Fluorosis in Assam, India

The first case of endemic fluorosis in humans from India was reported by Short *et al.*[1] from Prakasam district of Andhra Pradesh in 1937. In 1950 only four states in India – Andhra Pradesh, Tamil Nadu, Punjab and Uttar Pradesh were identified with people suffering from fluorosis. By 1986, 13 states were found as endemic for fluorosis and during 1990–92, two additional states, i.e. Kerala and Jammu & Kashmir had also joined the list. A report[2] published by Rajiv Gandhi National Drinking Water Mission, identified 14 states and Delhi as endemic for fluorosis. It was also mentioned in the report that in West Bengal (WB) and the seven northern hill states, the disease was not detected yet. However, the groundwater fluoride contamination and sufferings of people from Birbhum district of WB and Karbi-Anglong district of Assam have come to light[3,4]. In WB elevated levels of fluoride in underground water from Bardhaman, Bankura and Purulia districts were also reported[5]. Presently we have in record 17 states in India, which are endemic for fluorosis. Susheela[5] has also reported the present overall status of groundwater fluoride contamination and the sufferings of the people in India. It is stated, 'an estimated 62 million people in India in 17 out of 32 states are affected with dental, skeletal/or non-skeletal fluorosis'.

Moreover, the amount of fluoride coming from the food chain and crops irrigated with fluoride contaminated water also has to be considered. While studying an arsenic-affected area in WB we had found that background level of arsenic in urine samples of those using safe water is higher than the normal level due to preliminary elevated background level of arsenic in the area[6]. Nutrition status also plays an important role. It has been reported[7] that a properly designed nutritional regimen could beneficially interfere with the toxicokinetics and toxicodynamics of fluoride. We have also observed that in the arsenic-affected villages of WB and Bangladesh, people with better nutrition status[8,9] suffered much less. Further, to get a better idea about the effects of exposure to fluoride, total intake of fluoride from all sources in mg/day appears to be more useful than fluoride in their drinking water alone.

From the Bagpani area of Karbi-Anglong district (Figure 1), 2063 people from 8 villages (Kehang Engleng, Samik Teron, Nopak Killing, Ramsing Tisso, Sarsobey, Kangnok Tokbi, Kat Tisso and Bagpani) were examined for dental and skeletal fluorosis. 646 people (31.3%) have been identified with dental fluorosis (Figure 2) and 36 (1.74%) with skeletal fluorosis (Figure 3). Non-skeletal fluorosis is not reported, as it was not ascertained. From people having symptoms of fluorosis, 25 urine samples were analysed. Figure 4 *a* shows a positive correlation between fluoride in the drinking water and fluoride in the urine. We have also observed positive correlation of fluoride with calcium and sodium in drinking water (Figure 4 *b* and *c*). No positive correlation with potassium was observed.

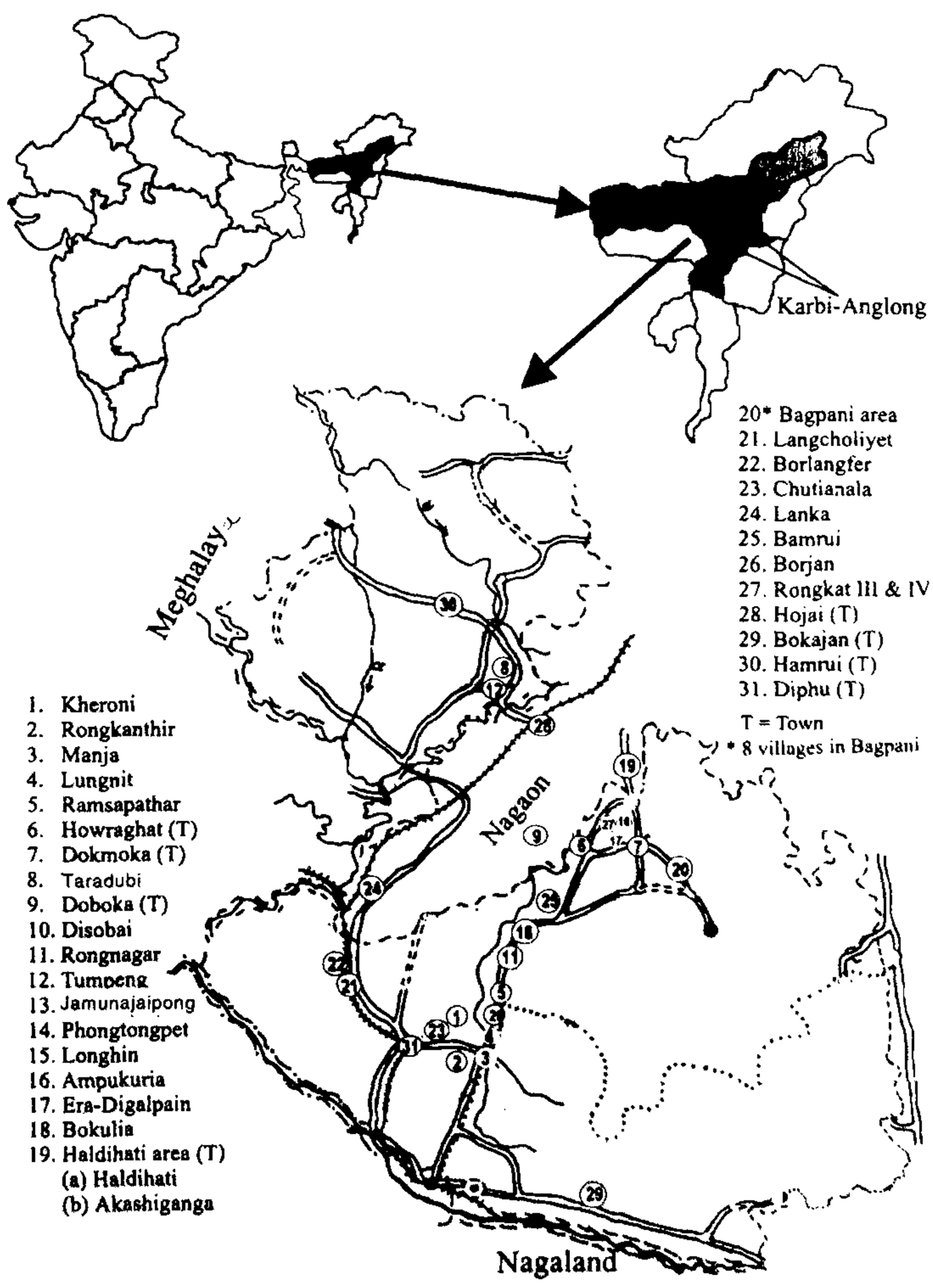

Figure 1. Map showing the position of Karbi-Anglong and Nagaon districts in Assam along with the position of 31 areas surveyed. (Numbers 10, 13–15 are not shown in the map).

Figure 2. Dental fluorosis; fluoride in drinking water, 8.02 mg/l; village Bagpani of Bagpani area, Karbi-Anglong district.

Figure 3. Skeletal fluorosis; fluoride in drinking water, 14.36 mg/l; village Nopak-Killing of Bagpani areas, Karbi-Anglong district.

Table 1. Fluoride above 1.0 mg/l in piped water supply schemes in Karbi-Anglong and Nagaon districts of Assam

Piped water supply scheme (groundwater)	Depth (m)	Fluoride concentration (mg/l)
Kheroni	60.9	3.44
Rongkanthir	106.7	3.43
Manja	79.27	1.58
Lungnit	76.21	15.40
Ramsapathar	137.2	20.6 (23.5)*
Howraghat (Zone II)	91.56	1.1
Dokmoka	135.00	2.8
Taradubi	94.51	1.78
Doboka (Nagaon Dist)	135.00	2.00
Disobai	76.30	1.6
Rongnagar	76.3	1.42
Tumpeng	91.5	1.44
Jamunajaipong	106.71	1.98
Phongtonggpet	56.00	1.30
Longhin	163.0	1.23
Ampukuria	107.0	1.1
Era-Digalpani	64.0	1.10
Bokulia	94.18	1.15

*Analytical report from Public Analyst, Assam.

Other than the fluoride-contaminated water from hand tubewells, the rural water supply schemes of the Public Health Engineering are also supplying fluoride-contaminated water in many villages. Out of the total 31 piped water supply schemes analysed, 18 of them contained fluoride above 1.0 mg/l (Table 1). Fluoride analysis was done using ion-selective electrode (Orion, Model 720A, Beverly, USA).

It is true that the Public Health Engineering Department (PHED) did not supply fluoride-contaminated water deliberately. PHED has assumed that the underground water was safe after it had tested some common water quality parameters. Though iron removal plants are available with most of the public water supply schemes (PWSS), these schemes were not tested for fluoride. The PHED department, Municipal Corporation and other agencies supplying potable water all over India need to test all groundwater sources for quality before being commissioned for supply.

Table 2 reports our findings about fluoride in Karbi-Anglong and Nagaon districts in Assam. We have informed the PHED-Assam about our study so as to help them supply safe water. PHED-Assam has now marked all contaminated tubewells red and safe tubewells green and warned people about the danger of drinking fluoride-contaminated water.

This is a preliminary study in one out of seven north-eastern hill states. A more detailed study is necessary in all districts of Assam and other hill

Table 2. Preliminary survey report of fluoride in groundwater from some villages of Karbi-Anglong and Nagaon districts of Assam

District	No. of villages surveyed	No. of towns	Approx. population of the villages and towns	No. of samples analysed	No. of samples having fluoride above 1.0 mg/l	No. of samples having fluoride in the range (mg/l)				
						<1.0*	1.0–2.0*	2.1*–3.0	3.1–4.0	>4.1
Karbi-Anglong	27	6	55,000	63	36	27	18	3	2	13
Nagaon	5	2	7000	12	7	5	1	Nil	Nil	6
Total	32	8		75	43	32	19	3	2	19

*Water sources having fluoride levels 1.0 mg/l or below considered as safe sources; ranging from 1.0 to 2.0 mg/l, marginally high fluoride level; 2.1–3.0 mg/l, risk source; 3.0–4.0 mg/l, high risk source; >4.1, extra high risk[10].

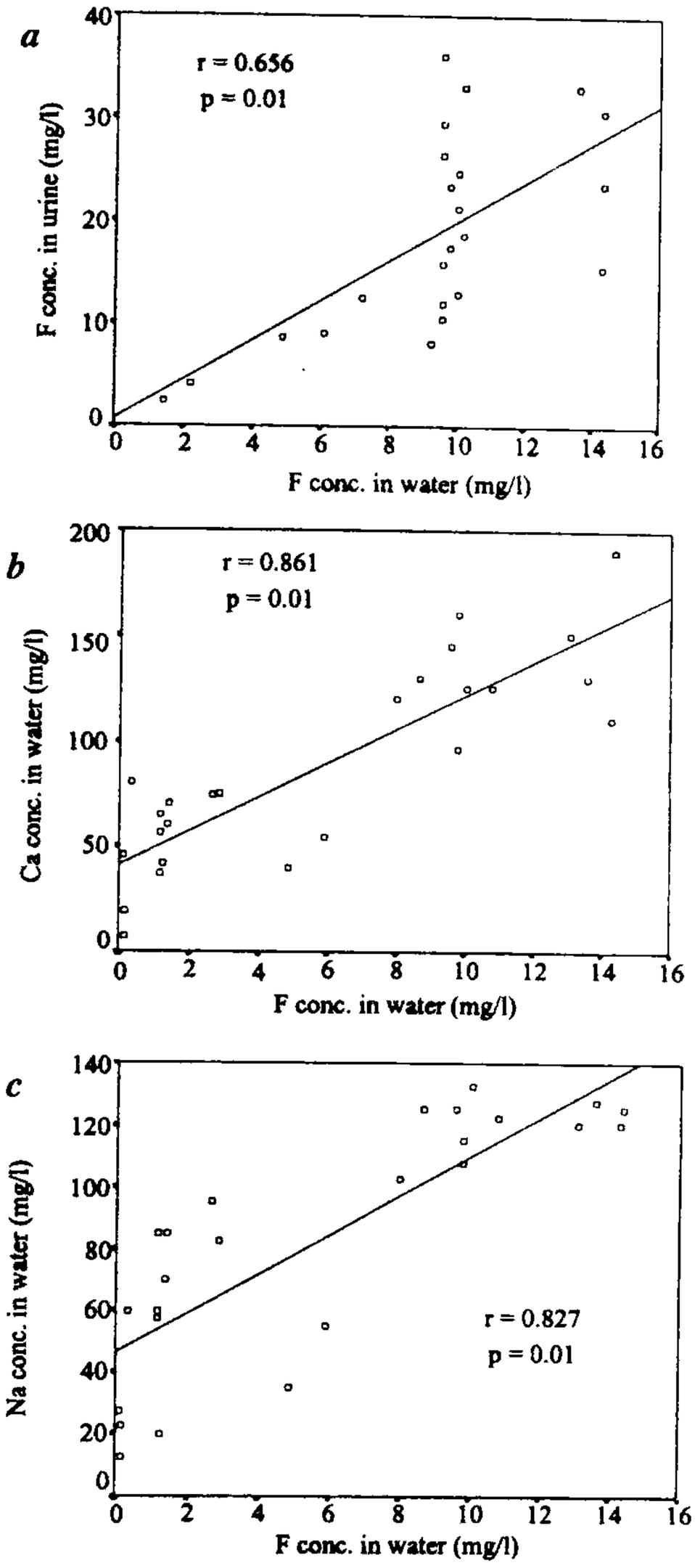

Figure 4. Correlation between *a*, fluoride in drinking water and fluoride in urine; *b*, fluoride and calcium in drinking water; *c*, fluoride and sodium in drinking water.

states to know the real magnitude of the problem.

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ACKNOWLEDGEMENT. We acknowledge the co-operation rendered by Secretary, PHED, Govt. of Assam.

Received 24 January 2000; revised accepted 3 March 2000

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