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FLUOROSIS - INDIA

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PROJECT REPORT
SUBMITTED
BY

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CHAPTER - I

1.1 INTRODUCTION:

Nalgonda district in Andhra Pradesh is one of the severely fluorosis affected districts in the State. Studies on distribution of fluoride have shown high frequency distribution exceeding 2.0 mg/l. in water sources. A maximum of 20.0 mg/l. has been recorded. Preliminary epidemiological surveys revealed that people consuming water having identical concentration of fluoride are unequally affected. It is also observed that labourers and harijans are more affected than teachers and land lords in the village. It has been reported by research workers that there has been significant reduction in the severity of disease on transferring the patients from high fluoride areas to non-endemic areas having lower fluoride concentration in drinking waters. Substantial improvement in the condition of patients has also been reported when they are shifted to hospital and provided with nutritive diet. In a highly endemic area in the district called Sivannagudem fluorosis belt having excessive fluoride containing minerals in rocks, soils even surface waters are found to have unusually high concentration of 5-7 mg/l.F

Reports in the literature tend to suggest that nutrition chemical characteristics of waters besides fluoride concentration of water influence the onset and severity of the disease. It is therefore planned to systematically study the effectiveness of providing nutritive supplements and defluoridated water to fluorosis patients previously consuming drinking water having excessive concentration of fluoride.

1.2 METHODOLOGY OF INVESTIGATION:

Four villages with water sources having fluoride concentration in the ranges:

A) 1.1 - 4.0 ppm
B) 4.1 - 8.0 ppm
C) 8.1 or above

were selected for the study. A total of 72 patients have been selected in each village so that different age groups are represented viz., 1) 0-5 years; 2) 5-10 years; 3) 10-18 years and 4) 18 + years. 24 patients of Vattipalli Village were selected after starting the project to compensate some patients who left Batlapalli. A village Nacharam near Hyderabad where the fluoride concentration in drinking water is less than 1.5 ppm has been selected as control for comparison of results.

1.3 COMPLETE CHEMICAL EXAMINATION OF DRINKING WATER:

Water samples were collected in 2 litre polythene cans from sources which are used by the patients in the four villages. The samples were analysed for pH, colour, turbidity, total hardness, alkalinity, calcium, magnesium, sodium, potassium, chloride fluoride and iodide following standard procedures recommended in A.P.H.A. Standard methods of examination of water and waste water. The data was recorded in a proforma.

1.4 DIETARY SURVEYS:

The total dietary intake of the individual patients was computed on the basis of different foods consumed. Amounts of cereals, pulses, milk and milk products, fats and oils, vegetables, roots,

fruits, eggs, meat, fish, sugar, gur and beverages consumed was determined by weighment method. Total diet prepared for the whole family consecutively for three days was ascertained and the individual dietary intake was then computed from the total members of the family. During dietary survey general food habits of the people, vegetarian or non-vegetarian and the prevalence of breast feeding, time of weaning and mode of food preparation and consumption were also ascertained. Individual nutrition evaluation was made by recording the data in a proforma.

1.5 CLINICAL EXAMINATION OF PATIENTS:

Incidence of dental fluorosis has been studied under the following classifications.

Grade 0 (Normal, transluscent, smooth and gloosy teeth)
Grade 1 (White Opacities, faint Yellow line)
Grade 2 (Changes of Grade 1 + Brown stain)
Grade 3 (Brown line pitting & clipped off edges)
Grade 4 (Brown black + fall of teeth)

1.6 SKELETAL FLUOROSIS:

Incidence of skeletal fluorosis has been examined as per following criteria.

0 - Normal
1 - Mild. Asymptomatic Radiographs with increased bone density.
2 - Moderate. Symptomatic - Stiffness, rigidity, pain, aches.
3 - Severe - Symptomatic with moderate Osteophytosis, exostoses, marked limiation of spine and joints, crippling deformities.

1.7 THE FOLLOWING CLINICAL FEATURES WERE STUDIED.

1. Generalised pains and aches.
2. Back-ache.
3. Stiffness.
4. Rigidity of spine.
5. Able to close fists.
6. Arthralgia.
7. Swelling of joints.
8. Cleaving of toes.
9. Flexion at cervical spine.
10. Flexion deformities at hips and knees.
11. Limitation of movements.
12. Exostoses.
13. Associated rickets.
14. Associated osteomalacia.
15. Tetany
16. Goitre
17. Skin lesion
18. Constipation
19. Others if any.

As patients of fluorosis in Andhra Pradesh were reported to have neurological symptoms patients of the present study were examined for:

1. Head Ache; 2. Giddiness; 3. Epileptic fits;
4. Signs of nerve/cord compression;
5. Musale wasting; 6) Paraesthesia.

1.8 RADIOLOGICAL EXAMINATION:

For assessing the radiological profile of fluorosis patients X-rays of:

1. Fore-arm; 2. Knee joints and
3. Spine were taken.

1.9 BIOCHEMICAL ANALYSIS:

Samples of blood and urine were collected from normal persons in Nacharam and flurosis patients in the four villages selected. The blood samples were analysed for:

1. Proteins.
2. Alkaline Phosphatase.
3. Urea.
4. Creatinine.
5. Calcium.
6. Phosphorous.
7. Magnesium.
8. Fluoride content

As it was difficult to collect and transport 24 hour urine samples, samples were collected two hours after taking meal. The samples were examined for:

1. Calcium.
2. Magnesium.
3. Phosphate.
4. Fluoride.
5. Creatinine.
6. Creatine-clearance.
7. Fluoride concentration.

The base line data was collected on chemical characteristics of drinking water, nutritional deficiencies of patients, their clinical features and radiological and biochemical profiles. The data was analysed and presented in Chapter - 2. Intervention programme was then initiated in each village by providing potable water and nutritional supplement to overcome the deficiencies after dividing the persons into the following groups:

Group - I: Normal healthy controls living in non-endemic area (Nacharam near Hyderabad) and consuming low fluoride concentration of water i.e. upto 1.5 ppm)

Group - II: Fluorotic controls: Fluoride content.

a) Drinking water containing: 1.1 to 4 ppm
b) Drinking water containing: 4.1 to 8 ppm
c) Drinking water containing: 8.1 and above

Group-III: Provided with water containing permissible levels of fluoride to those who were originally consuming:

a) Drinking water containing: 1.1 to 4 ppm
b) Drinking water containing: 4.1 to 8 ppm
c) Drinking water containing: 8.1 and above

Group - IV: Provided with nutritional supplement in addition to their regular diet to those who were consuming waters having fluoride concentration in the three ranges.

Group - V: Patients provided with drinking water with permissible levels of fluoride (by defluoridation) and nutritional supplement in addition to their normal diet.

In these studies it was ensured that sufficient number of persons were covered in each age group viz., 0-5 years; 5-10 years; 10-18 years and 18 + years so as to systematically determine the effect of providing nutritional supplement and low fluoride water. Since the date of intervention the clinical features, radiological profile and blood and urine biochemical parameters were determined after three months, six months, nine months and one year. The data has been recorded and analysed in Chapter - 3. Summary and conclusions of the investigations have been reported in Chapter - IV.

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C H A P T E R - 2

2. Base line data:

2.1 Chemical Characteristics of drinking water:

Water samples were collected from 85 wells in 5 villages as detailed in the following Table:

Table 2.1

Village	No. of Bore Wells	No. of open Wells	Total sources examined
Nacharam (Hyd)	2	3	5
Marriguda	3	22	25
Vattipally	1	5	6
Sivannagudem	3	32	35
Batlapalli	1	11	12

Samples were analysed for fluoride, pH, conductivity, alkalinity, hardness, calcium, magnesium, sodium, potassium, chloride and iodide. The analytical results have shown variations in the chemical characteristics of available well waters in every village surveyed. The fluoride concentration in the waters of Nacharam Village near Hyderabad, varies from 0.5 - 1.5 with an average of 0.9 mg/l. The mean fluoride concentrations in the four villages of Nalgonda District are 2.21; 3.2; 4.6 and 8.2 mg/l, respectively. Comparative study of chemical parameters of different villages revealed fluoride concentration of water is significantly related to calcium, hardness, alkalinity and alkalinity/Hardness values. Salient chemical characteristics of water of the 5 villages are recorded in Tables 2.2-2.6.

T A B L E - 2.2

MARRIGUDA:

SUMMARY STATISTICS OF CHEMICAL PARAMETERS OF WATERS:

Variable Statistics:	Mean:	Minimum:	Maximum:	Variable:	Std.Deviation	% Co-efficient variation
1. pH	7.76	7.1	8.2	0.147	0.383	44.44
2. Alkalinity as CaCo3	254.08	164	648	14695	121.22	47.71
3. Hardness (as CaCo3)	338.4	240	590	7217	84.96	25.10
4. Calcium (Ca)	90	41.6	181.6	1087	32.98	36.63
5. Magnesium (Mg)	28.8	9	76	222	14.91	51.82
6. Sodium (Na)	33.67	12	94	234.5	15.31	45.48
7. Chloride (cl)	64.4	20	180	2550	50.50	78.42
8. Fluoride (F)	2.21	1	3.8	0.6504	8064	36,49
9. Iodide (I)	0.016	0.01	0.026	0000271	0052	32.52

TABLE - 2.3

SUMMARY STATISTICS OF CHEMICAL PARAMETERS OF WATER

WATTIPALLI

Variable Statistics:	Mean:	Minimum:	Maximum:	Variable:	Std.Deviation	% Co-efficient variation
1. pH	7.23	7	7.6	0.0552	0.235	3.24
2. Alkalinity (as CaCo3)	455.67	430	488	330.0035	18.166	4.711
3. Hardness (as CaCo3)	376.667	352	420	524.9597	22.912	6.083
4. Calcium as Ca	48.66	72	156.8	776.1786	27.8568	24.44
5. Magnesium (Mg)	33.34	6.8	43	409.7526	20.24	41.68
6. Iodide (I)	0.018	0.01	0.025	0.00008	0.0028	21.45
7. Chloride (cl)	44	20	68	335.9889	18.33	41.660
8. Fluoride (F)	3.3	2.6	4.0	0.2362	0.486	14.74

TABLE - 2.4

SUMMARY STATISTICS OF CHEMICAL PARAMETERS.

VILLAGE: SIVANNAGUDA:

Variable Statistics.	Mean	Minimum	Maximum	Variance	Std.Deviation	%Co-efficient variation
1. pH	7.69	7.0	8.3	337	0.581	7.55
2. Alkalinity (as CaCo3)	490.23	176	736	33559	183.19	37.36
3. Hardness (as CaCo3)	331.72	170	620	15064	122.74	36.779
4. Calcium (as Ca)	97.48	12	128.8	538.24	23.2	61.86
5. Magnesium (as Mg)	59.36	225	124	710	26.65	44.92
6. Sodium (Na)	194.71	100	500	6256	79.1	40.6
7. Chloride (cl)	144.52	46	452	12328	111	76.82
8. Fluoride (F)	4.67	3.2	6.4	0.5226	0.7228	15.48
9. Iodide (I)	0.015	0.01	0.02	0.000012	0.00348	23.20

TABLE - 2.5

SUMMARY OF CHEMICAL PARAMETERS

VILLAGE: BATLAPALLI

Variable Statistics	Mean	Minimum	Maximum	Variance	Std.Deviation	%Co-efficient Variation
1. pH	7.67	7.2	8.2	0.67	0.259	3.38
2. Alkalinity (as CaCo3)	641.34	300	804	26825	163.79	25.54
3. Hardness (as CaCo3)	297.5	140	436	6300	79.37	26.68
4. Calcium (Ca)	33.6	16	51.2	112.95	10.63	31.63
5. Magnesium (Mg)	52.4	20	92.5	344.94	18.57	35.46
6. Sodium (Na)	210.17	70	360	9356	96.73	46.02
7. Chloride (cl)	109.5	18	272	6267	79.17	72.30
8. Fluoride (F)	8.2	8.0	8.5	4.004	2.001	29.43
9. Iodide (I)	0.011	0.01	0.015	0.0000039	0.00198	17.99

TABLE - 2.6

SUMMARY STATISTICS OF INTER RELATIONSHIPS OF CHEMICAL PARAMETERE

Parameter	Nacharam	Marriguda	Vattipalli	Shivannaguda	Batlapalli
Alkalinity / F	243.88	114.97	138.03	104.97	82.22
Hardness / F	315.55	153.1	114.24	71.03	38.14
Alkalinity / Hardness	0.78	0.95	1.21	1.48	2.16
Calcium / F	74.74	40.7	14.74	8.02	4.30
Magnesium / F	32.78	13.03	10.16	12.71	6.72

It will be seen from the results that waters of Nalgonda Villages have invariably alkalinity exceeding hardness in contrast to those of Nacharam.

The results indicate a positive correlation between F content, alkalinity, and alkalinity/hardness. An inverse correlation is also seen between fluoride and calcium contents.

No relation is discernable between F concentration and other parameters. The results indicate water of Nalgonda villages contains optimum amounts of iodide.

2.2 Selection of subjects for investigation:

Human subjects drinking the water from different wells in the villages with F content ranging from 1-9 mg/l. were selected so that both sexes in different age groups are represented as shown below:

TABLE 2.7A

Marriguda:

Age group	Male	Female	Total subjects
0-5	--	2	2
5-10	5	3	8
10-18	15	6	21
18+	31	10	41
Total:	51	21	72

TABLE 2.7B

Sivannagudem:

0-5	1	1	2
5-10	10	6	16
10-18	17	9	26
18+	18	10	28
Total:	46	26	72

TABLE 2.7C

Batlapalli:

Age Group	Male	Female	Total subjects
0-5	-	2	2
5-10	7	4	11
10-18	9	2	11
18+	8	7	15
Total:	24	15	39

TABLE 2.7D

Vattipalli:

0-5	1	-	1
5-10	2	1	3
10-18	2	1	3
18+	14	3	17
Total:	19	5	24

2.3 Dietary status of subjects:

Dietary surveys on the subjects revealed that the common staple foods consumed are Rice, Jawar, Bajra, Red gram dal, Green Gram dal, milk, curd, Amaranth, Cucumber, green and red chillis, sugar, edible oil, beans, onions, tomatto and tamarind. The total intake of proteins, fats, carbohydrates, vitamins, calcium, phosphorous and iron are computed from the quantities of food materials consumed by referring to I.C.M.R. Manual on nutritive value of Indian foods. The data is presented in Tables 8 to 10.

It is seen from the data all the subjects under investigation have low dietary status, the foods consumed having multiple deficiencies of essential nutrients. It is noteworthy that the intake of vitamins is less than the minimum prescribed for the lowest age group (1-5 years) of the subjects.

TABLE - 2.8

DIETARY STATUS

Intake of Proteins, Fats & Carbohydrates

Place	Proteins: (gms.)	Fats: (gms.)	Carbohydrates (gms.)	Energy (K.Cal)
Minimum requirements	19.2-53.7	-	-	1350-2500
Marriguda	9.9-27.7	14.4-18.5	102-305	584-1464
Vattipalli	21.8-37.8	10.8-14.0	184-374	922-1866
Sivannagudem	14.7-29.7	11.2-14.0	124-306	691-1490
Batlapalli	22.1-42.2	19.0-25.9	225-1002	998-2007

TABLE - 2.9

DIETARY STATUS

TABLE SHOWING INTAKE OF VITAMINS

Place	Vitamin A: (Units)	Vitamin B: (Mg)	Riboflavin (b) (Mg)	Vitamin C (Mg)
Marriguda	1100-3000	0.7-1.25	0.75-1.37	3.0-50
Vatlapalli	161-735.5	0.29-0.45	0.21-0.45	4.2-16.5
Sivannagudem	152-194	0.17-0.35	0.15-0.32	10-28
Batlapalli	216-845.8	0.32-0.65	0.47-0.67	4.3 -29.8

TABLE - 2.10

DIETARY STATUS.

INTAKE OF CALCIUM, PHOSPHOROUS, IRON.

Place	Calcium (Mg)	Phosphorous (Mg)	Iron (Mg)
Minimum requirement	400-800	--	1.5-25
Marriguda	127-163	243-675	4.1-13.9
Vattipalli	160-302	395-900	8 - 25
Sivannagudem	71-158	268-675	5.7-13.2
Batlapalli	72-222	657-1203	8.8-20

2.4 RESULTS OF CLINICAL EXAMINATION:

All the 207 patients of the four villages have dental fluorosis in varying degrees of severity. The degree of severity to generally found related to the concentration of fluoride in drinking water. However for the same levels of fluoride the degree of severity of dental fluorosis was found more with increasing alkalinity values of water. Clinical examination of the patients also revealed that they were suffering from the following symptoms of skeletal fluorosis.

1. General pains and aches, back ache.
2. Stiff neck.
3. Pain in joints.
4. Rigidity of spine.
5. Flexion deformity of hips.
6. Flexion defermity of knees.
7. Kyphosis.
8. Fixation of chest in the position of inspiration.
9. Head ache.
10. Signs of nerve/cord compression.

2.5 RESULTS OF RADIOLOGICAL EXAMINATION:

Radiological profiles of the Lumbar spine, fore arm and knee joints have the following features.

1. Osteoslerosis.
2. Calcification of interossious membrane.
3. Irregular periosteal bone formation.
4. Osteophytosis.
5. Exostosis.
6. Dense epiphyses and Metaphyses.
7. Osteomalacia.
8. Cystic expansion of bone.
9. Expansion of longbone ends.
10. Phalengeal resorption.
11. Neo osseous porosis.
12. Bony Ankylosis.

Some of the cases of fluorosis and radiological profiles are shown in figures 1 to 8 cases of dental fluorosis in different age groups are classified into grades I, II, III and IV and skeletal fluorosis as mild, moderate and severe respectively. The data is presented in Tables 2.10; 2.13.

TABLE - 2.11

The cases of dental and skeletal fluorosis in MARRIGUDA

Age group in Yrs.		Dental.				Skeletal.		
	No.of cases	I	II	III	IV	Mild	Moderate	Severe
0-5	2	2	--	--	--	--	--	--
5-10	8	-	6	2	--	4	--	--
10-18	21	-	6	10	6	6	--	--
18+	41	-	4	17	20	10	4	2
	72	2	16	29	26	20	4	2

VATTIPALLI.

Age Group in Yrs.	Dental.					Skeletal.		
	No.of cases	I	II	III	IV	Mild	Moderate	Severe
0-5	1	1	-	-	-	-	-	-
5-10	3	1	2	-	-	-	-	-
10-18	3	1	2	-	-	-	-	-
18+	17	-	4	7	6	1	2	2
	24	3	8	7	6	1	2	2

TABLE - 2.12

SHIVANNAGUDA

Age Group in Yrs.	Dental.					Skeletal.		
	No.of cases	I	II	III	IV	Mild	Moderate	Severe
0-5	2	2	-	-	-	-	-	-
5-10	16	1	7	4	4	9	-	-
10-18	26	-	8	8	10	2	10	6
18+	28	-	-	12	16	-	17	10
	72	3	15	24	30	11	27	16

TABLE - 2.13

BATLAPALLI

Age Group in Yrs.	Dental.					Skeletal.		
	No.of cases	I	II	III	IV	Mild	Moderate	Severe
0-5	2	2	-	-	-	-	-	-
5-10	11	-	2	7	2	-	-	-
10-18	11	-	1	3	7	4	6	1
18+	15	-	-	4	11	1	6	8
	39	2	3	14	20	5	12	9

CASES OF FLUOROSIS

PATIENTS WITH KYPHOSIS

BOW LEGS AND KNOCK KNEES

ADOLESCENT WITH DISTORTED LEGS

CASE OF SEVERELY DISTORTED LEGS

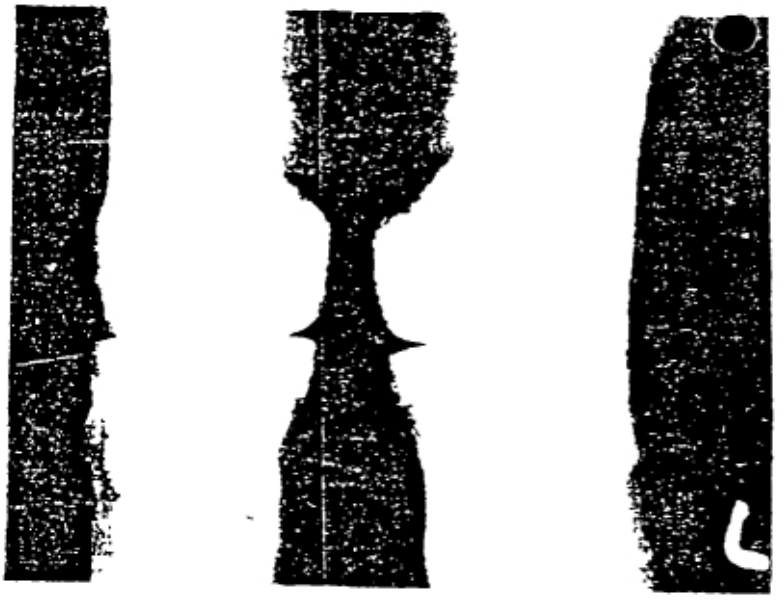
PHOTOS: COURTESY INSTITUTE OF PREVENTIVE MEDICINE, HYDERABAD.

X-RAY PROFILE.

CHALKY WHITE APPEARANCE OF LUMBAR SPINE.

SCOLOSIS WITH OSTEOPHYTOSIS OSTEOSCIEROSIS.

PERIOSTEOL NEW BONE FORMATION ECTOPIC CALCIFICATION.



PROMINENT AND THICKENED TIBIAL SPINE.

It will be seen from data in Tables 2.10 - 2.13 that in all the villages, the degree of severity of both dental and skeletal fluorosis increase with the age of patients. In Marriguda and Vattipalli majority of patients studied were suffering from dental fluorosis and a few from mild skeletal fluorosis. On the other hand in Sivannagudem and Batlapalli more number of cases of skeletal fluorosis are encountered in consonance with increasing concentration of fluoride in drinking water.

2.6 RESULTS OF BIOCHEMICAL ANALYSIS:

Results of Biochemical analysis of blood samples of the fluorosis patients of Nalgonda revealed raised alkaline phosphatase values ranging from 15-59 units. It could also be observed that serum fluoride concentration increased 5-10 fold (0.15-0.8) compared to values of normal persons of Nacharam (0.01 to 0.06). The values of blood urea, creatinine, phosphorous and magnesium are within normal limits.

The concentration of fluoride in the urine of fluorosis subjects range from 7.5 - 31 mg/l, while in normal persons of Nacharam the values are as low as 0.8 - 0.9 mg/l. The concentration of Urinary phosphate, creatinine and creatinine clearance values of fluorosis subjects are within normal ranges, observed for subjects of Nacharam Village.

It is note worthy that in some cases, the urinary fluoride concentration is more than the amount to be expected from the linearity relation normally observed with drinking water F.Concentration. The anamoly is seen mostly in patients drinking water containing below 5.0 mg/l.F. The anamoly suggests that some of the patients may be ingesting substaninal amounts of fluoride through food.

CHAPTER - 3

3.1 INTERVENTION:

After conducting epidemiological, nutritional surveys clinical examination and studying initial radiological profiles of the patients intervention programme was introduced by providing:

1. Defluoridated water to one group.
2. Nutritional supplement to second group.
3. Defluoridated water and nutritional supplements to the third group.

3.2 DEFLUORIDATION OF WATER:

A cheap and simple defluoridation process was evolved in Institute of Preventive Medicine. The process consists of adding a little calcium carbonate powder and measured dosage of saturated filter alum solution to the raw water in a pot or bucket and mixing for 5 minutes. The floccules of alluminium hydroxide complexes absorb fluoride and settle down in the bottom of the container in half an hour. The clean supernatant water contains permissive concentration of fluoride (F = 1.0 mg/lit).

The amounts of saturated filter alum $(A1_2(SO_4)_3\ 18H2_O$ to be added for different concentration of fluoride and alkalinity values are shown in following Table 3.1.

TABLE 3.1

REMOVAL OF EXCESS FLUORIDE FROM DRINKING WATER

Fluoride Conc. mg/l.	Rate of alkalinity (mg/l.)	Approximate amount of Calcium Carbonate to be added.	Amount of reagent (ml) to be added for treating 10 Lit. of water
2	200-300	250 mg.	4 ml
3	250-350	250	6
4	250-450	300	8
5	300-500	300	9
6	350-550	350	10
7	400-550	400	12
8	450-600	400	14
9	450-650	450	15
10	500-700	450	16
11	550-750	500	17
12	600-800	500	18

Note: In case, the alkalinity is different from the value mentioned, the amounts of reagents to be used will be the average of the quantities corresponding to the fluoride content alone the alkalinity of the raw water.

3.3 NUTRITIONAL SUPPLEMENTS:

On the basis of preliminary nutritional survey "Hyderabad Mix" was provided as a supplement to the diet. The "Hyderabad Mix" packet contain the following:

1. Wheat 70 gms.
2. Bengal gram 35 gms.
3. Jaggery 23 gms.
4. Groundnut 12 gms.

These 4 items are mixed in the ratio 6:3:2:1. This serves as an effective nutritional supplement to the regular meal as it contains approximately 20 gms. of protein; 526 K.calorie and 100 IU. of Vit.A. This is provided with materials locally available and

acceptable to the population of the area and who can continue to use them even after the intervention and our study is over.

METHOD OF PREPARATION:

Clean grains are roasted and ground into a powder. Each packet contains 140 gms.

MODE OF INTAKE:

1. As powder.
2. Mixed with milk as porridge.
3. Prepare the chapaties (daily bread as per local custom)
4. Laddoos (small balls consumed as sweet dish).

3.4 RESULTS OF INTERVENTION:

a) Biochemical profile of the patients

After intervention the blood and urine of the patients were analysed for different parameters once in 3 months. The results have been subjected to statistical analysis. The results have not shown significant changes in the following parameters.

Blood	Urine
Urea	Magnesium
Creatinine	Phosphate
Phosphorous	Creatinine
Magnesium	Creatinine clearance

The salient statistical data of values of significant parameters are presented in Tables 3.2 - 3.5.

It will be seen from the tables that there is moderate increase in the protein and calcium profiles of blood of groups II, III and IV compared to fluorosis control group (Group-I). The variations

are more pronounced in the case of Sivannaguda and Batlapalli Villages. As expected positive correlation could be seen in the groups III and IV who received nutritional supplement compared to other groups. However the variations were not found statistically significant.

Significant positive variation could be seen in the alkaline phosphatase values of blood in group-II, III and IV compared to Group-I (Control). The reduction is statistically significant ($P < 0.05$) in all the villages for group-IV (Nutritional supplements + Defluoridation).

The results of calcium content of urine have shown general reduction in all the groups. The reduction is significant ($P < 0.05$) in regard to Marriguda Village in groups III and IV compared to other groups.

Regarding urinary fluoride profile it is interesting to note that the values of groups - II, III and IV are uniformly high compared with the value of control group - I. It is therefore evident that the fluoride already absorbed is immobilized and excreted in the urine on cessation of excessive fluoride ingestion through drinking water.

TABLE 3.2

STATISTICAL SUMMARY OF BIO-CHEMICAL PROFILE OF MARRIGUDA PATIENTS.

Blood	Initial Mean + S.D.	3-months follow-up Mean + S.D.	6-months follow-up Mean + S.D.	9-months follow-up Mean + S.D.	12 months follow-up Mean + SD
Total Proteins (Gm%)					
Group-I	6.77 ± 0.60	6.88 ± 0.35	7.19 ± 0.31	7.12 ± 0.21	7.12 ± 0.28
Group-II	6.61 ± 0.55	6.72 ± 0.48	6.90 ± 0.41	7.06 ± 0.28	7.14 ± 0.28
Group-III	7.32 ± 1.50	6.91 ± 0.49	7.32 ± 0.34	7.47 ± 0.36	7.56 ± 0.34
Group-IV	6.64 ± 0.81	7.02 ± 0.49	7.32 ± 0.24	7.53 ± 0.19	7.70 ± 0.24
Calcium(Mg%)					
Group-I	11.82 ± 1.55	11.41 ± 0.70	11.49 ± 0.62	11.49 ± 0.76	11.74 ± 0.74
Group-II	10.55 ± 1.62	10.98 ± 1.51	11.12 ± 1.42	11.37 ± 1.56	11.80 ± 1.42
Group-III	11.42 ± 1.16	12.22 ± 1.42	11.94 ± 0.93	12.26 ± 0.96	12.52 ± 0.90
Group-IV	10.72 ± 1.65	11.26 ± 1.70	11.49 ± 1.61	11.91 ± 1.41	12.23 ± 1.37
Fluoride(Mg/l)					
Group-I	0.18 ± 0.05	0.16 ± 0.03	0.16 ± 0.03	0.15 ± 0.04	0.12 ± 0.03
Group-II	0.19 ± 0.09	0.15 ± 0.05	0.14 ± 0.02	0.13 ± 0.04	0.10 ± 0.02
Group-III	0.17 ± 0.05	0.15 ± 0.04	0.13 ± 0.03	0.14 ± 0.04	0.12 ± 0.02
Group-IV	0.19 ± 0.06	0.14 ± 0.04	0.14 ± 0.04	0.16 ± 0.03	0.13 ± 0.03

TABLE - 3.2 Contd..

Alk.Phost (K.A.U.)					
Group-I	24.54 ± 10.46	28.05 ± 9.22	20.08 ± 7.92	19.31 ± 7.39	19.89 ± 6.34
Group-II	24.69 ± 15.20	24.06 ± 16.17	21.07 ± 12.23	20.30 ± 11.24	18.40 ± 6.92
Group-III	23.00 ± 13.05	19.11 ± 10.87	16.94 ± 8.70	16.07 ± 7.93	14.32 ± 6.72
Group-IV	27.86 ± 13.76	21.21 ± 11.56	10.37 ± 9.90	17.19 ± 8.83	15.46 ± 8.53

TABLE - 3.2

URINE (Mg%) CALCIUM					
Group-I	9.27 ± 2.07	7.45 ± 2.11	6.99 ± 2.12	6.95 ± 2.19	6.74 ± 2.32
Group-II	10.46 ± 2.72	9.23 ± 3.07	8.57 ± 2.74	8.46 ± 2.72	7.89 ± 2.79
Group-III	11.16 ± 3.06	8.00 ± 2.87	6.84 ± 2.38	7.86 ± 3.61	6.73 ± 2.23
Group-IV	11.21 ± 3.79	8.28 ± 3.47	7.21 ± 3.01	6.46 ± 5.96	6.11 ±6.36
FLUORIDE (Mg/l)					
Group-I	6.12 ± 3.23	4.71 ± 2.49	4.62 ± 2.56	5.92 ± 3.46	6.20 ± 2.92
Group-II	5.28 ± 2.14	3.79 ± 1.43	3.41 ± 1.18	5.42 ± 2.07	6.21 ± 1.90
Group-III	5.85 ± 3.45	3.93 ± 1.93	3.86 ± 1.80	7.85 ± 3.00	8.85 ± 3.82
Group-IV	6.02 ± 3.29	4.79 ± 3.30	4.03 ± 1.99	8.53 ± 3.26	9.22 ± 3.25

Group - I: Fluorosis control.
Group- II: Patients receiving defloridated water.
Group-III: Nutritional supplement.
Group- IV: Defluoridated water + Nutritional supplement.

TABLE - 3.3

STATISTICAL SUMMARY OF BIOCHEMICAL PROFILE OF VATTIPALLY PATIENTS.

Blood	Initial Mean ± S.D.	6 months follow-up Mean ± S.D.	12 months follow-up Mean ± S.D.
Total Progeins (Gm%)			
Group-I	6.67 ± 0.58	6.92 ± 0.48	6.98 ± 0.34
Group-II	6.58 ± 0.62	6.96 ± 0.86	7.12 ± 0.36
Group-III	6.89 ± 0.76	7.29 ± 0.49	7.68 ± 0.24
Group-IV	6.62 ± 0.82	7.45 ± 0.35	7.77 ± 0.19
Calcium (Mg%)			
Group-I	9.96 ± 1.67	10.32 ± 0.82	10.46 ± 0.92
Group-II	9.48 ± 1.26	10.58 ± 0.98	10.94 ± 0.78
Group-III	10.22 ± 1.84	11.44 ± 1.02	12.84 ± 1.22
Group-IV	9.83 ± 1.66	11.14 ± 0.94	12.84 ± 1.22
Fluoride (Mg/l)			
Group-I	0.12 ± 0.04	0.11 ± 0.03	0.12 ± 0.04
Group-II	0.14 ± 0.06	0.11 ± 0.04	0.10 ± 0.05
Group-III	0.18 ± 0.03	0.15 ± 0.04	0.11 ± 0.05
Group-IV	0.17 ± 0.02	0.14 ± 0.05	0.10 ± 0.02
Alk. Phost (KAU)			
Group-I	25.68 ± 11.54	23.66 ± 8.88	22.88 ± 10.24
Group-II	22.72 ± 10.86	20.44 ± 9.26	20.28 ± 10.36
Group-III	27.54 ± 12.28	20.28 ± 10.34	18.42 ± 8.28
Group-IV	27.88 ± 11.45	19.45 ± 11.22	16.26 ± 9.34

TABLE 3.3

Urine	Initial Mean + S.D.	6 months follow-up Mean + S.D.	12 months follow-up Mean + S.D.
Calcium (Mg%)			
Group I	11.66 ± 2.84	10.84 ± 2.33	10.18 ± 2.86
Group II	10.39 ± 2.68	9.98 ± 2.44	9.67 ± 2.36
Group III	11.48 ± 3.08	8.22 ± 2.12	8.66 ± 2.32
Group IV	11.35 ± 2.12	8.14 ± 2.36	8.63 ± 2.48
Fluoride (Mg/l)			
Group I	8.72 ± 3.18	8.44 ± 2.38	8.64 ± 2.46
Group II	8.14 ± 2.94	8.65 ± 2.08	9.20 ± 2.18
Group III	7.88 ± 2.44	10.08 ± 2.36	11.28 ± 2.32
Group IV	8.54 ± 2.72	10.16 ± 2.27	12.14 ± 2.86

TABLE - 3.4

STATISTICAL SUMMARY OF BIO-CHEMICAL PROFILE OF SIVANNAGUDEM PATIENTS

Blood.	Initial	3-months follow-up	6-months follow-up	9 months floow-up	12 months follow-up
	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.
Total proteins (Gm%)					
Group I	6.84 ± 0.36	6.85 ± 1.36	6.92 ± 0.33	7.08 ± 0.38	7.15 ± 0.30
Group II	6.73 ± 0.51	6.65 ± 0.48	6.71 ± 0.38	6.88 ± 0.40	7.00 ± 0.29
Group III	6.81 ± 0.61	7.03 ± 0.42	7.25 ± 0.25	7.61 ± 0.21	7.66 ± 0.23
Group IV	6.83 ± 0.55	6.93 ± 0.40	7.21 ± 0.32	7.50 ± 0.21	7.61 ± 0.29
Calcium (Mg%)					
Group I	11.95 ± 1.86	11.37 ± 2.72	11.83 ± 1.50	11.87 ± 1.44	12.32 ± 1.41
Group II	12.56 ± 1.82	12.49 ± 1.62	12.13 ± 1.49	12.42 ± 1.36	12.76 ± 1.34
Group III	12.20 ± 1.64	12.65 ± 1.36	12.60 ± 1.55	12.88 ± 1.45	13.21 ± 1.43
Group IV	11.52 ± 2.23	11.58 ± 1.63	11.69 ± 1.46	11.99 ± 1.33	12.27 ± 1.26
Flouride (Mg/l)					
Group I	0.15 ± 0.07	0.16 ± 0.11	0.14 ± 0.05	0.13 ± 0.05	0.14 ± 0.04
Group II	0.176 ± 0.12	0.15 ± 0.10	0.17 ± 0.11	0.17 ± 0.10	0.15 ± 0.08
Group III	0.14 ± 0.05	0.15 ± 0.10	0.17 ± 0.11	0.17 ± 0.10	0.11 ± 0.03
Group IV	0.16 ± 0.08	0.15 ± 0.07	0.15 ± 0.07	0.15 ± 0.06	0.14 ± 0.07
Alk.Phost.(KAU)					
Group I	29.46 ± 12.01	23.51 ± 7.90	23.41 ± 7.46	23.73 ± 8.89	22.69 ± 9.24
Group II	29.94 ± 12.41	26.89 ± 11.53	23.48 ± 9.11	20.60 ± 8.19	17.80 ± 7.55
Group III	29.06 ± 14.12	26.21 ± 13.17	23.78 ± 11.98	20.19 ± 9.32	17.61 ± 8.15
Group IV	29.32 ± 9.05	21.16 ± 7.94	18.81 ± 7.25	16.48 ± 6.31	14.65 ± 5.19

TABLE 3.4

STATISTICAL SUMMARY OF URINE PROFILE OF SIVANNAGUDEM PATIENTS

Urine	Initial	3-months follow-up	6-months follow-up	9 months follow-up	12 months follow-up
	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.
URINE					
Calcium (Mg%)					
Group I	13.69 ± 3.14	10.56 ± 2.07	10.10 ± 1.58	9.90 ± 1.56	9.43 ± 1.58
Group II	12.00 ± 4.69	9.88 ± 3.43	9.88 ± 3.05	9.51 ± 2.77	9.25 ± 2.72
Group III	13.38 ± 3.56	10.68 ± 2.07	10.24 ± 2.15	9.75 ± 2.19	9.38 ± 2.05
Group IV	10.36 ± 3.13	8.47 ± 2.44	10.12 ± 3.15	9.73 ± 2.94	9.21 ± 2.69
Fluoride (Mg/l)					
Group I	6.88 ± 1.97	5.60 ± 1.75	5.62 ± 1.57	6.12 ± 1.97	6.43 ± 2.17
Group II	6.03 ± 2.23	5.04 ± 1.39	6.00 ± 2.93	7.52 ± 3.67	8.68 ± 3.66
Group III	6.83 ± 2.71	5.75 ± 2.09	8.50 ± 4.52	9.29 ± 4.61	10.12 ± 4.84
Group IV	6.90 ± 3.12	5.72 ± 2.55	10.49 ± 6.98	12.25 ± 6.74	13.10 ± 6.74

TABLE - 3.5

STATISTICAL SUMMARY OF BIO-CHEMICAL PROFILE OF BATLAPALLY PATIENTS

Blood	Initial	3-months follow-up	6 months follow-up	9 months follow-up	12 fo
	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.	Me
Total Proteins (Gm%)					
Group I	6.38 ± 0.59	6.65	6.92 ± 0.42	7.03	7.15
Group II	6.42 ± 0.53	6.70	6.88 ± 4.86	6.98	7.07
Group III	6.60 ± 4.92	6.74	6.90 ± 4.92	7.32	7.55
Group IV	6.62 ± 6.02	6.75	6.88 ± 0.45	7.094	7.50
Calcium (Mg%)					
Group I	8.69 ± 1.50	9.76	10.89 ± 1.41	11.04	11.33
Group II	7.76 ± 1.14	8.71	10.06 ± 1.58	10.365	10.66
Group III	7.78 ± 1.69	8.64	9.70 ± 1.61	10.06	10.52
Group IV	7.56 ± 1.61	8.48	9.57 ± 1.75	10.13	10.46
Fluoride (Mg/l)					
Group I	0.18 ± 0.04	0.42	0.14 ± 0.03	0.13	0.14
Group II	0.19 ± 0.04	0.19	0.13 ± 0.03	0.13	0.13
Group III	0.18 ± 0.03	0.13	0.12 ± 0.03	0.12	0.12
Group IV	0.17 ± 0.03	0.15	0.13 ± 0.03	0.13	0.12

TABLE 3.5 Contd..

Alk Phost (KAU)					
Group I	26.07 ± 9.71	23.07	19.24 ± 7.23	16.04	15.66 ± 8.32
Group II	25.81 ± 8.89	19.49	18.57 ± 10.45	16.32	12.88 ± 8.72
Group III	37.57 ± 12.87	34.01	32.67 ± 11.16	26.58	23.06 ± 10.34
Group IV	32.28 ± 10.91	27.31	24.44 ± 12.46	22.35	18.96 ± 8.69

TABLE - 3.5

STATISTICAL SUMMARY OF BIO-CHEMICAL PROFILE OF BATLAPALLY PATIENTS

Urine	Initial	3-months follow-up	6 months follow-up	9 months follow-up	12 months follow-up
	Mean + S.D.	Mean + S.D.	Mean + S.D.	Mean + S.D.	Mean + S.D.
Calcium(Mg%)					
Group I	9.81 ± 2.68	7.94	6.28 ± 1.05	6.01	5.76 ± 1.83
Group II	10.89 ± 3.37	9.48	6.89 ± 1.02	5.46	5.23 ± 1.57
Group III	9.91 ± 3.08	7.58	5.06 ± 1.11	4.96	4.10 ± 1.03
Group IV	9.95 ± 3.24	8.80	7.46 ± 1.63	6.04	5.80 ± 1.46

TABLE 3.5 Contd..

Fluoride (Mg/l)					
Group I	11.5 ± 1.39	11.52	9.54 ± 1.24	10.33	10.916 ± 2.48
Group II	11.03 ± 1.17	9.48	7.62 ± 1.47	8.49	9.40 ± 1.62
Group III	14.18 ± 1.88	11.79	9.64 ± 2.08	10.07	10.96 ± 2.55
Group IV	12.04 ± 1.57	11.01	8.75 ± 1.97	10.46	10.93 ± 2.16

Group I Fluorosis control
Group II Patients receiving Defluridated water
Group III Nutritional supplement
Group IV Defluoridated water ± nutritional supplement

The changes in the biochemical profiles of calcium, fluoride and alkaline phosphatase are also discernable in individual patients of different age groups when compared to values of normal individuals of Nacharam. Variations in salient biochemical parameters in individual patients of different age groups compared to normal individuals of Nacharam are shown in Tables 3.6 - 3.9.

3.5 OBSERVATIONS OF SERUM FLUORIDE DATA:

The data reveales that the subjects receiving the defluoridated water or nutritional supplement or both have serum fluoride levels gradually reducing from a maximum of 0.6 ppm to 0.08 ppm over a period of 12 months. The reduction is maximum in the subjects receiving both defluoridated water and nutritional supplements. The variations though not uniform, are observed in all age groups. Maximum initial concentration of 0.6 ppm and maximum reduction of 0.3 ppm could be seen in subjects of Batlapalli village who were previously exposed in highest levels of fluoride in drinking water. Maximum reduction in the fluoride content of serum is also seen in all the villages in the subjects over 18 years (18+).

The reduced F concentration in serum samples is invariably more than the maximum concentration of 0.06 ppm. in the samples of non-endemic area of Nacharam. These observations point out important message viz.

1. Providing defluoridation water or nutritional supplements brings out significant changes in the circulating serum fluoride.
2. Providing defluoridated water along with adequate nutritional supplements is a meaningful approach as it has potentials to induce maximum F. reduction.
3. It may take considerable length of time to get serum fluoride values comparable to that of non-endemic cases of Urinary fluoride level.

The results indicate general reduction in the urinary fluoride concentration in the subjects of D, N and D+N groups. However it is significant to note that subjects receiving defluoridated water and nutritional supplements have a tendency to excrete more F^- compared to those receiving nutritional supplements alone.

MARRIGUDA - 3.6

SERUM FLUORIDE PROFILE OF MARRIGUDA
(Mg/l)

Age Group	Group	Initial results	Six months follow-up	12 months follow-up
5-10	D	0.25	0.2	0.12
10-18	D	0.25	0.15	0.15
18+	D	0.4	0.15	0.1
18+	D	0.3	0.15	0.12
0-5	N	0.2	0.1	0.12
18+	N	0.3	0.2	0.12
10-18	N + D	0.3	0.15	0.1

TABLE - 3.7

URINARY FLUORIDE EXCRETION OF PATIENTS IN MARRIGUDA (Mg/l)

Age group	Group	Initial results	Six months follow-up	12 months follow-up
18+	D	4.0	3.0	7.0
0-5	N	2.0	6.6	9.2
5-10	N	5.0	11.2	17.0
10-18	N	2.8	2.0	7.0
18+	N	6.1	2.4	2.0
5-10	N + D	1.5	3.0	16.0
10-18	N + D	1.1	2.0	6.5
18+	N + D	3.4	2.4	1.4

TABLE - 3.8

NORMAL VALUES OF NACHARAM

Parameter.	Normal values of the age-group			
	0-5	5-10	10-18	18+
Serum fluoride (Mg/l)	0.04	0.06	0.05	0.06
Urine Fluoride (Mg/l)	0.8	0.9	1.1	1.4

TABLE - 3.9

SERUM FLUORIDE PROFILE OF VATTIPALLY
(Mg/l)

Age group	Group	Initial results	Six months follow-up	12 months follow-up
10-18	D	0.1	0.08	0.06
18+	D	0.15	0.08	0.06
5-10	N	0.2	0.12	0.1
10-18	N	0.15	0.1	0.08
18+	N	0.1	0.1	0.8
0-5	N + D	0.2	0.12	0.11
5-10	N + D	0.15	0.15	0.1
18+	N + D	0.2	0.15	0.1

TABLE - 3.10

URINARY FLUORIDE EXCRETION OF PATIENTS IN VATTIPALLY
(mg/l)

10-18	D	10.0	9.8	11.2
18+	D	11.0	10.6	12.8
5-10	N	6.8	7.2	10.8
10-18	N	7.6	7.4	10.4
18+	N	5.0	5.6	7.6
0-5	N + D	9.2	9.8	11.2
5-10	N + D	6.8	6.8	7.8
18+	N + D	6.0	7.0	8.4

TABLE - 3.11

SERUM FLUORIDE PROFILE OF SIVANNAGUDEM
(mg/l)

Age group	Group	Initial results	Six months follow-up	12 months follow.up
0-5	N	0.2	0.15	0.10
5-10	N	0.2	0.10	0.10
18+	N	0.2	0.15	0.10
10-18	D	0.35	0.25	0.25
0-5	N + D	0.15	0.10	0.1
5-10	N + D	0.15	0.15	0.08
10-18	N + D	0.40	0.25	0.15

TABLE - 3.12

URINARY FLUORIDE EXCRETION OF PATIENTS IN SHIVANNAGUDEM
(mg/l)

0-5	N	5.0	7.5	10.0
0-5	N	3.5	12.5	14.0
5-10	N	9.3	12.0	13.0
18+	N	9.0	22.0	24.0
18+	D	8.0	14.0	18.0
18+	D	4.0	31.0	28.0
5-10	N + D	4.0	7.5	10.6
5-10	N + D	4.0	19.0	22.0
10-18	N + D	4.2	8.0	10.0
10-18	N + D	4.2	17.0	20.0

TABLE - 3.13

SERUM FLUORIDE PROFILE OF BATLAPALLY (Mg/l)

Age Group	Group	Initial results	Six months follow-up	12 months follow-up
18+	D	0.25	0.15	0.12
18+	D	0.6	0.35	0.4
0-5	N	0.2	0.12	0.12
18+	N	0.4	0.2	0.12
5-10	N+D	0.3	0.1	0.08
18+	N+D	0.4	0.2	0.1

TABLE - 3.14

URINARY FLUORIDE EXCRETION OF PATIENTS IN BATLAPALLY (Mg/l)

5-10	N	28.0	8.0	10.0
10.18	N	28.6	18.0	17.5
0-5	N+D	13.8	8.0	10.4
5-10	N+D	14.0	10.6	20.0
10-18	N+D	5.0	11.0	16.0

3.6 SERUM AND URINARY CALCIUM LEVELS:

The data on serum and urinary calcium levels of some of the subjects on the four villages are presented in Table 3.15 to 3.23. The data indicate that the calcium levels in the serum substantially increased in subjects of all the age groups receiving nutritional supplements alone or in combination with defluoridated water. But those receiving deflucridated water alone have not registered any increase in serum fluoride level. In the case of urine, significant decrease in urine concentration is evident in all the groups. However the reduction in urine calcium concentration is more in the subjects receiving nutritional supplements either alone or combined with defluoridated water compared to only defluoridated water group.

TABLE - 3.15

SERUM CALCIUM PROFILE OF MARRIGUDA:
(Mg%)

Age-group	Group.	Initial results	Six months follow-up	12 months follow-up
0-5	N	13.0	13.0	13.2
5-10	N	6.0	8.4	10.0
10-18	N	11.0	12.8	14.0
18+	N	11.0	12.0	12.8
5-10	N+D	10.0	11.4	12.0
10-18	N+D	11.0	12.0	13.0
18+	N+D	8.8	8.8	10.6
18+	N+D	11.6	13.6	14.0

TABLE - 3.16

URINARY CALCIUM EXCRETION OF PATIENTS IN MARRIGUDA
(Mg %)

Age group	Group	Initial results	Six months follow-up	12 months follow-up
0-5	N	10.4	9.0	8.2
10-18	N	7.6	4.0	4.0
18+	N	12.0	9.0	7.2
18+	N	21.5	10.0	3.0
5-10	D	9.0	7.2	5.0

TABLE - 3.17

SERUM CALCIUM PROFILE OF VATTIPALLI
(Mg %)

Age group	Group	Initial results	Six months follow-up	12 months follow-up
10-18	D	7.0	7.2	7.8
18+	D	8.5	8.9	9.2
5-10	N	8.0	9.2	10.4
10-18	N	8.6	9.4	10.8
18+	N	9.0	9.8	11.0
0-5	N+D	10.0	11.0	11.5
5-10	N+D	9.0	9.8	11.0

TABLE - 3.18

URINARY CALCIUM EXCRETION OF PATIENTS IN VATTIPALLI (Mg%)

10-18	D	12.0	11.6	10.8
18+	D	11.5	11.0	10.0
10-18	N	11.5	10.8	9.8
5-10	N	11.0	10.5	9.8
18+	N	10.4	9.6	8.6
0-5	N + D	10.0	9.2	8.6
5-10	N + D	11.0	10.4	9.0

TABLE - 3.19

NACHARAM CONTROL GROUP
CALCIUM CONC. IN SERUM & URINE

Parameter	Mean values of age group			
	0-5	5-10	10-18	18+
Serum Calcium (mg %)	10.5	10.0	9.6	9.2
Urine Calcium (mg %)	10.2	10.8	10.2	9.8

TABLE - 3.20

SERUM CALCIUM PROFILE OF SHIVANNAGUDEM (Mg %)

Age Group	Group	Initial results	Six months follow-up	12 months follow-up
0-5	N	13.2	14.2	15.0
0-5	N	12.8	13.0	13.6
5-10	N	11.6	12.0	13.4
10-18	N	9.6	10.6	11.0
0-5	D + N	10.0	11.2	12.0
5-10	D + N	10.0	11.8	12.4
10-18	D + N	8.0	10.0	11.0
10-18	D + N	12.4	13.2	13.8
18+	D + N	12.0	12.6	13.0
18+	D + N	9.6	10.2	10.8

TABLE - 3.21

URINARY CALCIUM EXCRETION OF PATIENTS IN SHIVANNAGUDEM (mg %)

5-10	N	15.0	12.8	11.0
5-10	N	13.0	10.2	9.6
10-18	N	12.0	5.6	4.0
18+	N	11.0	8.6	8.0
5-10	D+N	12.0	8.6	9.0
5-10	D+N	18.0	7.8	7.0
10-18	D+N	12.0	10.0	10.0
18+	D+N	14.0	9.6	9.0

TABLE - 3.22

SERUM CALCIUM PROFILE OF BATLAPALLY (Mg %)

Age Group	Group	Initial results	Six months follow-up	12 months follow-up
0-5	N	7.2	9.6	10.4
10-18	N	7.0	9.4	10.0
18+	N	5.6	10.0	11.0
10-18	D	5.4	6.6	6.0
5-10	N+D	7.0	11.2	11.8
10-18	N+D	6.4	8.6	9.6
10-18	N+D	6.6	10.0	10.8
18+	N+D	7.8	10.0	11.6

TABLE - 3.23

URINARY CALCIUM EXCRETION OF PATIENTS IN BATLAPALLY (mg%)

Age Group	Group	Initial results	Six months follow-up	12 months follow-up
0-5	N	9.0	8.0	7.4
5-10	D	16.4	9.0	7.6
18+	D	17.0	12.2	11.6
0-5	N+D	16.0	10.4	9.6
10-18	N+D	9.8	3.4	4.0
18+	N+D	11.0	10.0	9.4

TABLE - 3.24

SERUM ALKALINE PHOSPHATASE PROFILE OF MARRIGUDA
(K.A.U.)

Age Group	Group	Initial results	Six months follow-up	12 months follow-up
5-10	D	59	52	44
10-18	D	43	18	16
18+	D	61	48	40
5-10	N	35	22	16
5-10	N	34	18	16
10-18	N	56	36	30
18+	N	17	11.6	11.0
5-10	N+D	15	12.5	10.0
10-18	N+D	32	20.5	18.0
18+	N+D	23.5	18	14

TABLE - 3.25

SERUM ALKALINE PHOSPHATASE PROFILE OF VATTIPALLI
(K.A.U.)

10-18	D	51	40	32
18+	D	36	26	22
5-10	N	49	32	26
10-18	N	36	26	20
18+	N	49	36	27
0-5	N+D	45	36	29
5-10	N+D	38	30	25
18+	N+D	24	18	12

TABLE - 3.26

SERUM ALKALINE PHOSPHATASE PROFILE OF SHIVANNAGUDEM (K.A.U.)

Age Group	Group	Initial Results	Six months follow-up	12 months follow-up
0-5	N	31.5	24.0	20.0
0-5	N	39.25	34.0	18.0
5-10	N	31.5	28.0	22.0
10-18	N	39.7	30.0	22.0
18+	N	16.0	14.0	11.0
0-5	N+D	26.0	20.0	16.0
5-10	N+D	29.0	20.0	14.0
5-10	N+D	33.0	30.0	24.0
10-18	N+D	21.0	20.0	16.0
10-18	N+D	31.0	22.0	18.0
18+	N+D	16.0	10.0	9.0
18+	N+D	23.0	10.0	16.0

3.7 SERUM ALKALINE PHOSPHATASE:

The data of serum alkaline phosphase has been presented in Tables 3.24 to 3.28.

It will be seen from the results that there has been significant reduction in the alkaline phosphatase values in all the age groups and indeferent groups of study, after intervention. However the values are far higher than the normal values recorded for persons of Nacharam.

TABLE - 3.27

SERUM ALKALINE PHOSPHATASE PROFILE OF BATLAPALLY
(K.A.U.)

Age Group	Group	Initial results	Six months follow-up	12 months follow-up
5-10	D	40.0	24.0	20.0
18+	D	12.0	10.2	9.6
0-5	N	63.6	48.0	34.0
5-10	N	44.0	22.0	16.0
10-18	N	28.0	18.0	14.0
18+	N	12.0	9.6	8.0
0-5	N + D	31.0	24.0	20.0
5-10	N + D	25.0	20.0	16.0
10-18	N + D	33.0	28.0	20.0
18+	N + D	48.0	36.0	24.0

TABLE - 3.28

NACHARAM SUBJECTS

MEAN SERUM ALKALINE PHOSPHATASE ACTIVITY

Age Group	Serum Alkaline Phosphatase K.A.U. (Units)
0-5	15
5-10	16
10-18	18.5
18+	20.5

3.8 RESULTS OF CLINICAL EXAMINATIONS AFTER INTERVENTION:

The results of clinical and radiological examinations after intervention are tabulated and presented in Tables 3.29 to 3.44.

It will be observed from the results that patients of control group continued to suffer from all the symptoms found initially.

There has been significant improvement in the physical disabilities experienced by the subjects on receiving nutritional supplements alone or in combination with defluoridated water. In the case of patients receiving defluoridated water alone, they were relieved of vague body pains but the joint pains persisted.

Maximum relief could be observed in the subjects of Marriguda and Vattipalli Villages and minimum in patients of Batlapalli Village.

The results suggest that some of the symptoms experienced by the people can be attributable to malnutrition.

3.9 RESULTS OF RADIOLOGICAL EXAMINATION:

Findings of radiological examination reveal no change in the radiological profiles in some cases and slight changes in others. The changes include
1. Little regression in coarse trabiculation pattern.
2. Decreased periosteal new bone formations.
3. Decreased Osteosclerosis and 4. Decreased ossification of interosseous membrane.

TABLE - 3.29

CONTROL GROUP MARRIGUDA

Sl. No.	Age				Sex		Initial		12 Months	Final	
	0-5	5-10	10-18	18+	M	F	Clinical feature	Radiological feature		Clinical	Radiological
1.			6		5	1	Body Aches, Back ache, Arthralgia, stiffness.	Moderate:- Increased Bone density Osteosclerosis, Irrigular periosteal bone formation calcification of Interosseous membrane, coarse trabiculation.		Complains of Backache and stiffness, Arthralgia.	No change
2.				9	9		Generalised Body pains, Backache, stiffness, swelling of joints, limitation of movements rigidity of the spine and numbness.	Crippled:- Increased bone density Osteosclerosis coarse trabiculation, Irregular periosteal bone formation, calcification of Interosseous membrane thickened, exostosis, Osteophytosis, deformed bone.		Complains of stiffness, swelling of joints. No change in limitation movements, rigidity of the spine, slight improvemen in numbness.	No change

TABLE - 3.30

DEFLUORIDATION GROUP MARRIGUDA

Sl. No.	Age 0-5	5-10	10-18	18+	Sex M	F	Initial Clinical Feature	Initial Radiological Feature	12 Months Final Clinical	12 Months Final Radiological
1.	2					2	VagueBody pains, & joint pains.	Mild: Increased Bone density.	Complains of joints pains only.	No change
2.		3			3		Body Aches, Back aches, Arthralgia, Stiffness.	Moderate:- Increased Bone density Osteo-selerosis, Irregular periosteal bone formation, calciification of Interos-seous, membrane, coarse trabicula-tion.	Complains of Backache, and stiffness.	Slight regressic in coarse tra-biculationpatt-ern decreased periosteal New bone formation decreased Osteoselerosis and calcificatic of Interosecus membrane.
3.			14	14			Generalised Body pains, Backache, stiffness, swell-ing of joints, limitation of move-ments rigidity of the spine, and numbness.	Crippled:-Increased Bone density, Osteo-selorosis, Coarse-trabiculation, Irre-gular periosteal bone formation, calci-fication of Interosseous membrane, thickened, exostosis, Osteophy-tosis, deformed bone.	Complains of stiffness, swelling of joints. No change in limitation movements, rigi-dity of the spine slight improvement of in numbness.	Slight regre-ssion noted. Interosseous membrane and coarse tra-biculation.

TABLE - 3.31

NUTRITION GROUP MARRIGUDA

Sl. No.	Age 0-5	5-10	10-18	18+	Sex M	F	Initial Clinical features	Initial Radiological features	12 Months	Final Clinical	Final Radiological
1.	2				1	1	Mal-Nutrition	--		Moderate improvement.	--
2.		1			1		VagueBody pains & joint pains	Mild increased bone density		No complaints of Body pains and joint pains.	No change
3.			4		3	1	Bodyaches, backache, Arthralgia, stiffness.	Moderate:-Increased bone density Osteoselerosis, irregular periosteal bone formation calcification of interosseous -- membrane, coarse trabiculation.		No complains of body aches & backaches, reduction of stiffness.	Slight regression in coarse trabiculation petter n decreased periosteal - new bone formation, decreased Osteoselerosis and osification of interosseous membrane.
4.				12	8	4	Generalised body pains, backaches stiffness, swelling of joints, limitation of movements. regidity of the spine and numbness.	Crippled:-Increased bone density, Osteosclerosis, coarse trabiculation, irregular periosteal bone formation, calcification of interosseous membrane thickened, exostosis, Ostephytosis, deformed bone.		No complains of body pains and backaches, reduction of stiffness, slight changes in limitation of movements, no complains of numbness.	Slight regression noted intrasious membrane and coarse trabiculation.

TABLE - 3.32
NUTRITION + DEFLUORIDATION GROUP MARRIGUDA

Sl. No.	Age 0-5	5-10	10-18	18+	Sex M	F	Initial Clinical feature	Initial Radiological feature	12 Months Clinical	12 Months Final Radiological
1.	1				1		Mal Nutrition	--	Moderate Improvement.	--
2.		4			3	1	Vague Body pains & Joint pains.	Mild:-Increased bone density.	No complains of body pains & joint pains.	No change
3.			8		3	5	Bodyaches, Backache, Arthralgia. Stiffness.	Moderate:-Increased Bone density Osteosclerosis. Irregular periosteal bone formation, calrification of Interosseous Membrane, coarse trabiculation.	No complains of bodyaches, and Backaches, reduction of stiffness.	Slight regression In coarse trabiculation pattern. decreased periosteal new bone formation, decreased Osteoselerrsis and Osification of Intrasious membrane.
4.				7	2	5	Generalised body pains Backaches, Stiffness, swelling of joints, limitation of movements, regidity of the spine & Numbness.	Crippled:-Increased bone density Osteosclorosis. Coarse trabiculation. Irregular periosteal bone formation of Interosseous Membrane thickened, Exostosis, Osteophytosis, deformed bone.	No complains of Body pains and Backache. Reduction of stiffness, slight changes in limitation of movements. No complains of numbness.	Slight regression noted Interosseous Membrane and coarse trabiculation.

TABLE - 3.33

CONTROL GROUP - VATTIPALLY

Sl. No.	Age 0-5	5-10	10-18	18+	Sex M	F	Initial Clinical Features	Initial Radiological Features	6 months	Final Radiological	Final Clinical
1.	-				-		-				-
2.	-				-		-				-
3.	-				-		-				-
4.			2		2		Generalised Body pains, backache, stiffness, swelling of joints, limitation of movements. Regidity of the spine and numbness.	Crippled:-Increased Bone density Osteosclerosis coarse trabiculation Irregular periosteal bone formation, calcification of Interosseous membrane thickened, exostosis, osteophytosis, deformed bone.	No change		Complaints of stiffness, swelling of joints, No change in limitation movements, Regidity of the Spine, slight improvements and numbness.

TABLE - 3.34

DEFLUORIDATION GROUP - VATTIPALLY

Sl. No.	Age				Sex		Initial		6 months	Final	
	0-5	5-10	10-18	18+	M	F	Clinical feature	Radiological feature		Radiological	Clinical
1.			-				-				-
2.		1			1		Vague Body pains, and joint pains.	Mild:-Increased Bone density.		No change	Complaints of Joint pains only.
3.			-				-				-
4.			5		4	1	Generalised Body pains, Backache, Stiffness, Swelling of Joints, limitation of movements. Regicity of the spine and numbness.	Crippled:-Increased Bone density Osteosclerosis coarse trabiculation - Irregular periosteal bone formation, calcification of Interosseous membrane thickened, exostosis osteophytosis, deformed bone.		Slight regression noted Interosseous membrane and coarse trabiculation.	Complaints of stiffness, swelling of joints, No change in limitation movements, Regidity of the spine, slight improvement in numbness.

TABLE - 3.35

NUTRITION GROUP - VATTIPALLY

Sl. No.	Age 0-5	Age 5-10	Age 10-18	Age 18+	Sex M	Sex F	Initial Clinical Features	Initial Radiological Features	6 months	Final Radiological	Final Clinical
1.	--				-			-			-
2.		3			1	2	Vague Body pains, and joint pains.	Mild:-Increased Bone density.		No change	Complaints of joint pains only.
3.			2		1	1	Bodyaches, Backache, stiffness, Arthralgia.	Moderate:-Increased Bone density Osteosclerosis, Irregular periosteal bone formation calcification of Interosseous membrane, coarse trabeculation.		Slight regression in coarse trabeculation-pettrin decreased periosteal New bone formation decreased osteosclerosis and osification of Interosseous membrane.	Complaints of Backache and stiffness.
4.			4		3	1	Generalised Body pains. Backache, stiffness, Swelling of joints, limitation of movements. Regidity of the spine and numbness.	Crippled:-Increased Bone density Osteosclerosis coarse trabeculation, Irregular periosteal bone formation, calcification of Interosseous membrane thickened, exostosis, osteophytosis deformed bone.		Slight regression noted Interosseous membrane and coarse trabiculation.	Complaints of stiffness, swelling of joints, No change in limitation of movements. Regidity of the spine, slight improvements in numbness

TABLE - 3.36

NUTRITION+DEFLUORIDATION GROUP - VATTIPALLY

Sl. No.	Age 0-5	5-10	10-18	18+	Sex M	F	Initial Clinical feature	Initial Radiological feature	6 Months	Final Radiological	Final Clinical
1.	-						-				-
2.		3			1	2	Vague Body pains, and joint pains.	Mild:Increased Bone density.		No change	No complaints of Body pains and joint pains.
3.	-		-		-		-				-
4.			4		3	1	Generalised Body pains, Backache, Stiffness, Swelling of Joints, limitation of movements. Regidity of the Spine and numbness.	Crippled:-Increased Bone density, Osteosclerosis coarse, trabiculation, Irregular periosteal bone formation, calcification of Interosseous membrane thickened, exostosis, osteophytosis, deformed bone.		Slight regression noted Interosseous membrane and coarse trabiculation.	No complaints of Bodypains and Backache, Reduction of stiffness, slight changes in limitation of movements. No complaints of numbness.

TABLE - 3.37

CONTROL GROUP ~ SIVANNAGUDA

Sl. No.	Age 0-5	5-10	10-18	18+	Sex M	F	Initial Clinical feature	Initial Radiological feature	12 Months	Final Clinical	Final Radiological
1.	2				2		Malnutrition	--		Moderate Improvement	--
2.		1			1		Vaguebody pains and joint pains	Mild-Increased Bone density		Complains of joints pains only	No change
3.			6		6		Bodyaches, Back ache, Arthralgia, stiffness.	Moderate:-Increased Bone density, Osteo-selerosis, Irregular periosteal bone formation, calcification of Interosseous-membrane, coarse trabuculation.		Compalins of Backache and stiffness.	No change
4.				5	4	1	Generalised Body pains, Backache stiffness, swelling of Joints, limitation of movements, rigidity of the spine and numbness.	Crippled: Increased Bone density Osteo-selorosis, coarse trabuculation. Irregular periosteal bone formation, clasification of Interosseous membrane thickened, exostosis, Osteophytosis, deformed bone.		Complains of stiffness, swelling of joints. No change in limitation of movements, rigidity of the spine, slight improvements in numbness.	No change

TABLE - 3.38

DEFLUORIDATION GROUP SIVANNAGUDA

Sl. No.	Age 0-5	5-10	10-18	18+	Sex M	F	Initial Clinical feature	Initial Radiological feature	12 Months Final Clinical	12 Months Final Radiological
1.	4				4		Vaguebody pains & joint pains.	Mild:-Increased Bone density.	Complains of joints pains only.	No change
2.			7		6	1	Bodyaches, Back-Ache, Arthralgia, stiffness.	Moderate:-Increased Bone density Osteosclerosis. Irregular periosteal bone formation calcification of Interosseous-membrane. Coarse trabeculation.	Complains of Backache and stiffness.	Slight regression in coarse trabeculation pattern decreased, periosteal-New bone formation, decreased-Osteosclerosis and calcification of Interosseous membrane.
3.				6	6		Generalised Body pains, Back-Ache, stiffness, Swelling of joints, limitation of movements, Rigidity of the Spine and Numbness.	Crippled: Increased Bone density Osteosclerosis, Coarse trabeculation. Irregular periosteal bone formation calcification of Interosseous-membrance, thickened, exostosis, Osteophytosis, deformed bone.	Complains of Stiffness, Swelling of joints. No change in limitation of movements. Rigidity of the spine slight improvements in numbness.	Slight regression noted interosseous membrance and coarse trabeculation.

TABLE - 3.39
NUTRITION GROUP SIVANNAGUDA

Sl. No.	Age 0-5	5-10	10-18	18+	Sex M	F	Initial Clinical feature	Initial Radiological feature	12 Months Final Clinical	12 Months Final Radiological
1.	5				4	1	Malnutrition	--	Moderately Improved.	--
2.		7			7		Vague Body pains, & joint pains.	Mild:-Increased Bone density.	No complains of Bodypains & Joint pains.	No change
3.			1		1		Body Aches, Backache, Arthralgia Stiffness.	Moderate:-Increased Bone density Osteosclerosis, Irregular periosteal bone formation calcification of Interosseous membrane, coarse trabiculation.	No complains of Bodyaches and Backache, reduction of stiffness.	Slight regression in coarse trabiculation pattern decreased periosteal. New bone formation, decreased Osteoselerosis and calcification of Interossed membrane.
4.				5	5		Generalised Body pains, Backache, stiffness, swelling of joints, limitation of movements, rigidity of the spine, and numbness.	Crippled:-Increased Bone density Osteoselorosis, coarse trabiculation, Irregular periosteal bone formation. Calcification of Interosseous membrane thickened, exostosis, Osteophytosis, deformed bone.	No complains of Bodypains and Backache, reduction of stiffness, slight changes in limitation of movements, no complains of numbness.	Slight regression noted Intraseous membrane and coarse trabuculation.

TABLE - 3.40

NUTRITION + DEFLUORIDATION GROUP SHIVANNAGUDA

Age 0-5	Age 5-10	Age 10-18	Age 18+	Sex M	Sex F	Initial Clinical feature	Initial Radiological feature	12 Months	Final Clinical	Final Radiological
2				1	1	Malnutrition	--		Moderate Improvement.	--
	5			4	1	VagueBody pains and joint pains.	Mild: Increased Bone density.	12	No complains of Body pains & joint pains.	No change
		3		3		Body Aches, Back ache, Arthralgia, Stiffness.	Moderate:-Increased Bone density Osteosclerosis, Irregular periosteal bone formation Calcification of Interosseous-membrane, coarse trabuculation.		No complains of Bodyaches, and Backache, reduction of stiffness.	Slight regression in coarse tribuculation pattern, , decreased periosteal-New bone formation, decreased Osteosclerosis and calcification of Intraseous membrane.
			13	9	4	Generalised body pains, Backache, stiffness, swelling of joints, limitation of movements, regidity of the spine and numbness.	Crippled:-Increased Bone density Osteosetorosis, Coarse trabuculation, Irregular periosteal bone formation, colciasification of Interseous membrane thicked, exostosis, Osteophytosis, deformed bone.		No complains of Body pains and Backache, Reduction of stiffness slight changes in limitation of movements. No complains of numbness.	Slight regression noted. Interosseous membrane and coarse trabuculation.

TABLE - 3.43

NUTRITION GROUP BATLAPALLY

Sl. No.	Age 0-5	Age 5-10	Age 10-18	Age 18+	Sex M	Sex F	Initial Clinical feature	Initial Radiological feature	12 Months Final Clinical	12 Months Final Radiological
1.		1				1	Vague Body, Joint pains.	Mild:-Increased Bone Density.	No complaints of Body, Joint pains.	No change
2.			7		5	2	Bodyaches, backaches, Arthralgia, stiffness.	Moderate:-Increased Bone density Osteoselorosis, Irregular periosteal - bone formation - calcification of Interosseous membrane, coarse trabeculation.	No complaints of Bodyaches, and backache, Reduction of stiffness.	Slight regression in coarse trabeculation pattern decreased periosteal-New bone formation, decreased Osteoselerosis and calcification of Intrasious membrane.
3.			2		1	1	Generalised body pains, backaches, stiffness, swelling of joints, limitation of movements, rigidity of the spine, and numbness.	Crippled:-Increased bone density, Osteosclorosis, coarse trabeculation. Irregular periosteal bone formation, calcification of Interosseous membrane thickened, exostosis, Osteophytosis, deformed bone.	No complaints of Body pains and Backache, Reduction of stiffness. Slight changes in limitation of movements. No complaints of numbness.	Slight regression noted interosseous membrane and coarse trabeculation.

TABLE - 3.41

CONTROL GROUP - BATLAPALLY

Sl. No.	Age 0-5	5-10	10-18	18+	Sex M	F	Initial Clinical feature	Initial Radiological feature	12 Months Final Clinical	Final Radiological
1.	2				2		Vague Body pains, and Joint pains.	Mild:-Increased Bone density.	Complains of Joint pains only.	No change
2.		3			2	1	Body Aches, Backache, Arthralgia, Stiffness.	Moderate:-Increased Bone density Osteosclerosis, Irregular periosteal bone formation celcification of Interosseous membrane, Coarse trabuculation.	Complains of Backache and stiffness.	No change
3.			9		8	1	Generalised Body pains, Backache, stiffness, swelling of joints, limitation of movements. Rigidity of the spine and numbness.	Crippled:-Increased Bone density Osteselorosis, coarse trabuculation. Irregular periosteal bone formation, celcification of Interossesous membrane thickened, exostosis, Osteophytosis, deformed bone.	Complains of stiffness, swelling of joints, No change in limitation of movements, Rigidity of the spine, slight improvement in numbness.	No change

TABLE - 3.42

DEFLUORIDATION GROUP - BATLAPALLY

Sl. No.	Age 0-5	5-10	10-18	18+	Sex M	F	Initial Clinical feature	Initial Radiological feature	12 Months Clinical	12 Months Radiological
1.	1				1		Vague Body and Joint pains.	Mild: Increased Bone density.	Complains of Joint pains only.	No change
2.		3			2	1	Bodyaches, Back aches, arthralgia, stiffness.	Moderate:-Increased Bone density Osteo-selerosis, Irregular periosteal bone formation clcification of Interosseous-membrane, coarse trabuculation.	Complains of Backache and stiffness.	Slight regression in coarse trabuculation pattern, decreased periosteal New bone formation, decreased Osteosclerosis and calsification of interosseous membrane.
3.			9		4	5	Generalised Body pains, Backache, stiffness, swelling of Joints, limitation of movements, rigidity of the spine, and numbness.	Crippled:-Increased Bone density Osteosclorosis, coarse trabuculation, Irregular periosteal bone formation, calcification of Interosseous membrane. Thickened exostosis, Osteophytosis, deformed bone.	Complains of stiffness, swelling of Joints, no change in limitation of movements. Rigidity of the spine. Slight improvement in numbness.	Slight regression, note interosseous membrane, and coarse trabuculation.

TABLE - 3.44

NUTRITION+DEFLUORIDATION GROUP BHATLAPALLY

Age 0-5	Age 5-10	Age 10-18	Age 18+	Sex M	Sex F	Initial Clinical feature	Initial Radiological feature	12 Months Final Clinical	12 Months Final Radiological
3				1	2	Malnutrition	--	Moderate Improvement.	--
	3			1	2	Vague Body pains and Joint pains.	Mild:-Increased Bone density.	No complaints of body and jointpains.	No change
		2		2		Bodyaches, Backaches, Arthrlgia, stiffness.	Moderate:-Increased Bone density Osteosclerosis. Irregular periosteal bone formation calcification of Interosseous-membrane, coarse tuabuculation.	No complaints of Bodyaches, and Backache. Reduction of stiffness.	Slight regression in coarse trabuculation pattern decreased periosteal-New bone formation - decreased-Osteoselerosis and Ossification of Interosseous membrane.
		2		2		Generalised Body pains, Backache, stiffness, swelling of joints, limitation of movements, rigidity of the spine, and numbness.	Crippled:-Increased Bone density, Osteosclorosis, coarse trabiculation, irregular periosteal bone formation, calcification of Interosseous, Membrane thickened exostosis, Osteophytosis, deformed bone.	No complaints of Body pains and backache, Reduction of stiffness, slight changes in limitation of movements. No complaints of numbness.	Slight regression noted interosseous membrane and coarse trabuculation.

It can be concluded from the observations that the remobilisation of deposited fluoride is possible and the changes of skeletal fluorosis are reversible but the process is slow. The duration of 12 months is too short a period to expect substantial improvement in bone structural configuration. Beneficial changes can be expected by providing defluoridated water and nutritional supplements. These measures will be more useful in the period proceeding the on set of crippling deformities.

C H A P T E R - IV

SUMMARY AND CONCLUSIONS:

1. Water borne fluorosis is prevalent in 10 States in India. The disease is highly endemic in as many as 17 districts of Andhra Pradesh. Epidemiological investigations revealed, low nutritional status of people, besides fluoride concentration in drinking water might aggrevate severity of symptoms.

A research project has been sponsored by International development and research centre to study the effectiveness of providing defluoridated drinking water and nutritional supplements separately as well as in combination in arresting the progress of fluorosis. Four villages have been selected in Nalgonda District so that the fluoride concentrations of drinking water sources are in the ranges 1.1 - 4.0, 4-1 - 8.0 and above 8 mg/l. 72 patients have been selected in each village so that both sexes in the age groups 1-5, 5-10, 10-18 and above 18 years old are represented. Normal persons of a village, Nacharam near Hyderabad, whose water sources contain permissible fluoride concentration have also been included in the study for comparison of results. Base line data was computed on chemical characteristics of drinking water, dietary intake of the subjects, their clinical radiological and biochemical profiles. Intervention programme was then initiated deviding the subjects of each village into the following groups.

1. Normal controls of Nacharam.
2. Fluorosis control group.
3. Subjects provided with defluoridated water.
4. Subjects provided with nutritional supplement.
5. Subjects provided with defluoridated water and nutritional supplements.

The simple process of domestic defluoridation evolved in Institute of Preventive Medicine has been used for removing excessive fluoride. A product termed Hyderabad Mix is provided as Nutritional supplement.

Results of water analysis revealed that the characterics of water of Nalgonda villages are distinctly different from those of Nacharam. The alkalinity of former is always more than hardness and the ratio of the two parameters increased with fluoride concentration.

Data of dietary intake of the subjects revealed that foods consumed have multiple deficiencies of essential nutrients viz. proteins, calcium, phospharous, iron, vitamins etc.

The values of biochemical parameters - Blood, urea, creatinine, phosphorous, magnesium are within normal limits. The results have shown significant increase in the alkaline phosphatase activity of serum and fluoride concentration in blood and urine. It is interesting to note normal linearity relation between fluoride concentration in drinking water and urine has not been found in some of the cases. The urinary fluoride concentrations has been significantly high indicating substantial intake of fluoride through foods also.

All the subjects of the four fluorosis endemic villages were found suffering from dental fluorosis in varying degrees of severity in direct relation to fluoride concentration of drinking water. The severity of symptoms were also influenced by increasing alkalinity content of water. Some of the subjects of investigations were also suffering from skeletal fluorosis, mild to severe in intensity, depending on drinking water F. Concentration. Most of the severe cases are from Sivannagudem and Batlapalli villages, where the average fluoride concentration of water exceeds 5.2 ppm and 7.8 ppm respectively.

After initiation of intervention programme gradual relief from body pains and joint pains were reported by the subjects who drunk defluoridated water or consumed nutritional supplement. Radiological profiles of the patients, showed slight changes. The results indicate that the process of mobilisation of skeletal fluoride is reversible but the duration of investigationis too short a time to find substantial rectification of skeletal abnormalities. The findings of clinical and radiological examinations are substantiated by biochemical data. Statistical evaluation of biochemical data revealed significant reduction in alkaline phosphatase activity, and serum fluoride concentration. However, these values are far higher than the normal values even 12 months after intervention. Significant urinary fluoride concentration has been found even on cessation of fluoride ingestion thus indicating remobilisation of fluoride and its exeretion. The results of the present investigation provide evidence to show that significant relief can be obtained in severity of fluorosis on using defluoridated drinking water and nutritional diet.

The inferances of present study suggest that it is worthwhile to conduct further studies

1. To determine the effectiveness of providing calcium salts either orally as medicines or by addition in water.
2. To find out effectiveness of reducing alkalinity of fluoride water to the normal level.
3. To determine the contribution of fluoride intake from different foods grown in endemic areas of fluorosis.
4. To determine the relationship of formation of urinary calculi and fluorosis.
5. Feasibility of supplying extra nutrients to the undernomished people who are prepared to defloridate their drinking water.
6. To study the effect of Tamarind juice in the food preparation of fluoride patients.