; 2.54 mg-F/L.

Permission to examine school children in the villages was obtained through the teachers. The examination was carried out by one person (YI) according to WHO's criteria for field studies[5]. One hundred and thirteen children (55 in TeB and 58 in AG), 6 to 16 years old, were available for examination. Fluorosis was scored according to Deans Index[6], based on inspection of the upper central incisors.

RESULTS

The fluoride contents of water samples from fiftyfive different villages ranged from 0.08 to 3.55 mg-F/L. The average value was 0.34 mg-F/L. Regional differences were moderate, as appears from Table 1.

Dental fluorosis was found in all the AG children. As demonstrated by Figure 1, the fluorosis scores varied from 1 (very mild) to 4 (severe). The "community fluorosis index" (Fci) of AG was 2.44. Dental fluorosis was observed in 91% of the children in TeB. The fluorosis scores covered the whole spectre, from 0 to 4. Fci of TeB was 1.40.

TABLE 1. Fluoride concentration of ground water in mg-F/L, according to region.

Region	Mean	s.d.	Range	n
Kordufan	0.27	0.16	0.12-0.63	13
Red Sea area	0.28		0.18-0.38	5
Gezira	0,34	0.43	0.09-1.96	21
Northern area	0.40	0.29	0.13-0.81	4
Khartoum area	0.46	0.99	0.08-3.55	12
Overall average	0.36	0.55	0.08-3.55	55

DISCUSSION

The wells examined were all placed within areas dominated by Nubian sandstone. Fluoride containing aquifers may be found in sandstone, but high-F water is less prevalent in the Sudan than e.g. in the Rift Valley areas of East Africa. The highest value found in the present investigation was 3.55 mg-F/L. Previous reports have recorded fluoride containing ground water, e.g. in the Western provinces of Kordofan and Darfur[1]. In these areas pockets of volcanic basalt may be found.

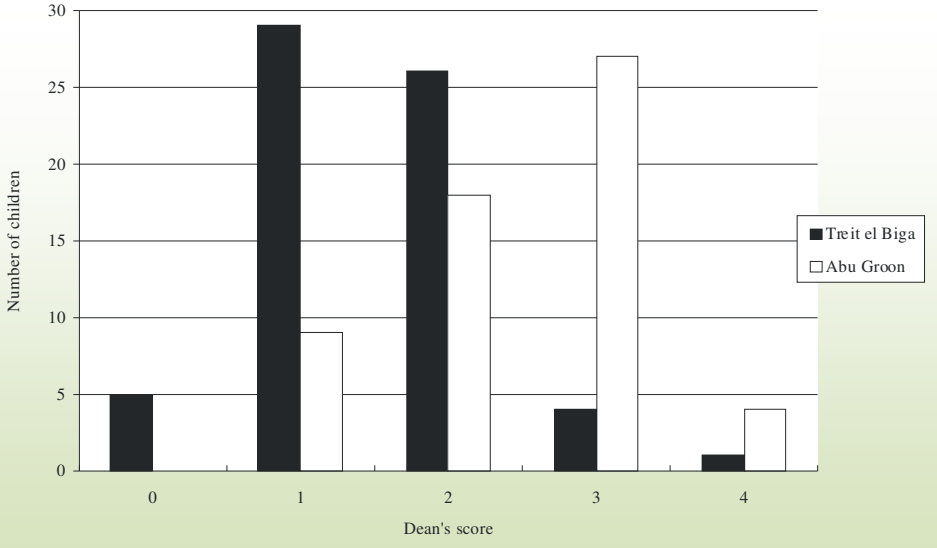

FIGURE 1: Dean's score for dental fluorosis among children in the cities Treit el Biga and Abu Groon.

Dental fluorosis in the Sudan was first reported in 1953, when Smith, Harris and Kirk examined schoolboys in the Butana desert[7]. The prevalence of fluorosis was 60.6 per cent. The relevant water sources contained fluoride in the range of 1.1 to 4.0 mg-F/L. According to the generally held opinion, Smith and co-workers regarded fluoride concentrations of less than 0.8 mg-F/L as harmless, and consequently had problems in explaining the fact that five (out of eight) boys living in a village with only 0.65 mg-F/L in the drinking water developed dental fluorosis. Emslie (1966) found fluoride concentrations in Sudanese drinking water of up to 5 mg-F/L and reported a prevalence of 90 per cent fluorosis in one area[2]. Conflicting information on the prevalence of dental fluorosis in the Sudan has appeared recently: Ghandour, Ibrahim and Shehata found a fluorosis-prevalence of 64 per cent in boys and 50 per cent in girls from Omdurman[8], while Elhassan found dental fluorosis only in 4.5 percent of the children in neighbouring Khartoum[9]. The fluoride concentration of the relevant drinking water is not mentioned, but the two cities would be expected to take water from the same source; the river Nile.

The prevalence of dental fluorosis presently found in Abu Groon is high, but comparable to results from other African villages with similar fluoride concentrations in the water[10]. The results from low-fluoride Treit el Biga are unexpected. Equally high prevalence of dental fluorosis has not previously been reported in areas with only 0.25 mg-F/L in the drinking water.

CONCLUSION

Based on the present material, the average fluoride contents in Sudanese ground water is relatively low (~ 0.3 mg-F/L), but pockets of high-fluoride water may exist, even in low-fluoride areas. Water sources used for household purposes should, consequently, be analysed for fluoride.

It is important to bear in mind that the development of dental and skeletal fluorosis depends on the total daily intake of fluoride. The Treit el Biga findings (more than 90 percent prevalence of dental fluorosis in a community using water with 0.25 mg-F/L), may therefore indicate that drinking water is not the only fluoride source to be taken into consideration. Until all relevant sources are known, no safe limit can be defined for fluoride in water.

Follow-up studies are needed in order to assess total daily water intake, scrutinise feeding habits during the critical weaning period, and identify possible additional fluoride sources, such as tea, fish and - maybe - fluoride containing trona.

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