CHAPTER - V

SUMMARY

AND

CONCLUSIONS
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This is a cross-sectional study, as the disease and exposure status are measured simultaneously in a given population. This type of data is used to assess the prevalence of acute or chronic conditions in population. Like other cross-sectional analysis, it pertains to how variables affect each other at the same time.

The present study was undertaken to evaluate the prevalence of dental and skeletal fluorosis in the population of selected villages i.e., Sandramakulapalli, Peddatippasamudram, Kandluru and Adaram. Two hundred and forty two subjects residing in Sandramakulapalli, Peddatimmasamudram and Adaram where drinking water fluoride levels range from 1.3 to 1.88 ppm were categorized into “Fluorotic group I”, 83 fluorotic adults residing in Kandluru where drinking water fluoride level was 2.18 ppm were categorized into “Fluorotic group II”. Two hundred and twenty five non-fluorotic subjects residing in Satyavedu and Rajanagaram where drinking water fluoride levels range from 0.03 to 0.74 were categorized into non-fluorotic group. Further, fluoride status, nutritional, protein, bone mineral, biochemical and hormonal statuses are assessed in fluorotic and non-fluorotic subjects. The data is discussed with comparison between the subjects of fluorotic and non-fluorotic groups; between males and females of fluorotic and non-fluorotic groups.

The following are the salient features of the present study:

- The fluoride levels of drinking water sources in fluorotic and non-fluorotic areas are in a range of 1.41 and 1.76 ppm in Sandramakulapalli; 1.88 and 1.97 ppm in Peddatippasamudram; 1.38 and 1.70 ppm in Adaram; 0.03 and 0.74 ppm in Satyavedu and 0.21 and 0.45 ppm in Rajanagaram. In Kandluru with one source, the fluoride level is 2.18 ppm.

- Fluoride content of different types of foods grown in the fluorotic areas ranged from 1.45 ppm to 5.1 ppm. Among several foods, groundnuts accumulated highest fluoride compared to any other food, followed by staple foods such as rice, and ragi. Compared to cereals, vegetables accumulated lower fluoride amounts. In non-fluorotic areas with <1 ppm
fluoride in drinking water, fluoride contents of foods grown in the local area were much lower.

- A significant difference is found between the fluorotic and non-fluorotic males and females with respect to water (P<0.01) and food (P<0.01) fluoride intakes.

- The mean total fluoride intake of fluorotics is found to be higher when compared to non-fluorotics.

- The prevalence of dental fluorosis is higher in fluorotic group II than the fluorotic group I. With regard to the grades of severity of the disease, fluorotic group II showed higher prevalence of highest grades of 'moderate' and 'severe' fluorosis, compared to the fluorotic group I.

- Among the boys the prevalence of dental fluorosis is highest in the age group of 12 to 15 years, followed by 9 to 12 years and 4 to 9 years. Among the girls the prevalence of dental fluorosis is highest in the age group of 12 to 15 years followed by 4 to 9 years, and 9 to 12 years.

- In adults, among the males, the prevalence of dental fluorosis is the highest in the age group of 51 to 90 years, followed by 25 to 50 years and 15 to 25 years. Among the females, the prevalence of dental fluorosis is highest in the age group of 51 to 90 years, followed by 25 to 50 years and 15 to 25 years.

- Fluorotic group II males and females showed higher prevalence of skeletal fluorosis compared to fluorotic group I males and females.

- In the present study none of the children below 16 years showed skeletal fluorosis and it is observed from the age groups of 25 years.

- The prevalence of skeletal fluorosis is found to increase with age. In males and females the prevalence of skeletal fluorosis is higher in the age group of 50 to 90 years than in 25 to 50 years. Further, between the two sex groups males showed higher prevalence of skeletal fluorosis than the
females. However, severity wise all the subjects with skeletal fluorosis are in grade 1.

- The mean food intakes of fluorotics and non-fluorotics are lower compared to the RDA by ICMR. The mean intake of pulses, milk and milk products, fats and oils, green leafy vegetables, roots and tubers, fruits, sugar and jaggery intake are lower in fluorotic males and females compared to the non-fluorotic males and females.

- The mean energy and nutrient intakes of fluorotics and non-fluorotics are lower compared to the RDA. The mean protein, calcium, phosphorus intakes are lower in fluorotic males and females compared to the non-fluorotic males and females. The mean energy, iron, vitamin B₁ and C intakes are higher in males of fluorotic group II compared with males belonging to fluorotic group I and non-fluorotic group. The mean vitamin A intake is higher in females of fluorotic group II compared with females belonging to fluorotic group I and non-fluorotic group. The mean intake of Phytates and phytate-to-calcium ratio are higher in males and females of fluorotic group I compared to males and females of fluorotic group II and non-fluorotic group. The mean fat intake is similar in fluorotic and non-fluorotic females.

- The mean weight, BMI and waist-to-hip ratio of females belonging to fluorotic group II are lower compared to the females of fluorotic group I and non-fluorotic group. Correlation between fluoride intake and BMI is found to be negative and significant (P<0.01) at 1 per cent level.

- Mean biceps, triceps, sub-scapular, supra iliac and sum of skin folds are found to be lower in fluorotic males and females compared to non-fluorotic males and females.

- Mean percent fat and total body fat is found to be lower in fluorotic males and females compared to non-fluorotic males and females. Mean body density is found to be higher in fluorotic males and females compared to non-fluorotic males and females.
- The serum fluoride levels are found to be significantly higher in fluorotic males and females compared to non-fluorotic males and females.

- The serum calcium, protein and albumin levels are found to be significantly lower in fluorotic males and females compared to non-fluorotic males and females. Mean serum phosphorus levels are found to be significantly higher in males and females of fluorotic group I compared to the males and females of fluorotic group II and non-fluorotic group.

- Mean serum creatinine levels are found to be significantly higher in males and females of fluorotic group II compared to the males and females of fluorotic group I and non-fluorotic group.

- Mean serum alkaline phosphatase and tartrate resistant acid phosphatase levels are found to be significantly higher in fluorotic males and females compared to non-fluorotic males and females.

- Mean urinary fluoride levels are found to be higher in fluorotic males and females compared to non-fluorotic males and females.

- Mean FE_Ca, Ca/Cr, FE_P, and U.Hyp/Cr are found to be lower in males and females of non-fluorotic group compared to both fluorotic groups. Mean TRP, TmP/GFR, and CrCl are found to be lower in males and females of fluorotic group II compared to fluorotic group I and non-fluorotic group.

- The males and females of fluorotic group II showed significantly elevated parathyroid hormone levels compared to males and females of fluorotic group I and non-fluorotics.

- Correlation between fluoride intake and serum 25(OH)D is found to be positive and significant (P<0.01) at 1 per cent level. Correlation between fluoride intake and serum parathormone is found to be positive and not significant.

- The 25(OH)D levels in males of fluorotic group I, fluorotic group II and non-fluorotic groups, under the three categories of vitamin D deficiency,
insufficiency and normal vitamin D groups are not statistically significant. Similar results were found in our previous studies on rural males (Harinarayan et al., 2004; Chittari et al., 2007).

- No significant difference is found in 25(OH)D levels in females of fluorotic group I, fluorotic group II and non-fluorotic groups, under the categories of vitamin D insufficiency and normal vitamin D groups. In vitamin D deficiency group, the females of non-fluorotic group have significantly lower (P<0.005) 25(OH)D levels than the females of fluorotic group I and II.

- In both males and females of fluorotic and non-fluorotic groups, in all the groups categorized based on 25(OH)D levels, the PTH levels are inversely proportional to 25(OH)D levels.

Conclusions:

- High intake of fluoride along with low intakes of energy and nutrients are associated with the low-normal BMI in fluorotics.

- The degree of severity of fluorosis increased with age, which is an indicative of accumulation of fluoride in the body.

- The prevalence and degree of severity of fluorosis increased with increase in water fluoride levels as evidenced in fluorotic group II compared to fluorotic group I. Males showed higher prevalence of dental and skeletal fluorosis compared to females in both the fluorotic groups.

- In fluorotics, bone mineral markers i.e., serum calcium is significantly lower and serum alkaline phosphatase, tartrate resistant acid phosphatase are significantly higher than the non-fluorotics. An increase in bone turnover in fluorotic subjects evidenced by increased serum alkaline phosphatase and tartrate resistant acid phosphatase levels.
• Significant positive association is found between fluoride intake and urinary parameters such as $\text{F}_{\text{Ca}}$, $\text{Ca/Cr}$, $\text{FE}_{\text{Pi}}$, $\text{U.Hyp/Cr}$, TRP and $\text{TmP/GFR}$.

• Regarding hormonal status, though within the normal range, the males and females of fluorotic group II showed significantly elevated serum parathyroid hormone levels than the non-fluorotics. Correlation between fluoride intake and serum $25(\text{OH})\text{D}$ is found to be positive and significant ($P<0.01$) at 1 per cent level.

• In both males and females of fluorotic and non-fluorotic groups, in all the groups categorized based on $25(\text{OH})\text{D}$ levels, the PTH levels are inversely proportional to $25(\text{OH})\text{D}$ levels.

• To conclude, there is a high prevalence of vitamin D deficiency in South Indian population. In the present study area with water fluoride levels between 1 to 2 ppm and $>2$ ppm, there is no impact of water fluoride levels on $25(\text{OH})\text{D}$ levels.

From the predetermined conclusions it can be inferred that there is a need to surmount this problem following certain strategies:

❖ As a long-term measure, it is obligatory to establish RDA for calcium and vitamin C in different degrees of fluorosis as these nutrients have been shown to counteract fluoride affect and bring in beneficial results.

❖ Since malnutrition is generally observed to coexist with fluorosis, Nutritional education programmes need to be contemplated to educate people in the fluorotic areas regarding

• the adequate intakes of foods, energy and nutrients as per the recommendations of ICMR and also to overcome the chronic energy deficiency and low-normal nutritional status.

• the need to step up the intakes of milk and milk products, green leafy vegetables, citrus fruits and ragi in order to meet the heightened need for calcium and vitamin C in fluorosis.
the compulsive inclusion of tamarind pulp to the extent of 10 g and more per day in the diets of fluorotic population, in the form of chutneys, soups, rasam etc. as it entraps fluoride ion and makes it less absorbable.

The Government and non-government agencies can take up the supply of anti fluoride factors like the following through either PHCs or schools especially in rural areas affected with fluorosis.

- Nutrient mixtures with precise permutation of calcium, vitamin C and vitamin D
- Tamarind pulp pills or bar (with jeera + salt)
- Public water works department can set up defluoridation plant by using Nalgonda technique (using alum and lime) and involve the community participation in order to make people aware of the benefits of defluoridation of water and extend their sustained support to the plant. But because of certain limitations defluoridation may not be a practical solution for ever growing problem of fluorosis. Therefore, the possible alternative is to take up the afore mentioned nutrition education programme along with supplying the multi nutrient mixture and tamarind bar to the affected and vulnerable people.