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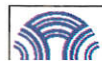
Volume LII, Number 4, October–December 2017



Impact of Behaviour Change Communication on Non
Skeleton Fluorosis: A Case Study from Tamil Nadu

Mapping the Coverage of DST in the Indian Press

Public Screening of Documentaries in Rural India



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IMPACT
OF
BEHAVIOUR CHANGE
COMMUNICATION
ON
NON-SKELETAL FLUOROSIS

➤
A CASE STUDY FROM TAMIL NADU

➤
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Abstract

Fluorosis is a major public health problem caused by ingestion high concentrations of fluoride through drinking water, food, and other items, over prolonged periods. It manifests in three forms – dental, skeletal and non-skeletal. Prevention is most appropriate to mitigate fluorosis problem as there is no cure. A comprehensive approach - three pronged namely school, hospital and community was adopted in two district of Tamil Nadu under the Hogenakkal Water Supply and Fluorosis Mitigation (HWS & FM) Project. Behaviour change communication resulted in people using safe water supplied by the project; increase in consumption of food rich in micronutrient important for mitigation of fluorosis; decrease in consumption of items with high fluoride content such as black tea, areca nut etc. The base line and end line data revealed that there has been reduction in symptoms of non-skeletal fluorosis. This was associated with reduction in the level of fluorides in the urine of people affected by non-skeletal fluorosis.

Fluorine is a highly reactive element hence often found as fluoride in nature, mainly in earth crust. Fluoride is a micronutrient and is essential for wellbeing of teeth and bones. Adequate intake of fluoride prevents 'caries' in teeth. However, ingestion or inhalation of high concentrations of fluoride over prolonged periods causes fluorosis, a public health problem which cripples the affected people. Men, women and children of all age groups are affected by it. Dental fluorosis starts with appearance of white patches. In the more severe form, reduced mineralisation of the enamel results in stained and pitted teeth. Progressive accumulation of fluoride in bones, over many years, results in skeletal fluorosis. Early symptoms include stiffness and pain in the joints (WHO, 2010). Due to both beneficial and detrimental effects fluoride is often referred to as 'double edged sword' (Park, 2011).

Non-skeletal forms of fluorosis include symptoms such as muscle fibre degeneration, low haemoglobin levels, excessive thirst, headache, skin rashes, neurological manifestations, gastro intestinal problems, urinary tract malfunctioning, repeated abortions, male sterility, etc. By detecting early, non-skeletal fluorosis can be prevented from developing in to a more severe and debilitating forms of skeletal fluorosis.

Globally fluorosis is endemic in 25 countries, including India, affecting tens of millions (Susheela & Mudgal, 1999). In India 230 districts of 20 States are affected by high levels of fluoride. In 2014 the population at risk in the country is estimated at 11.7 million (DGHS, 2014, p. 5). In Tamil Nadu, Dharmapuri and Krishnagiri districts experience regular spells of drought and also do not have perennial water storage sources. This has led to high fluoride concentration in ground water sources. Predominant dependency on borewell water for drinking renders the people in these districts susceptible to high risk of fluorosis. The Government of India initiated the 'National Programme for Prevention and Control of Fluorosis' (NPPCF) during the 11th Five Year Plan in 2008-09 with the aim to control fluorosis. In the first phase 100 districts of 17 States were covered and Dharmapuri district was included in the first year 2008-09 of the first phase (DGHS, 2014, p. 23).

Review of Literature

Role of Drinking Water

Primary sources of intake of fluoride are drinking water and water used for cooking. The rate and extent of fluorosis was found to increase in Manur block of Tirunelveli District with increase of fluoride level in drinking water

Madhya Pradesh it was found that inspite of safe water being provided under fluorosis mitigation project, people continue to use water from hand pumps for drinking as well as cooking. This has led to reduction of fluoride level only in eight people out of 21 during impact assessment. Hence, there is need to motivate people with using appropriate communication strategies (PSI, 2011).

Role of food and other items

Various food items, especially packaged food, and other items such as black tea, pan, and black salt and exposure to industrial emissions also contribute to ingestion of fluoride. A study of school children in villages having different levels - low, medium, and high - in drinking water in North Karnataka reported positive association between consumption of jowar, with severity of dental fluorosis. Children who consumed jowar had 2.67 times more chance of getting severe dental fluorosis compared to those who did not. Prevalence of severe dental fluorosis was more among the children who started consuming jowar before eight years of age compared to their counterparts (Chandrasekhar, Thanakappan & Sundaram, 2010). A study of health status of children in the age group 7-9 residing in low endemic fluoride affected areas of Chittor district in Andhra Pradesh (Lakshmi, 2013) found the average intake of fluoride through food (3.09 ppm) is higher than that through the drinking water (2.48 ppm).

Effects of change in diet and nutrition supplementation

The Guidance Manual on 'Integrated Fluorosis Mitigation' (NEERI, 2007) offers a list of - a) calcium rich food; b) vitamin C rich food; c) iron rich food and d) anti-oxidant rich food that can be consumed regularly and in higher frequency and quantities and e) food containing high fluoride content, which can be avoided. Consumption of *amla* (gooseberry) powder may play an important role in mitigating fluoride-induced toxicity. Mean urinary fluoride level declined in a group of residents of Bhupnagar a fluoride endemic village in Gaya district, Bihar, who were given *amla* powder as dietary supplement for nine months compared to a control group (Ranjan & Yasmin, 2015). Analysing debilitating Juvenile Skeletal Fluorosis in Bhil tribe from Jhabua district of Madhya Pradesh, Sapur (2012) argues that, in addition to providing safe drinking water and supplementation of micronutrients such as Calcium, Magnesium and Vitamin C through diet or drugs to address fluorosis action needs to be taken to address overall nutritional deficiency and malnutrition.

diet counselling for promoting intake of essential nutrients, micronutrients and antioxidants through dairy products, vegetables and fruits. A pictorial booklet revealing various aspects of food viz. items that need to be eliminated and how intake of larger portions of fruits, vegetables and dairy products are possible through fruits juices, buttermilk, milk-shakes, salads and soups, were provided to every patient when they come for counselling, to constantly reminding them and reinforcing the message (Susheela, Mondal, Tripathi & Gupta, 2014).

Importance of IEC and BCC

Behaviour Change Communication (BCC) interventions are important in making the people aware, accept and use de-fluoridation technologies to make drinking water safe. BCC is also required to encourage people use safe water supplied under different water supply projects. Change in diet and nutrition supplementation play important role in fluorosis mitigation. In order to bring these changes by the affected population intense and continuous Information, Education and Communication (IEC) and Behaviour Change Communication (BCC) are required. Behavioral changes through appropriate IEC strategy is an important activity of fluorosis mitigation (MDWS, 2014). The diet/nutrient counselling should promote message that for fluoride toxicity can be effectively tackled diet consisting of sufficient Calcium, Iron, Vitamin C, E and other antioxidants and also by avoiding fluoride contaminated food and beverages. Daily consumption of daily diet comprising vegetables and fruits rich in vitamins and other antioxidants, in a matter of a couple of weeks, can nullify the poisonous effect of fluoride with remarkable recovery (Susheela, 2003).

Massive awareness generation under Fluorosis Mitigation Program, in Khaira, a village in the district of Munger in the state of Bihar under safe drinking water campaign had been initiated in support of use of safe alternate drinking water sources. The intake of fluoride through drinking water became less but the existing fluoride deposits in the body through some other means can still be found in the excreted urine samples (KVSS, 2013). Hence there is a need for awareness creation about avoiding food and other materials which have high level of fluoride. It was recommended that there is need to add calcium rich food and vegetables in the menu of the *anganwadi* centers of Khaira village and schools. Awareness creation through periodical group meetings of the village women, in Mandla district in Madhya Pradesh, with the help of *anganwadi* workers and Female Health Workers for a period of three years helped increase in consumption of a locally available green leaf called 'Chakoda Bhaji', which have calcium, vitamin C and iron, from

Behaviour Change Communication (BCC) interventions are important in making the people aware, accept and use de-fluoridation technologies to make drinking water safe. BCC is also required to encourage people use safe water supplied under different water supply projects.

once in a week to at least five times in a week. Myths related to occurrence of diarrhea due to consumption of this plant were removed. Nutritional intervention along with therapeutic supplementation of Calcium, vitamin C and iron revealed that there was a reduction in the prevalence (<20 years) of Genuvalgum from 51% at base line to 2.6% after intervention. Cases with mild fluorosis showed complete reversal of bone deformity, whereas partial reversal was observed in severe cases after intervention. This correction in the deformity was also detected radiologically (Chakma, 2016).

Continuous supervision and motivation of users of domestic and community based water filters to remove fluoride in three villages in Rampurhat Block I of Birbhum district of West Bengal reduced number of people using fluoride based toothpaste and drinking of black lemon tea. It also increased in number of people taking plenty of green leafy vegetables containing antioxidants. These behaviour changes resulted in significant decrease in percentage of people with symptoms of non-skeletal fluorosis such as pain in stomach and bloating or flatulence; constipation followed by diarrhea; polyuria and polydipsia, and fatigue or depression and muscle weakness and loss of appetite. Proportion of people with symptoms of skeletal fluorosis such as inability to touch the chin with chest; inability to bend to touch the toes, and inability to stretch the arm to touch the back of the head also showed a decline (Majumdar, 2011).

A number of earlier studies focused on prevalence and mitigation of dental and skeletal fluorosis information on non-skeletal fluorosis scarce. When detected early, measures to mitigate fluorosis can be undertaken to reverse the effects of non-skeletal fluorosis. This study contributes to the body of knowledge related to non-skeletal fluorosis and impact of IEC and BCC on its mitigation.

Research problems and methodology

Fluorosis mitigation in Tamil Nadu

There is no treatment available for severe cases of dental and skeletal fluorosis. However, it can be prevented by taking measures such as avoiding drinking water from fluoride contaminated sources; minimising consumption of food and other material rich in fluoride. Provision of safe drinking water, promoting appropriate nutrition and nutrition supplementation will help mitigating the effects of fluorosis. Tamil Nadu Water and Drainage (TWAD) Board taken up Hogenakkal Water Supply and Fluorosis Mitigation (HWS &

Dharmapuri and Krishnagiri districts covering 33.87 lakh populations. The surface water is drawn from river Cauvery, flowing near Hogenakkal village. Centre for Symbiosis of Technology, Environment and Management (STEM) has supported the TWAD Board, over a period of five years 2010 to 2015, in implementing the Fluorosis Mitigation Component (FMC) of the HWS and FM Project.

HWS and FM project adopted a comprehensive Strategy 3 PHASE-3 APPROACH model.

APPROACH	STAGE		
	<i>Capacity Building</i>	<i>Survey & Lab Tests</i>	<i>Interventions</i>
<i>School</i>	<ul style="list-style-type: none"> • School teachers trained to identify dental fluorosis among students 	<ul style="list-style-type: none"> • Teachers examine students for dental fluorosis • Collect and send water samples for lab analysis 	Health education
<i>Hospital</i>	<ul style="list-style-type: none"> • Doctors trained to identify different types of fluorosis • Laboratories equipped with ion meters for testing fluoride content in water and urine samples 	<ul style="list-style-type: none"> • Medical camps • Urine test • Radiological examination • Cosmetic interventions and • Corrective surgeries 	<ul style="list-style-type: none"> • Health education • Individual counselling on nutrition • Supply of nutrition supplements to people with non-skeletal fluorosis
<i>Community</i>	<ul style="list-style-type: none"> • Village Voluntary Force (VVF) of local NGOs, Village Health Nurses (VHN) at Health Sub Centres trained to identify symptoms of fluorosis 	<ul style="list-style-type: none"> • Household survey to identify people with symptoms of fluorosis • Water samples for lab analysis 	<ul style="list-style-type: none"> • IEC activities on fluorosis symptoms and useful dietary changes • Group counselling on nutrition

This study pertains to the Information, Education and Communication and health education intervention on the people affected by non-skeletal fluorosis in two project districts. IEC involves educating the target groups by communicating information in a way in which they can understand. IEC aims at creating awareness and influence attitude and beliefs of selected

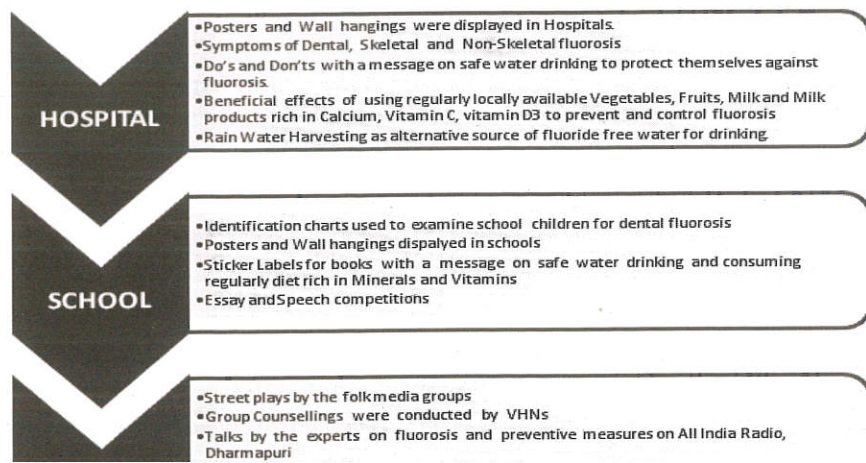
sanitation etc. Behaviour Change Communication (BCC) takes the impact of IEC by facilitating change in the behaviour of target groups. The following are the objectives of the IEC under the FMC of the project.

1. To create awareness among the community on ill effects of drinking high fluoride containing water.
2. To make known to the people that fluoride is the cause of Dental, Skeletal and Non-Skeletal fluorosis.
3. To motivate the people to drink safe (Hogenakkal) water regularly.
4. To educate the people on Rain Water Harvesting (RWH) as alternate source of fluoride free water.
5. To educate the people on beneficial effects of using regularly diet rich in Calcium, vitamin D3, Vitamin C and Anti-oxidants to antagonise the ill effects of fluorosis.
6. To create awareness on the ill effects of using fluoride rich black rock salt smeared pickles and black tea and motivate them to avoid.
7. To educate the people on hazardous effects of using paan, supari and arecanut which are rich in fluoride content.

IEC strategy

IEC strategy under FMC adopted an optimal mix of – a) mass communication; b) interpersonal communication and c) group approaches on preventive and control measures of fluorosis.

Figure 1: IEC and Health Education under Different Approaches



A Human Resource Development (HRD) approach was adopted for implementing the IEC strategy. IEC was included as a component of training manuals developed under the project. It was also included in the training schedule by training doctors (841 both government and private), teachers (3785), VHNs (418) and VVF (1887) on fluorosis mitigation to improve their skills with respect to understanding and using the IEC material effectively to bring about a change in knowledge, attitude and practices of the people and achieving the intended goals of the project.

Table 1: Print material developed under various approaches

School Approach	No. of (Tamil)	No. of (English)
Posters	5,000	500
Stickers	6,00,000	1,000
Fluorosis Identification Charts	3,500	500
Hospital Approach	Tamil	English
Fluorosis Identification Charts	500	1,000
Dos & Don'ts	3,000	1,000
Wall Hangings	4,000	500
Community Approach	Tamil	English
Fluorosis Identification Charts	2,500	1,000
Pamphlets (Brochure)	7,00,000	1,00,000
Posters	6,000	500
Flip Charts	2,500	1,000
Printing of Small Stickers	16,00,000	

This study presents – a) prevalence of non-skeletal fluorosis among the people in two districts under the HWS and FM project; b) the IEC and BCC interventions carried out and c) the impact of the BCC on non-skeletal fluorosis.

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of both the project districts covering a population of 6.62 lakh.

Table 2: Details of Household Survey and Population Covered

S. No.	Unit	District		Total
		Dharmapuri	Krishnagiri	
1	No. of the Blocks	8	10	18
2	No. of Households	307944	359280	667224
3	Population	1209730	1452555	2662285
	• Males	629835	752376	1382211
	• Females	579895	700179	1280074

Data analysis and implications

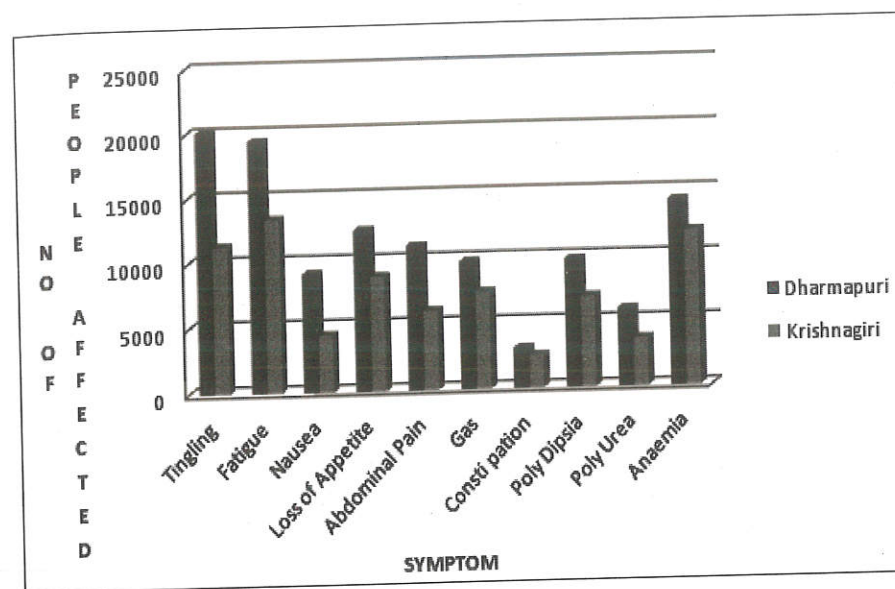
Prevalence of non-skeletal fluorosis

The household survey generated data on prevalence of all three forms of fluorosis namely – a) dental fluorosis; b) skeletal fluorosis and c) non-skeletal fluorosis. In this study data pertaining to non-skeletal fluorosis and impact of project interventions, especially communication interventions are presented. In case of non-skeletal fluorosis data on occurrence of the following symptoms was generated with the help of a questionnaire.

1. Tingling
2. Fatigue
3. Nausea
4. Loss of appetite
5. Abdominal pain
6. Gas
7. Constipation
8. Polydipsia
9. Polyuria and
10. Anaemia

Non-skeletal fluorosis was reported by 7.21% of the population surveyed. Proportion of people affected in Dharmapuri 4.3% is higher compared to 2.9% Krishnagiri. Tingling, fatigue and anaemia are the three most frequently reported symptoms of non-skeletal fluorosis.

Figure 2: Prevalence of non-skeletal fluorosis - by Symptom



Out of all the different age groups, 3.7% in the age group of 19-45 is affected with non-skeletal fluorosis followed by 1.5% in the age group of 46-60. Out of non-skeletal affected population, the female population (4.1%) is more affected with non-skeletal fluorosis than the male population (3.1%) in both the districts.

Table 3: Prevalence of non-skeletal fluorosis – by gender and age group

District	Gender	Age Group (years)					Total
		1-12	13-18	19-45	46-60	> 60	
Dharmapuri	Female	7106	5685	26871	10795	4884	55341
	Male	7904	6736	33281	8003	3911	59835
Krishnagiri	Female	674	1050	30043	13532	7326	52625
	Male	596	550	8958	7745	6164	24013
Total	Female	7780	6735	56914	24327	12210	107966
	Male	8500	7286	42239	15748	10075	83848
Grand Total		16280	14021	99153	40075	22285	191814

Analysis of urine samples

selected for study of impact of interventions. As the symptoms related to non-skeletal fluorosis and early skeletal symptoms could be reversed in a short period of 3 weeks to 8 months by adopting safe water drinking practices and regular use of diet rich in micronutrients as explained above.

As per house to house survey by the village volunteers 39,800 persons in both the districts with various symptoms related to non-skeletal fluorosis were selected for the purpose of impact study. In order to confirm the provisional diagnosis based on the symptoms, urine samples of all the suspected persons were collected and analysed for fluoride level. Those persons with fluoride level more than normal range of 1.0mg/l were selected for study of impact of interventions.

Table 4: Fluoride levels in urine samples of people affected by non-skeletal fluorosis

S. No.	District Name	Number of samples examined	Fluoride level	
			Below 1 Mg/L	More than 1 Mg/L
1	Dharmapuri	16207	4049	12158
2	Krishnagiri	12256	4356	7900
	Total	28463	8405	20058

Change in behaviour

The impact of IEC and BCC activities was assessed based on 1014 people from Krishnagiri block in Dharmapuri district and 651 people Shoolagiri block in Krishnagiri district who exhibited non-skeletal fluorosis symptoms and with urine fluoride level was more than 1mg/l. Change in the behaviour of people with respect to – a) drinking water source; b) diet rich in micronutrients; c) consumption of fluoride rich items is presented below. The impact of these behaviour changes on – a) urine fluoride level and b) reduction in symptoms of non-skeletal fluorosis are also presented.

Drinking water source

Prior to Hogenakkal Water Supply all the residents were drinking pipe water supplied by the nanchavat and other ground water sources. Subsequent

Table 5: Change in use of drinking water sources

S.No.	Source of water	Number of people			
		Krishnagiri block		Shoolagiri block	
		Baseline	After 3 months	Baseline	After 3 months
1	Pipe	1014	0	651	0
2	Tubewell	417	0	227	0
3	Drawwell	17	0	11	0
4	Others	31	0	3	0
5	Hogenakkal	0	1014	0	651

Consumption of food rich in micronutrients

Milk, Curd and Green leafy vegetables, especially drumsticks which are commonly used daily by the residents are rich in calcium and other micronutrients and are of great help in minimising the ill effects of fluorosis. The seasonal fruits like guava, orange, mango and tapioca rich in vitamin-C and other anti-oxidants are also of great help in antagonising the ill effects of fluorosis. Impact of the sustained health education and IEC and BCC activities on people with non-skeletal fluorosis was assessed in terms of change in consumption of food items rich in calcium and other micro-nutrients.

Table 6: Increase in consumption of food items rich in calcium and other micro nutrients

S.No.	Diet rich in micro nutrients	Number of people			
		Krishnagiri block		Shoolagiri block	
		Baseline	After 3 months	Baseline	After 3 months
1	Milk	886	1014	396	618
2	Curd	828	1010	382	543
3	Green Leafy Vegetables	886	995	375	593
4	Drumstick	886	995	431	542
5	Guava	846	804	182	357
6	Amla	227	790	211	574
		486	964	225	574

Though many people reported to be using milk regularly, they may be using in the form of coffee or tea. Hence they should be encouraged to use milk directly, especially children to whom it will be of great help since the milk is rich in calcium content.

Consumption of fluoride rich items

Due to individual counselling during house to house survey and also IEC activities through mass media and group counselling, there was a substantial decline in habits like drinking black tea and chewing tobacco, areca nut, supari and paan, items which contains high level of fluoride in both blocks of the district.

Table 7: Reduction in consumption of food items rich in fluoride

S.No.	Name of fluoride rich item	Number of people			
		Krishnagiri block		Shoolagiri block	
		Baseline	After 3 months	Baseline	After 3 months
1	Black Tea	427	21	98	12
2	Tobacco	711	114	607	107
3	Supari				
4	Areca nut				
5	Paan				

Symptoms related to non-skeletal fluorosis

Change in drinking water source, increased consumption of diet rich in calcium and other micronutrients and reduction in consumption of fluoride rich items, due to sustained and targeted IEC and BCC interventions, resulted in decrease in symptoms of non-skeletal fluorosis.

Table 8: Reduction in symptoms of non-skeletal fluorosis

S.No.	Symptom	Number of people			
		Krishnagiri block		Shoolagiri block	
		Baseline	After 3 months	Baseline	After 3 months
1	Tingling & Numbness	796	310	524	157
2	Fatigue & Weakness	935	351	459	123

6	Gas formation & Bloating of Stomach	688	168	447	238
7	Constipation	541	169	193	104
8	Poly Urea	551	95	172	92
9	Polydipsia	603	333	324	257
10	Anaemia	822	787	373	206

Urine fluoride levels

The reduction in non-skeletal fluorosis is also accompanied by a change in fluoride level in the urine samples of the people affected people.

Table-9: Change in fluoride levels > 1 mg/l in the urine samples of people affected with non-skeletal fluorosis

S.No.	District	Number of people	
		Baseline	After 3 months
1	Krishnagiri	1014	238
2	Dharmapuri	651	243

Conclusions

The IEC and BCC interventions in two districts of Dharmapuri and Krishnagiri districts in Tamil Nadu have been successful in bringing in behaviour change – a) with respect to drinking water from safe sources; b) increase in consumption of diet rich in calcium and other micronutrients and c) reduction in consumption of items rich in fluoride. Such behaviour changes have been effective in reducing the symptoms of non-skeletal fluorosis, accompanied by change in fluoride level in urine samples of these people.

Limitations

The household health survey was by the Village Volunteers identified by the NGOs of the concerned blocks, who are not medically qualified. All of them are provided two days training on identification of persons with skeletal and non-skeletal fluorosis based on the symptoms expressed by the persons affected and entered in the survey questionnaires.

Conflict of interest

funded by the Tamil Nadu Water and Drainage Board and supported by the Japan International Cooperation Agency (JICA).

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