A STUDY ON THE PREVALENCE OF DENTAL FLUOROSIS AND ASSOCIATED FACTORS IN AMBALAPUZHA TALUK IN ALAPPUZHA DISTRICT KERALA

DISSERTATION

P. GOPALAKRISHNAN

ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES
Sree Chitra Tirunal Institute for Medical Sciences and Technology
Thiruvananthapuram
Kerala- 695 011
1998

CERTIFICATE

This is to certify that the work has been carried out in this dissertation by Mr. P. Gopalakrishnan under my guidance in partial fulfillment of the regulation laid down by the Sree Chitra Thirunal Institute for Medical Sciences and Technology for the Master of Public Health degree examination.

Thiruvananthapuram,
20-6-1998.

Dr. R.S. Vasan, M.D.,D.M.,F.A.C.C.
Associate Professor,
Achutha Menon Centre for Health Science Studies.

ACKNOWLEDGMENT

I express my deep sense of gratitude and profound thanks to my teacher Dr. R.S. Vasan for his valuable guidance and constructive criticism in the successful completion of this study. His talented advice, liberal devotion of time in spite of his busy schedule have been a source of perpetual inspiration to me. With immense gratitude I sincerely thank my teacher Dr. P .S. Sharma for his esteemed guidance in statistical analysis in executing and completing this study. I sincerely thank Dr. K.R. Thankappan for his able guidance in completing this study. I express thanks to Miss. Laura Talasky from Arizona University for visiting the project area and helping me in the studies.

I recollect with gratitude the cooperation and helps extended by Mr.K.Gopalan, District Education Officer, Alappuzha, the Assistant Education Officers, Heads of schools, teachers and students in carrying out this study.

I sincerely thank Dr. K.S.Ravindran Nair, Lecturer in Oral and Maxillo-facial surgery, T.D. Medical college hospital Alappuzha for extending services in the assessment of dental fluorosis in school children in the study area.

Thiruvananthapuram,
25 June, 1998.

P. Gopalakrishnan

CONTENTS

ABSTRACT

BACKGROUND:- Although fluoride is an essential element for the` calcification of bones and teeth, excessive intake of the element leads to fluorosis The optimal dietary intake of fluoride in drinking water is approximately 1ppm (parts per million). Fluorosis is considered endemic in fifteen states in India. In Kerala, fluorosis is endemic in the districts of Alappuzha and Palakkad.

OBJECTIVES:- The objectives of the study were (1) To study the prevalence of Dental Fluorosis among children in the age group of 10-15 years in Ambalapuzha Taluk in Alappuzha District of Kerala and (2)To assess factors associated with the problem of Dental Fluorosis.

METHODS:- 1142 Children in the age group of 10-15 years (studying in 5th to 10th standards) were selected randomly for the study. A prestructured questionnaire was used to assess exposure to sources of fluoride. A dental specialist performed oral examination of all children and determined presence / absence of fluorosis and graded the degree of dental fluorosis using Dean's index. Water fluoride content in the study area was obtained from the water authority department, Alappuzha.

Bivariate association were examined using the Chi Square trend test. Multiple logistic regression was used to evaluate the association of select risk factors with presence of dental fluorosis.

RESULTS:-The overall prevalence of dental fluorosis in Ambalapuzha taluk is 35.64%. The prevalence is higher in urban area (55.28%) compared to that in rural area(16.84%), and in girls (39.21%) compared to boys (31.25%). Pipe water has a higher fluoride content both in urban and rural areas. The main factor associated with presence of dental fluorosis is the high fluoride content in drinking-water. A stepwise increase in prevalence of dental fluorosis was noted with a corresponding increase in water fluoride content in different Panchayaths ($p=0.00342$). There is also a significant positive association between the quantity of water consumed by children and the prevalence of dental fluorosis in different Panchayath areas.

No significant association was observed between brick-tea drinking habit, consumption of sea-fish, dry-fish ,use of tooth paste for dental cleaning and prevalence of dental fluorosis in our study sample.

CONCLUSION:- Dental fluorosis is a public health problem in Ambalapuzha taluk. Active steps have to be taken to defluoridate the water before distribution to reduce the morbidity associated with dental fluorosis in this area.

A STUDY ON THE PREVALENCE OF DENTAL FLUOROSIS AND ASSOCIATED FACTORS IN AMBALAPUZHA TALUK, ALAPPUZHA DISTRICT, KERALA.

I. INTRODUCTION

Fluoride is an element essential for human health. It plays a critical role in the calcification of bones and teeth. The main dietary source of fluoride is drinking water. When consumed in adequate amounts, fluoride prevents dental caries. The optimal dietary intake of fluoride in drinking water is approximately 1ppm (parts per million). Depending on the climatic conditions of different countries and the quantity of water consumed by the people, there is variation in the requirement of fluoride in drinking water. Since people in the tropics consume larger amounts of water compared to those in the temperate climates, the optimal concentration of fluoride in drinking-water may be lower in the tropics. In some of the western countries, where fluoride content of water is less, water fluoridation is undertaken to prevent dental caries among school children. In India, on the other hand, fluorosis (excess fluoride in tissues) is a serious public health problem. Fluorosis is a disease in which excessive dietary fluoride cause damage to teeth and bone.

II. REVIEW OF LITERATURE

1. Fluoride - a double edged sword

Fluoride is often called a double edged sword because deficiency of fluoride intake leads to dental caries while an excess consumption leads to dental fluorosis. This dose-response curve is represented in figure 1. The difference between the desirable dose (to prevent dental caries) and the toxic dose leading to fluorosis is narrow. Thus, the optimum fluoride content of drinking - water is that level which protects against dental caries but does not cause fluorosis.

2. Fluorosis as a public health problem

Fluorosis is a public health problem in several parts of the world. It affects young and old alike. The association between mottled appearance of teeth and residence in certain geographic areas was initially noted by McKay and Black (1916). Subsequently, Smith et al (1931) established the fact that the presence of excessive amount of fluoride in drinking - water is the primary cause in mottling of teeth. Drinking - water with a content of 0.5 to 0.75 ppm of fluoride caused no mottling of teeth while well- water with fluoride content of 1 to 7 ppm caused dental mottling (1). The individual suffering from fluorosis may present with:-

1.Dental fluorosis, or

2. skeletal fluorosis, or

3. Non skeletal manifestations, or

4. All or a combination of the above.

3. Fluorosis in India.

Fluorosis is considered endemic in fifteen states in India. The highest rates of endemicity are reported in Andhra Pradesh, Haryana, Karnataka, Punjab, Rajasthan, Tamil Nadu and Kerala. The first report in India was from Nellore district in Andhra Pradesh in 1937. The worst affected areas are Nalgonda and Prakasam districts of Andhra Pradesh. In Kerala, fluorosis is endemic in the districts of Alappuzha and Palakkad.

4.Dental fluorosis

In the case of dental fluorosis enamel loses its lustre and becomes rough resulting in a mottled appearance characterised by chalky white patches and bands of brown pigmentation. Small pits may also be present on the surface of the teeth. While all the teeth may be affected, mottling is usually best seen on the incisors of the upper jaw (2). Dental fluorosis develops only if infants and children

are exposed to high dietary intake of fluoride during the calcification of their teeth. (from birth to 14 years of age). Mothers living in fluorosis endemic areas have increased fluoride concentration in their breast milk (3).

5.Grading of fluorosis

Several indices have been used to describe the clinical appearance of dental fluorosis. The three principal indices in use today are: those developed by Dean [1934, 1942],Thylsirup and Fejerskov [1978], and Horowitz et al [1984]. A recent index developed by Pendrys [1990] is Fluorosis risk index [3]. A new index for measuring the prevalence of dental fluorosis, the Tooth Surface Index Fluorosis [TSIF], has also been used to assess the condition in the permanent teeth of children [6]. Dental mottling or discolouration due to fluoride toxicity can be classified as: grade 1- white opacities, faint yellow line; grade 2- changes of grade 1 + brown stain; grade 3- brown line, pitting and chipped off edges; and grade 4- brown black and fall of teeth [3].

Dental fluorosis is a reflection of fluoride exposure only during the time of enamel formation, limiting its use as a biomarker. In addition, the degree of fluorosis is dependent not only on the total fluoride dose but also on the timing and duration of fluoride exposure. At the level of an individual response to fluoride exposure, factors such as body weight, activity level, nutritional factors and the rate of skeletal growth are also important. These variables, along with an individual variability in response indicate that the enamel fluorosis cannot be used as a biological marker of the level of fluoride exposure of an individual(7).

6.Disease definition

The currently popular scoring systems used for diagnosis, use different measurement units, evaluate variable numbers of sites per person, and involve non-comparable groupings of clinical symptoms. The desirable factors to

be incorporated in to a scoring system include: the inclusion of a questionable category, the minimal level of fluoride involvement, and the number of affected sites within a subject required for case definition. Thus, a case definition of fluorosis for each scoring, although not mandatory would certainly be desirable so that dental epidemiologists and clinical investigators can interpret fluorosis scores relative to risk assessment [6].

7. Skeletal Fluorosis.

In older people fluorosis affects the bones, tendons and the ligaments. This presents as pain and stiffness of the back and joints, and limitation of neck movements. Radiological changes are quite characteristic; there is excess bone formation [exostosis] and calcification of tendons and ligaments. Skeletal fluorosis has been reported to be a public health problem of considerable magnitude in several districts of Andhra Pradesh, Haryana, Karnataka, Punjab, Rajasthan, Tamil Nadu and Kerala.

An increased incidence of spina bifida occulta [a congenital deformity of posterior wall of vertebrae of spine] in fluorosis- prone areas has also been noted. [7]

8.Nonskeletal manifestations

The other health problems due to fluorosis include gastrointestinal disorders, neurological manifestations, muscular manifestations, allergic manifestations and problems of urinary system.

Among the various manifestations mentioned above dental fluorosis can be detected and diagnosed easily without any expensive investigation and expertise. If dental fluorosis in the community is detected and corrected all the other problems related to fluorosis may be reduced.

9.Sources of excess fluoride consumption.

Drinking water is the main source of excess fluoride consumption. In most parts of India the fluoride content of drinking water is about 0.5ppm, but in fluorosis endemic areas it may be as high as 3 to 12ppm. In addition, fluoride may be consumed from other sources. Tea leaves contain 75 to 100ppm of fluoride. A cup of tea supplies approximately 0.1mg of fluoride [8].Vegetables, meat, cereals and fruits contain between 0.2 and 1.5ppm of fluoride. Sea fish contains large amount of fluoride [5 to 10ppm][9].The other sources of excess fluoride consumption are tooth paste and drugs containing fluoride and inhalation of air contaminated with fluoride in industrial environments. In India, a rich source of fluoride is brick tea (Chinese tea)[9]. However, the Indian style of preparation of tea with milk (which contains calcium) reduces the harmful effects of fluoride.

Through all sources the daily intake of fluoride should not exceed 3mg. For an adult individual the lethal dose of fluoride is 2.5gm [9]. Soft water contains no fluoride, while hard water may contain as much as 10ppm of fluoride.

In order to identify risk factors associated with human exposure to fluoride in San Luis Potosi [SLP] Mexico, a biochemical and epidemiological study was carried out in 1992. Results from the analysis of fluoride sources showed that 61 per cent of tap water samples had fluoride levels above the optimal level of 0.7 to 1.2ppm. Furthermore, the levels were higher after boiling [10].

The prevalence of dental fluorosis is increasing in communities with or without fluoride supplementation of drinking water. A study conducted in Chile tried to understand the relationship between prevalence and severity of fluorosis with socio-economic level of families and the fluoride content of drinking water. The global prevalence of fluorosis in that study was 32 per cent,

being 61.4 per cent in the city areas with highest drinking water fluoride concentration and 20 per cent in the city areas without fluoride in drinking water. The prevalence of fluorosis was higher in children belonging to a high socio-economic status [11].

In another study conducted in a Mexican community at 2066 meter above sea level, it was found that the water fluoride concentration was 2.8ppm. Among the school children aged 10 to 12 years, 57 per cent had moderate fluorosis and 19 per cent had severe fluorosis. The high prevalence and severity of fluorosis in the population examined, emphasised the need to study the factors determining dental fluorosis [12].

Brick tea-drinking fluorosis is a problem specific to areas where there is tea consumption. Investigations conducted in Sichuan province of China in Tibetans showed that a long history of brick tea-drinking habit lead to dental and skeletal fluorosis [13].

The prevalence of dental fluorosis among students in four selected schools in Sri Lanka was investigated by dental examination. In the endemic zone the prevalence of dental fluorosis ranged from 51 to 78 per cent while in the non-endemic area prevalence was 5.4 per cent. Water sample analysis showed that water from tube wells in those areas have a higher concentration of fluoride than those from shallow wells (15).

Between 1977- '85 the fluoride content of drinking water and the incidence of endemic fluorosis were assessed and correlated in 16 large farms, villages and towns in the Ethiopian Rift Valley. The fluoride level of drinking water collected from wells there ranged from 1.2 ppm to 36 ppm, (with a mean of 10 ppm). Dental fluorosis was observed in more than 80 per cent of sampled children residing in the Rift Valley since birth, with maximum prevalence in the age group of 10 to 14 years. Thirty two per cent of the children showed severe dental

mottling. Males were affected more than the females in that study (16).

10. Epidemiological studies conducted in India.

Several studies have evaluated the prevalence of fluorosis in India. The results of two studies are presented in Table 1.

Table 1: Epidemiological studies conducted in India.

Sl. No.	Author &Year	State or Place	No.Surveyed	Water fluoride ppm.	Preva. of Dental fluorosis	Preva. of skeletal fluorosis
1.	S.L. Choubisa (1997, Ref.(19)	Rajasthan	978 children 1305 Adults	0.1 to 5.5	31.9 % 33.4 %	10.2 %
2.	B.L. Thamboli (1977, Ref.(20)	Rajasthan	357 Individuals	13.9 to 14.3	83.5%	26.9%

A study conducted in school going children in Rajura taluk of Chandrapur district in Maharashtra showed that the people in that area appear at risk for fluorosis. The water fluoride level of 20ppm from the village of Dhoptala is the highest reported fluoride concentration in drinking water sources in Maharashtra [14].

A study conducted in Delhi reveals the prevalence of skeletal and non-skeletal manifestations of fluorosis in 36 patients investigated at the All India Institute of Medical sciences. In the study area covering 1485 sq. km with a population of 9 million , people consumed water naturally contaminated with fluoride up to 32.46 ppm.(17)

According to a study conducted in various places in India, a statistically significant increase in the prevalence of dental fluorosis was found: (a) with higher levels of fluoride in drinking water,(b) with rise in age, peak being found at 15 to 19 years of age group, and (c) amongst the bonafide residents of the area.

A significant positive correlation was found between fluoride in drinking water and community fluorosis index (18).

III.OBJECTIVES OF THE STUDY

The objectives of the present study are:

(1) To study the prevalence of Dental Fluorosis among children in the age group of 10-15 years in Ambalapuzha Taluk in Alappuzha District of Kerala

(2) To assess potential risk factors associated with the problem of Dental Fluorosis.

IV.METHODOLOGY

A. Sampling Frame

School children in the age group of 10-15 in Ambalapuzha taluk of Alappuzha district constituted the sampling frame. Children in this age group were selected because dental fluorosis develops in the vulnerable population during the period of calcification of teeth from infancy to fourteen years of age. Ambalapuzha taluk is a coastal belt in Kerala. The study area includes 3 Panchayaths (Purakkad, Ambalapuzha and Punnapra) and the Alappuzha Municipal areas. In two schools located in the northern part of Ambalapuzha taluk certain students come from neighbouring Panchayaths. Thus, 81 students in the sample selected are from Aryad, Mannanchery and Mararikkulam. The majority of the people in the study area belong to low socio- economic class and the principal occupations are fishing works, coir works and agriculture. Students in the age group of 10 -17 years studying in 5th to 10th standard were examined on the basis of the sample selected. Though the study was aimed to be conducted among school children in the age group of 10-15, 36 children in the age of 16 years and 7 children in the age of 17 were also included as they were enrolled in the classes examined.

B. Sampling method.

The list of schools having standards 5th to 10th in the Ambalappuzha taluk area was prepared by contacting the District Education Officer, Alappuzha and the Assistant Education officers in Ambalapuzha and in Alappuzha. The total divisions in the above schools were serially numbered for each school and the cumulative total was obtained. Thirty out of 738 divisions were selected using random number tables expecting to get more than 1000 children on the basis of the average strength in a class. All the students in these divisions were screened and surveyed to cover the sample size selected. Thirteen schools were selected: 2 higher secondary schools, 2 Government high schools, 7 'aided' high schools and 2 'aided' upper primary schools.

The information regarding fluoride content of water in the study area has been obtained from the water authority department, Alappuzha.

C. Sample size

With 5 per cent Alpha error and an assumed prevalence rate of 40 per cent with an acceptable error of ± 3 per cent in the estimate, the sample size needed to be at least 1024. Accounting for a 10 per cent non-response rate, the sample size required was estimated as 1127. In the present study the sample size was 1142.

D. Data Collection.

1 (a) The aim of the study was explained to the Heads of schools and Assistant Education Officers in the meeting conducted by the District Education Officer, Alappuzha.

1 (b) The District Education Officer was consulted to request the co-operation of the Heads of upper primary and high schools in Ambalappuzha taluk for the study. Dates were fixed in consultation with the school authorities. Education sessions on oral hygiene and dental fluorosis were conducted in many of the school

assemblies and, in some cases, in the concerned classes to motivate the students and staff.

1(c) The printed questionnaires were supplied to the students in the selected divisions in the presence of the teacher in the class. Each question was read out loudly and explained to the students. The students were requested to write their answers in the space provided for the purpose. This work of answering the questionnaires was done one or two days prior to the dental examination.

2.A dental expert and a public health personnel (author) were the investigators.

3.The data were collected and recorded based on the prestructured questionnaire (Appendix 1). The questionnaire sought information on the socioeconomic status, occupation and level of education of the parents. The questionnaire also obtained information on the source of drinking-water, amount of water consumed, brick-tea consumption, sea-fish intake and the use of fluoride-containing toothpastes by the students.

The oral examination of each student was carried out by a dental specialist in the common hall of the school or in the concerned classroom with the subject seated in an ordinary chair and under bright day light. The dental specialist used a sterile mirror and a dental probe to facilitate the oral examination. The presence and severity of fluorosis was recorded, along with any other dental conditions observed.

E.1.Grading of Dental Fluorosis:-

Dean's index was used to determine the grade of dental fluorosis, thus:

Normal - No white discolouration to the teeth

Grade I - *Questionable fluorosis:-* occasional white flecking over the tooth surface mainly on the incisor tips and cusp tips.

Grade II - *Mild fluorosis:* - White opaque areas involving less than 25% of the tooth surface

Grade III - *Moderate fluorosis:* - White opaque areas involving more than 25% and less than 50% of the tooth surface

Grade IV -*Severe fluorosis:* - White opaque areas involving more than 50% of the tooth surface

E.2. Intraobserver Variability in Assessment of dental fluorosis

A subsample of students was evaluated by the dental specialist on a second occasion, approximately one month after the initial examination. The prevalence and the degree of dental fluorosis was evaluated by the specialist blinded to the result of the initial examination. The agreement between the two sets of readings obtained on two different occasions was used as a measure of intraobserver variability.

F. Water fluoride content

There is public water supply system in the majority of the area, though some people use well water. The fluoride content of water sources was obtained from water authority department Alappuzha. This department conducts routine water analysis by taking water samples from different places in the Municipal and Panchayath areas.

V. ANALYSIS

(a) The prevalence of dental fluorosis is estimated by taking all cases of dental fluorosis as the numerator and total the child population evaluated in the age group of 10 - 17years as the denominator.

(b) The association of Dental fluorosis with select individual risk factors was studied using Chi-square test.

(c) Multivariable analysis:- Besides examining bivariate associations, we performed multivariable analysis to evaluate the independent association of select risk factors with prevalence of dental fluorosis. Multivariable logistic regression

with stepwise forward selection was used. The dependent event was dichotomous (presence or absence of dental fluorosis). The predictor variables were age(continuous variable), sex (male=1, female=2), water fluoride content (<1ppm=1, ≥1ppm=2), quantity of water consumed (2-3 glasses=1; 4-6 glasses=2; 7 and more glasses=3), consumption of brick-tea(yes=1,no=2),consumption of sea fish (yes=1,no=2) and use of tooth paste(yes=1,no=2). A p value <0.01 was used for entry of the variables in the multivariable models. Odds Ratios (and their 95%C.I.) for the association of the predictor variables with the dependent variable were computed.

(d) A p value less than 0.05 was taken as indicating statistical significance

VI. RESULTS

1.Study sample characteristics

The study population includes 1142 students (630 females and 512 males) in the age group of 10- 17 years. The mean age of the population was 13.45 years.

2.Water fluoride content.

The fluoride content of water in the Rural water supply system (pipe water) in the Panchayath area is as shown below.

Name of System	*No. of tube well*	*Fluoride content(ppm)*
1. RWSS Aryad north (Komalapuram)	1	1.4
2. RWSS Ambalapuzha	1	1.1
3. RWSS Karumady	1	O.7
4. RWSS Purakkad	3	0.7
5.RWSS Vandanam	1	1.0
6. RWSS Punnapra	3	1.2
7. RWSS Mannanchery	1	0.7
	Average	0.971 ppm

The fluoride content of Urban water supply system in Alappuzha Municipal area is tabulated below.

Name of W.S.S.	No. of tube wells	Fluoride content
1. Alissery	2	0.4
2. Vazhichery	1	0.6
3. Convent square area	1	0.5
4.Chudukade	1	-
5. Pazhavangady	1	2.1
6. Chadanakkavu	2	1.2
7. Vadikad. (Thathampally north)	1	2.1
8. Chathanad	2	1.2
9. Kommady	1	2.1
	Average	1.275 ppm

Water fluoride content of Well water.in rural areas.

Well water is used by about 20 per cent of population in the study area. The Wells are constructed by individual houses and are having a depth of 20- 30 ft. in Alappuzha. According to the result of water analysis the average fluoride content of well-water in Panchayaths are as follows:

1. Purakkad	0.669 ppm
2. Ambalapuzha	0.75 ppm
3. Aryad	0.623 ppm
4. Punnapra	0.45 ppm
Overall average	0.623 ppm

Water fluoride content of well water in urban areas

Sl No.	Ward No. and place	Water fluoride level
1.	I.Thumpoly	0.9
2.	II.Kommady	1.2
3.	III.Poonthoppu	0.6
4.	IV.Ashramam	0.1
5.	V.Kottankulangara	0.6
6.	VI.Avalookkunnu	1.7
7.	VII.Thathampally	0.3

8.	VIII.Nehrutrophy	0.3
9.	IX.Thirumala	1.8
10.	X.Zilla court	1.7
11.	XI.Thondankulangara	0.3
12.	XII.Arattuvazhy	1.3
13.	XIII.Kanjiramchira	0.5
14.	XIV.Cherthala Canal	0.7
15.	XV.Power House	0.3
16.	XVI.Sanathanam	0.6
17.	XVII.Mullakkal	2.2
18.	XVIII.Vazhichery	0.4
19.	XIX.Seaview	0.4
20.	XX.Civil Station	0.1
21.	XXI.Beach	1.4
22.	XXII.Zacharia Bazar	1.2
23.	XXIII.Lajanath	1.3
24.	XXIV.Alissery	1.1
25.	XXV.Vellakkinar	1.1
26.	XXVI.Municipal Office	1.1
27.	XXVII.Thiruvampady	-
28.	XXVIII.Palace	0.1
29.	XXIX.Pallathuruthy	1.3
30.	XXX.Chungam	2.2
31.	XXXI.Pazhaveedu	0.1
32.	XXXII.Kalarcod	-
33.	XXXIII.Iravukad	1.3
34.	XXXIV.Vattayal	2.8
35.	XXXV.Kuthirappanthy	1.3
36.	XXXVI.Vadakkal	0.4

The average fluoride content of well-water in the municipal area is 0.932 ppm.

The prevalence of dental fluorosis in our study sample is displayed in table II below.

Table II - Prevalence of dental fluorosis in Ambalappuzha taluk.

Area	No of children	PREVALENCE OF FLUOROSIS					All grade
		Normal	Gr:I	Gr:II	Gr:III	Gr:IV	
Municipality	560	251 (44.82%)	100 (17.89%)	91 (16.28%)	61 (10.91%)	57 (10.20%)	55.28 %
Panchayath	582	484 (83.16%)	51 (8.76%)	27 (4.64%)	10 (1.72%)	10 (1.72%)	16.84 %

p= .0001

The overall prevalence of dental fluorosis in school children in Ambalapuzha taluk is 35.64 per cent. The prevalence of dental fluorosis is higher in urban areas (55.28 per cent) compared to that in rural areas (16.84 per cent) p=0.0001. Among the children having dental fluorosis, the severity is also more in the urban areas.

Table III displays the prevalence of dental fluorosis by age.

Table III - Age distribution and dental fluorosis

Age	Total children surveyed	PREVALENCE OF FLUOROSIS					All grade
		Normal	Grade I	Grade II	GradeIII	GradeIV	
10-11	86	48 (55.81%)	18 (20.93%)	9 (10.46%)	4 (4.65%)	7 (8.14%)	44.19%
12-13	488	295 (60.45%)	77 (15.78%)	46 (9.43%)	30 (6.15%)	40 (8.20%)	39.55%
14-15	525	363 (69.14%)	54 (10.28%)	56 (10.66%)	34 (6.48%)	18 (3.43%)	30.86%
16-17	43	29 (67.44%)	2 (4.65%)	7 (16.28%)	3 (6.98%)	2 (4.65%)	32.56%

p= .00973

There is a significant variation in the prevalence of dental fluorosis in different age groups with a higher prevalence in the younger children.. The prevalence of dental fluorosis ranged from 30.86 to 44.19 per cent, with lowest prevalence in the age group of 14 -15 years and the highest prevalence in the age group of 10 -11 years.

Table IV presents the variation in the prevalence of dental fluorosis according to the gender of the students examined.

Table IV - Gender and prevalence of dental fluorosis

Gender	Total children surveyed	PREVALENCE OF FLUOROSIS					All grade
		Normal	Grade I	Grade II	GradeIII	GradeIV	
Male	512	352 (68.75%)	62 (12.10%)	48 (9.38%)	22 (4.30%)	28 (5.47%)	31.25%
Female	630	383 (60.79%)	89 (14.13%)	70 (11.11%)	49 (7.78%)	39 (6.19%)	39.21%

p= .00524

It is evident from the table that dental fluorosis in Ambalapuzha taluk is more prevalent among girls (39.21per cent) than that among boys (31.25 per cent).

Table V relates the prevalence of dental fluorosis to the water fluoride content in different Panchayath areas in our study sample.

Table V - Prevalence of Fluorosis and water fluoride content

Name of Panchayath	Total children	PREVALENCE OF DENTAL FLUOROSIS						Water fluoride content ppm
		Normal	Grade I	Grade II	GradeIII	GradeIV	All grades	
Mararikulam & Mannanchery	38	37 (93.37%)	NIL	1 (2.63%)	NIL	NIL	2.63%	0.7
Purakkad	93	78 (83.87%)	9 (9.68%)	2 (2.15%)	2 (4.65%)	2 (8.14%)	16.13%	0.7
Ambalapuzha	162	141 (60.45%)	9 (15.78%)	8 (9.43%)	3 (6.15%)	1 (8.20%)	12.96%	1.1
Punnapra	231	184 (69.14%)	28 (10.28%)	9 (10.66%)	3 (6.48%)	7 (3.43%)	20.35%	1.2
Aryad	58	44 (67.44%)	5 (4.65%)	7 (16.28%)	2 (6.98%)	NIL	24.14%	1.4

A stepwise increase in prevalence of dental fluorosis was noted with a corresponding increase in water fluoride content in different Panchayaths (p=0.00342, Chi-square trend test).

Table VI shows the prevalence of dental fluorosis according to the sources of water consumed by the subjects

Table VI - Source of drinking water and prevalence of fluorosis

Source of drinking water	Total children surveyed	PREVALENCE OF FLUOROSIS					All grades
		Normal	Grade I	Grade II	GradeIII	GradeIV	
Pipe	806	445 (55.21%)	130 (16.13%)	105 (13.03%)	65 (8.06%)	61 (7.57%)	44.79%
Well	213	186 (87.32%)	14 (6.57%)	8 (3.75%)	4 (1.88%)	1 (0.47%)	12.68%
Tube well	101	90 (89.11%)	3 (2.97%)	4 (3.96%)	2 (1.98%)	2 (1.98%)	11%
Pipe and well	22	14 (63.64%)	4 (18.18%)	1 (4.55%)	-	3 (13.64%)	36.36%

p= .0001

The prevalence of dental fluorosis is high among children who consumed pipe water (44.79 per cent). Among children who used water from both pipe and wells, the prevalence of dental fluorosis was 36.36 per cent. Among children who used water from wells and tube wells, the prevalence of dental fluorosis was 12.68 and 11 per cent, respectively.

Table VII relates dental fluorosis prevalence to the source of drinking-water in the urban area.

Table VII. Fluorosis prevalence in the urban area according to sources of drinking water.

Sources of drinking-water	Total children surveyed	LEVEL OF DENTAL FLUOROSIS					
		Normal	Grade I	Grade II	GradeIII	GradeIV	All grades
Pipe water	506 (93.9)	216 (42.7%)	93 (18.4%)	84 (16.6%)	58 (11.5%)	55 (10.5%)	290 (57.31%)
Well water	33 (6.1)	23 (69.7%)	5 (15.2%)	3 (9.1%)	2 (6.1%)	-	10 (33.30%)

p=.02945

There is significant association between consumption of pipe-water and prevalence of dental fluorosis.

Table. VIII. shows prevalence of dental fluorosis and drinking-water source in rural area.

Table VIII. Fluorosis prevalence in the rural area according to source of drinking- water

Sources of drinking-water	Total children surveyed	PREVALENCE OF DENTAL FLUOROSIS					
		Normal	Grade I	Grade II	GradeIII	GradeIV	All grades
Pipe water	300 (62.5%)	229 (76.3%)	37 (12.3%)	21 (7%)	7 (2.3%)	6 (2%)	71 (23.66%)
Well water	180 (37.5%)	163 (90.6%)	9 (5.0%)	5 (2.8%)	2 (1.1)	1 (0.6%)	17 (9.44%)

p=.00410

There is a significant association between dental fluorosis and drinking-water source. The prevalence is more among children who drink pipe-water.

Table IX shows the prevalence of dental fluorosis and the quantity of water consumed by the children.

Table IX. - Fluorosis and quantity of water consumed

Quantity of water consumed per day	Total children surveyed	PREVALENCE OF FLUOROSIS					
		Normal	Grade I	Grade II	GradeIII	GradeIV	All grades
2-3 glasses	204	134 (65.69%)	29 (14.22%)	21 (10.29%)	8 (3.92%)	12 (5.88%)	34.31%
4-6 glasses	454	309 (68.06%)	53 (11.67%)	35 (7.71%)	31 (6.83%)	26 (5.73%)	31.93%
7 and >	484	292 (60.33%)	69 (14.26%)	62 (12.81%)	32 (6.61%)	29 (5.99%)	39.67%

p= .04297

There is a significant positive association between the prevalence of dental fluorosis and the quantity of water consumed. We also noted in our study sample that boys consumed more water than girls(p=<.oo1) Hence the quantity of water consumed does not explain the increased prevalence of dental fluorosis in girls noted earlier (p. 21: table IV).

Table. X .depicts the prevalence of dental fluorosis and the use of brick-tea by the students.

Table X.- Brick tea drinking and prevalence of fluorosis

Brick-tea drinking habit	Total children surveyed	PREVALENCE OF FLUOROSIS					All grades
		Normal	Grade I	Grade II	GradeIII	GradeIV	
Daily	550	344 (62.55%)	78 (14.18%)	60 (10.91%)	33 (6%)	35 (6.36%)	37.45%
Twice in a week	160	106 (66.25%)	17 (10.63%)	19 (11.87%)	7 (4.37%)	11 (6.88%)	33.75%
Once in a week	62	41 (66.13%)	8 (12.90%)	5 (8.06%)	5 (8.06%)	3 (4.84%)	33.87%
Occasional	136	85 (62.5%)	16 (11.76%)	15 (11.02%)	12 (8.82%)	11 (4.68%)	37.05%
NIL	234	158 (67.52%)	32 (13.67%)	19 (8.12%)	14 (5.97%)	10 (4.27%)	32.05%

p= 0.69943

There is no association seen between dental fluorosis and brick-tea drinking habit of students in the study area.

The relation of sea-fish consumption and dental fluorosis are presented in table XI.

Table XI. - Sea- fish consumption and prevalence of fluorosis

Sea fish consump-tion	Total children surveyed	PREVALENCE OF FLUOROSIS					A ll grades
		Normal	Grade I	Grade II	GradeIII	GradeIV	
Daily	626	388 (61.98%)	82 (13.10%)	66 (10.54%)	46 (7.35%)	44 (7.03%)	38.02%
Alternate days	190	124 (65.26%)	25 (13.16%)	19 (10%)	10 (5.26%)	12 (6.32%)	34.74%
Twice in a week	48	37 (77.08%)	3 (6.25%)	6 (12.50%)	2 (4.16%)	-	22.92%
Once in a week	26	18 (69.23%)	3 (11.54%)	4 (15.38%)	-	1 3.85	30.77%
Occasional	207	140 (67.63%)	27 (13.04%)	22 (10.63%)	10 (4.83%)	8 (3.86%)	32.37%
NIL	45	28 (62.22%)	11 (24.44%)	1 (2.22%)	3 (6.66%)	2 (4.44%)	37.77%

From the above table it is evident that there is no significant association between the consumption of sea fish and the prevalence of dental fluorosis (p = 0.27585).

Table XII. - Dry fish consumption and prevalence of fluorosis

Dry fish consumption	Total children surveyed	PREVALENCE OF DENTAL FLUOROSIS					
		Normal	Grade I	Grade II	GradeIII	GradeIV	All grades
Frequently	254	169 (66.54%)	31 (12.20%)	23 (9.06%)	16 (6.30%)	15 (5.90%)	33.46%
Once in a week	73	48 (65.75%)	8 (10.96%)	8 (10.96%)	7 (9.59%)	2 (2.74%)	34.25%
Occasional	580	354 (61.03%)	84 (14.48%)	65 (11.21%)	38 (6.55%)	39 (6.72%)	38.97%
NIL	235	164 (69.79%)	28 (11.91%)	23 (9.79%)	9 (3.83%)	11 (4.68%)	30.21%

p = 0.25588

Table XII indicates no association between the habit of consuming dry-fish and dental fluorosis.

Table XIII. Materials used for dental cleaning and Dental fluorosis

Material used for dental cleaning	Dental fluorosis present	Dental fluorosis absent	Total
Tooth paste & paste with other materials.	310 (37.17%)	524 (62.83%)	834
Materials other than tooth paste.	97 (31.80%)	208 (68.20%)	305

p = 0.109

Missing observations - 3

Tables XIII shows no association between dental fluorosis and the materials used for dental cleaning.

Table XIV. -Education of father and prevalence of fluorosis in children

Education of father	Total children surveyed	PREVALENCE OF DENTAL FLUOROSIS					
		Normal	Grade I	Grade II	GradeIII	GradeIV	All grades
Primary	313	207 (66.13%)	37 (11.82%)	36 (11.50%)	19 (6.07%)	14 (4.47%)	33.87%
Secondary	658	415 (63.07%)	85 (12.92%)	71 (10.79%)	43 (6.53%)	44 (6.69%)	36.93%
Graduates and above	165	111 (67.27%)	27 (16.36%)	10 (6.06%)	9 (5.45%)	8 (4.85%)	34.51%

p = 0.41245.

Table XIV shows the relation between educational status of father and the prevalence of dental fluorosis among children. From this, it is seen that education of father has no influence on the development of dental fluorosis among children.

Table XV. Occupation of father and prevalence of fluorosis in children

Occupation of father	Total children surveyed	PREVALENCE OF DENTAL FLUOROSIS					
		Normal	Grade I	Grade II	Grade III	Grade IV	All grades
Labourer	593	372 (62.73%)	79 (13.32%)	69 (11.64%)	36 (6.07%)	47 (7.92%)	38.95%
Non service sector	350	239 (68.29%)	40 (11.43%)	28 (8%)	25 (7.14%)	22 (6.29%)	32.86%
Service sector	192	124 (64.58%)	29 (15.10%)	21 (10.94%)	10 (5.21%)	8 (4.17%)	35.42%

p= 0.39235

Table XV shows no association between occupation of father and fluorosis prevalence among children.

Table XVI. Education of mother and prevalence of fluorosis

Education of Mother	Total children surveyed	PREVALENCE OF DENTAL FLUOROSIS					
		Normal	Grade I	Grade II	Grade III	Grade IV	All grades
Primary	350	226 (64.57%)	45 (12.86%)	39 (11.14%)	18 (5.14%)	22 (6.29%)	35.43%
Secondary	666	423 (63.51%)	88 (13.21%)	71 (10.66%)	41 (6.16%)	43 (6.46%)	36.49%
Graduate and above	122	85 (69.67%)	17 (13.93%)	7 (5.74%)	12 (9.84%)	1 (0.82%)	30.33%

Missing observations -4 p =0.41245

From tables XIV, XV and XIII it is seen that education and occupation of parents have no influence on the development of fluorosis in the study area.

Multivariable Analysis

Five hundred and eighty two children had complete information on fluoride content of water consumed and other predictor variables. These children were eligible for study in the multivariable logistic regression models. The results of multivariable analysis are presented in table XVIII.

Table XVIII. Multivariable logistic regression with stepwise forward selection

Variable in order of entry	Regression coeff. β	Odds Ratio	p value
Water fluoride content	.615	1.85	.007
Constant	−1.9343	-	-

Variables considered not in the final model = age, sex, quantity of water consumed, brick-tea consumption, fish consumption, use of tooth paste.

Table XVIII displays that the fluoride content of drinking-water was the principal determinant of dental fluorosis. A water fluoride content ≥ 1ppm was associated with a 1.85 fold elevated risk of prevalence of dental fluorosis compared to the referent group with a water fluoride content <1ppm. Once water fluoride content entered the multivariable model, none of the remaining predictor variables were significantly associated with dental fluorosis.

VII. Intraobserver variability

Intraobserver Variability in general:- Standard IX D of St. Joseph's High school Alappuzha showed highest prevalence of fluorosis among all the classes examined. This class was selected for measuring intraobserver variability. The students in this class were examined for fluorosis on two different days. The variability found was as shown below.

16 .1 . 1998			20 .2 . 1998
Severe with pitting	1	Severe with pitting	1
Severe	3	Severe	4
Moderate	10	Moderate	6
Mild	12	Mild	12
Questionable	6	Questionable	11
Normal	19	Normal	13
Absent	2	Absent	6
Total	53	Total	53

Table XIX. Observation of fluorosis among children on two different days of examination.

Dental fluorosis	Present on day II	Absent on day II	Total
Present on day I	**31**	**0**	**31**
Absent on day I	**2**	**13**	**15**
Total	**33**	**13**	**46**

Table XIX shows the presence and absence of dental flourishes on first and second day of examination. The percentage of agreement is as follows.

44/ 46 x 100= 95.65%

Table XX. Intraobserver variability according to grade of fluorosis.

	Examination 2					
Examin. 1	Normal	GradeI	GradeII	GradeIII	GradeIV	Row total
Normal	**13** (28.3%)	**2** (4.3%)				**15** (32.6%0
GradeI		**4** (8.7%)	**2** (4.3%)			**6** (13.0%0
GradeII		**4** (8.7%)	**4** (8.7%)	**2** (4.3%)	**1** (2.2%)	**11** (23.9%)
GradeIII		**1** (2.2%)	**5** (10.9%)	**4** (8.7%)		**10** (21.7%)
GradeIV					**4** (8.7%)	**4** (8.7%)
Column total	**13** (28.3%)	**11** (23.9%)	**11** (23.9%)	**6** (13.0%)	**5** (10.9%)	**46** (100%)

The result of examinations when represented in table shows the following observations

Number of children in normal category on both days - 13

Number of children in grade I flourishes on both days - 4

Number of children in grade II flourishes on both days - 4

Number of children in grade III flourishes on both days - 4

Number of children in grade IV flourishes on both days - 4

29

Two children were absent on the first day and six children were absent on the second day of survey. These eight children are excluded for calculating intraobserver variability, and thus 46 children constitute the denominator.

(29/ 46)100 = 63.04%

VIII. DISCUSSION

1.Prevalence of Dental Fluorosis

The overall prevalence of dental fluorosis was 35.64 per cent in our study area. On the basis of this study it is seen that dental fluorosis is a major public health problem in Ambalapuzha taluk.

2. Rural vs. Urban differences

The prevalence of dental fluorosis is high in urban areas (55.3 %) compared to the in rural areas (6.8%) in the present investigation. The severity of dental fluorosis is also more in the urban areas. For example, while there is a prevalence of 1.72 % of grade III and grade IV fluorosis in the rural areas, the prevalence of grade III and grade IV fluorosis is 10.91 % and 10.20 % in the urban

areas (Table II). Even in the Panchayath area the prevalence of dental fluorosis and the water fluoride content is more in those Panchayaths which are nearer to Alappuzha municipal area. Thus, Purakkad (the southern most panchayath in Ambalappuzha taluk) and Mararikkulam and Mannanchery (the northern most area away from Alappuzha municipality) have a lower water fluoride content and a lower prevalence of dental fluorosis compared to Ambalappuzha, Punnapra and Aryad Panchayaths, which are nearer to the Alappuzha municipality (Table V). These Panchayaths have an independent water supply system. So apart from proximity to municipal areas, the high water fluoride content in Ambalappuzha, Punnapra and Aryad Panchayaths may be due to the geographical location of these Panchayaths. In both the studies conducted by S.L. Choubia and B.L. Thomboly et al (Ref.19&20), no urban-rural difference in the prevalence of dental fluorosis was reported.

3.Gender-related differences

In the present study the prevalence of dental fluorosis is higher among female children (39.21%) than that among males (31.25 %)(Table IV).This difference is statistically significant. Prior literature suggests that the prevalence of dental fluorosis is slightly more (87.56%) in males compared to females (78.66%). The increased prevalence of dental fluorosis among girls in our study is intriguing especially because girls consumed less water than boys in our study sample. The reason for a higher prevalence of fluorosis among females in our study area is unclear and merits further investigation.

4. Age-related differences

The prevalence of dental fluorosis is more in the younger age groups in the present study. Thus, it can be seen that students in the age group of 10-11 years and 12-13 years have higher prevalence of dental fluorosis (44.19 % and 39.55 %, respectively) compared to the age group of 14-15 years and 16-17 years (30.86 % and 32.56 %, respectively). One possible explanation for this intriguing observation is that the increase in intake of dietary fluoride may be a recent phenomenon (within approximately 13 years) in Ambalappuzha taluk. This hypothesis can be verified by observing the water fluoride content in the study area for the last about 25 years. Unfortunately, the results of water analysis for fluoride content are not available for the time period prior to 1994 with the authorities to substantiate or refute this hypothesis.

This trend of a higher prevalence of fluorosis in younger age groups can

further be examined by studying the prevalence of dental fluorosis in younger children in the study area. A study of the prevalence of skeletal fluorosis and nonskeletal manifestations in the area in older people(with the cooperation of orthopedics experts and gastroenterologists) may also shed further light on this observation.

5.Water fluoride content, source of drinking-water and prevalence of Dental Fluorosis

There is a significant correlation between water fluoride content and prevalence of dental fluorosis in our study sample. This was noted in both bivariate associations presented and in the multivariable analysis. A stepwise increase in prevalence of dental fluorosis was noted with a corresponding increase in water fluoride content in different Panchayaths. Prevalence of dental fluorosis is high among children who used pipe water for drinking purpose. The reason for this may be that the high fluoride content of pipe-water compared to that of other water sources. In both the urban and the rural areas, pipe-water contains more fluoride. In Alappuzha, ground-water pumped from deep wells are the source of water supply through pipes in both the urban and the rural areas. This may be the reason for a higher fluoride content in the water supply system in this area.

6. Other Risk factors and Dental Fluorosis

Socio-economic status of the parents had no influence on the prevalence of dental fluorosis in children in our study area. This is contrary to a prior report that described a higher prevalence of fluorosis in children belonging to high socio-economic status. Furthermore, brick-tea drinking and sea-fish consumption and dry-fish consumption have been reported to enhance the development of dental fluorosis (Ref.10,11& 13). But in the present study brick-tea drinking, sea-fish and dry-fish consumption were not associated with prevalence of dental fluorosis. It is seen that the use of tooth paste was also not associated with dental fluorosis in our study.

Multivariable Analysis

Our multivariable logistic regression analysis demonstrated that water fluoride content was the principal determinant of dental fluorosis in the subsample eligible for such analysis. The inverse relation with age seen in bivariate analysis were not observed in the multivariable models.

IX. PLANNING AND POLICY IMPLICATIONS

As high fluoride content in drinking-water is the main reason for Dental fluorosis in Ambalapuzha taluk, measures have to be taken to distribute water after defluoridation of the water supply system. It requires the synergistic action of health planners, health administrators, engineers and the water supply authorities.

X. LIMITATIONS OF THIS STUDY

1. Study design:- This is a cross sectional study. The major risk factor in the development of dental fluorosis is drinking water. Fluorosis develops in the individual during the time of calcification of teeth, which takes place even from the early stage of infancy . The fluorosis content of water which was consumed during that period is of critical importance, but cannot be measured now. It is presumed in this study that the fluorosis content of water in each area has not changed over the last 15 years.

2. Methods:- School children were selected for the present study for determining the dental fluorosis level in the community. This has been done because most of the children will be in schools during working hours in day time and will be available for investigation. It is likely that school dropouts in the study area are excluded from our sample. This is not a major limitation because it is estimated that school dropouts are very few in Kerala state.

XI.CONCLUSION

Our study suggests that dental fluorosis is a major public health problem among school children in Ambalapuzha taluk. Dental fluorosis was more prevalent in the urban areas and was associated with consumption of pipe-water(as oppose to well-water) and an increase in the fluoride content of drinking-water. Our study emphasises the urgent need to institute defluoridation of drinking-water in Ambalapuzha taluk in order to lower the burden of dental fluorosis in this community.

REFERENCES

1. **Kurth H. Thoma., Hendry M. Goldman**. Oral Pathology 5th Edition (1960) p.103

2. **Teotia S.P.S., Teotia. M.,** Endemic fluorosis in India. A challenging national health problem. Journal of Associations of physicians in India. 1984 April; 32(4) p347-52.

3. **Rozier R.G.,** Epidemiological indices for measuring the clinical manifestations of dental fluorosis: Overview and critique. Adv Dent. Res.1994 June; B(1):39-55.

4. **Horowitz H.S., Driscoll W.S.,Meyers R.J.,Heifetz S.B.,Kingman A.** A new method for assessing the prevalence of dental fluorosis -the surface index of fluorosis. Journal of American dental Association. 1984-July, 109 (1) 37-41.

5. **Den Beston P.K.** Dental Fluorosis : its use as a biomarker. Adv. Dent Res 1994 June :8(1) 150-60

6. **Kingman A.** Current techniques for measuring dental fluorosis; issues in data analysis Adv devt Res 1994 June: 8(1)56-65.

7. **Gupta S.K., Gupta R.C.,Seth A.K.,Chaturvedi C.S**. Increased incidence of spina bifida occulta in fluorosis prone areas. Acta paediatr, June 1995 Aug: 37(4): 503-6

8. **Maurice E. Shills, Vernon R. Young**. Modern Nutrition in Health and Disease. 1988 p. 1075-7

9. **M.N.Chatterjee, Rana Shinde.** Text Book of Medical Biochemistry 1993. p 819.

10. **Brimaldo.M.,Borja-Aburto V.H.,Ramirez.A.L.,Ponce.M., Rosas.M. Diaz-Barriga. F.,** Endemic fluorosis in San Luis Potosi, Mexico. Identification of risk factors associated with human exposure to fluoride. Environ Res Jan;68 (1) 25-30 1995.

11. **Mella.S., Molina X., Atalah.E.** Prevalence of endemic dental fluorosis and its relation with fluoride content of public drinking water.Rev. Med. Chil. 1994 Nov: 122(11): 1263-70

12. **Irigoyen .M.E., Molina. N.,Loengas.I**. Prevalence and severity of dental

fluorosis in Mexican community with above-optimal fluoride concentration in drinking water. Community Dent oral Epidemiology 1995 Aug: 23(4): 243-5.

13. **Cao.J.,Bai.X.,Zhao. Y.,Zhou.D.,Fang.S.,Jia.M,Wu.J.**
The relationship of Fluorosis and Brick tea drinking in Chinese Tibetans.
Environment health prospect 1996.Dec.104(12) 1340-3.

14. **Somvanshi.P.K.,Chanbey.B.S.,Phadake.R.V.,Sakharde.P.M.,**
Fluorosis in Maharashtra.
Journal of Association Physicians India 1990.March;38(3);217-9.

15. **Warnakulasuriya.K.A.,Balasuriya.S.,Perera.P.A.,**
Prevalence of dental fluorosis in four selected school from different areas in Sri Lanka.
Ceylon Medical journal 1990 Sep:35(3) 175-8.

16. **Haimanot.R.T.,Fekadu.A.,Bushra.B.**
Endemic fluorosis in the Ethiopian Rift Valley
Trop. Geogr. Med 1987 Jul;39(3):209-17.

17. **A.K. Susheela., Madhu Bhatnagar and Arbind Kumar**. Status of drinking-water in the mega city Delhi (1996) 22nd WEDC Conference, New Delhi.

18. **Chandra.S.,Sharma.R.,Thengoanker.V.P.,Chaturvedi.S.K**.
Determination of optimal fluoride concentration in drinking water in an area in India with dental fluorosis.
Community dental oral epidemiology 1980 April; 8(2):92-6.

19. **S.L. Choubisa.** Fluoride Distribution and Fluorosis in some villages in Banswara district of Rajasthan. INDIAN. J.ENVIRON HLTH. Vol.39, No.4,281-288(1997)

20. **B.L. Thamboli, G.M. Mathur, A.P. Mathur, S.K.Lalla and O.P. Goyal.**
Prevalence of fluorosis in Pratabpura and Surajpura villages, district Ajmer (Rajasthan)Indian J Ed Res 71, January 1980,pp 57-67.

APPENDIX

DENTAL FLUOROSIS - AN EPIDEMIOLOGICAL STUDY

QUESTIONNAIRE

Name of the School

1. Name of the student -

2. Age - 2 a. Sex- 3.Standard -

4.Whether resident of Alleppey from birth -

a. If not, period of stay outside Alleppey -

5.Residential Address (with ward & Panchayath / Municipality) -

6.Sourse of drinking water - Pipe / Well / Others (Specify)

7.Quantity of water the Child drink per day - 2-3 glasses / 4-6 / 7 or more

8.Brick tea drinking habit - Yes / No

a. If yes, specify - One glass per day / Two per week /once in week / Occasionally

9.Sea fish consumption - Yes / No

a. If yes, specify - Daily on availability / Alternate days / Twice in week /Once in week / Occasional

10.Dry fish consumption - Yes / No

a. If yes, specify - When raw fish is not available / Once in week / Occasional

11.Materials used to clean the tooth -Paste/ tooth powder/ Ayurvedic/ charred rice husk/ mango leaf/ others

11a. If tooth paste is used, the brand -Colgate/ Close up / Promise/ Binaca/ Cibaca/Pepsodent/ Babool/Others (specify)

12.Name of the parent -

13. Education of father -Primary/ Secondary/ Graduate/ Professional

14.Occupation of father - Labourer / Coir worker / Fisherman / Farmer/ Private employee / Govt.employee gazetted / Non- gazetted / Others (specify)

-

15.Education of mother -Primary / Secondary / Graduation / Professional

16. Occupation of mother -House wife/ Labourer/ Coir worker/ Private employee/ Govt.- Gazetted/ Non-gazetted

17.Dental Fluorosis -Yes/No

18. In case of fluorosis -GradeI/ GradeII/ GradeIII/ GradeIV

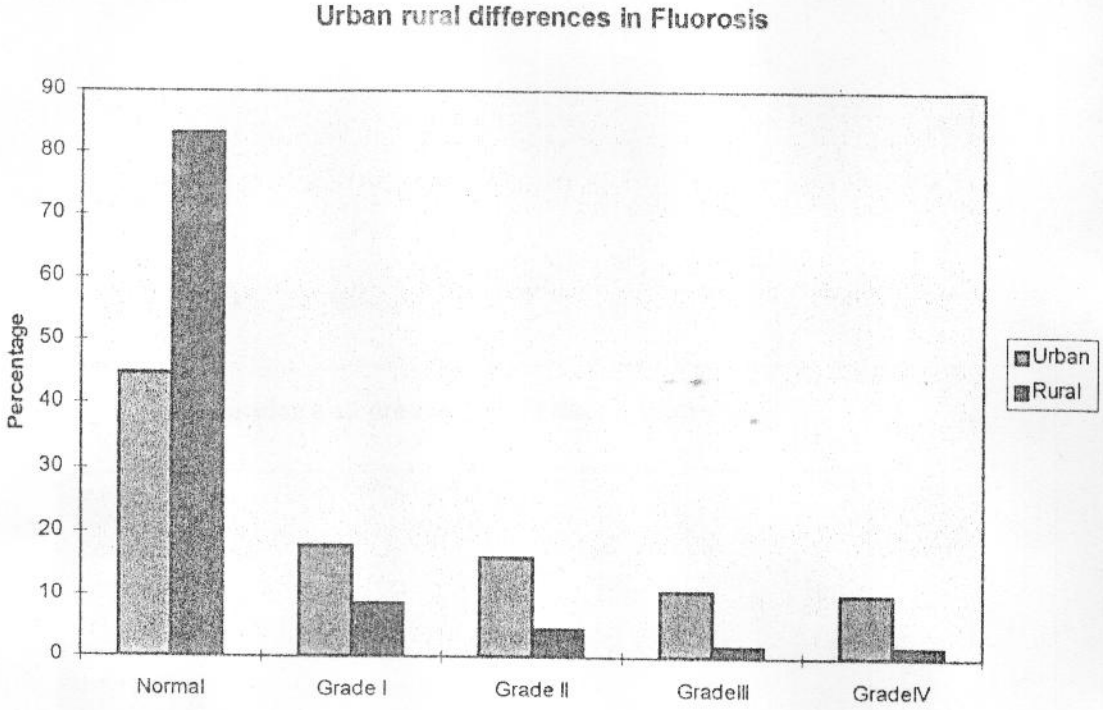
19. Any other dental disease -

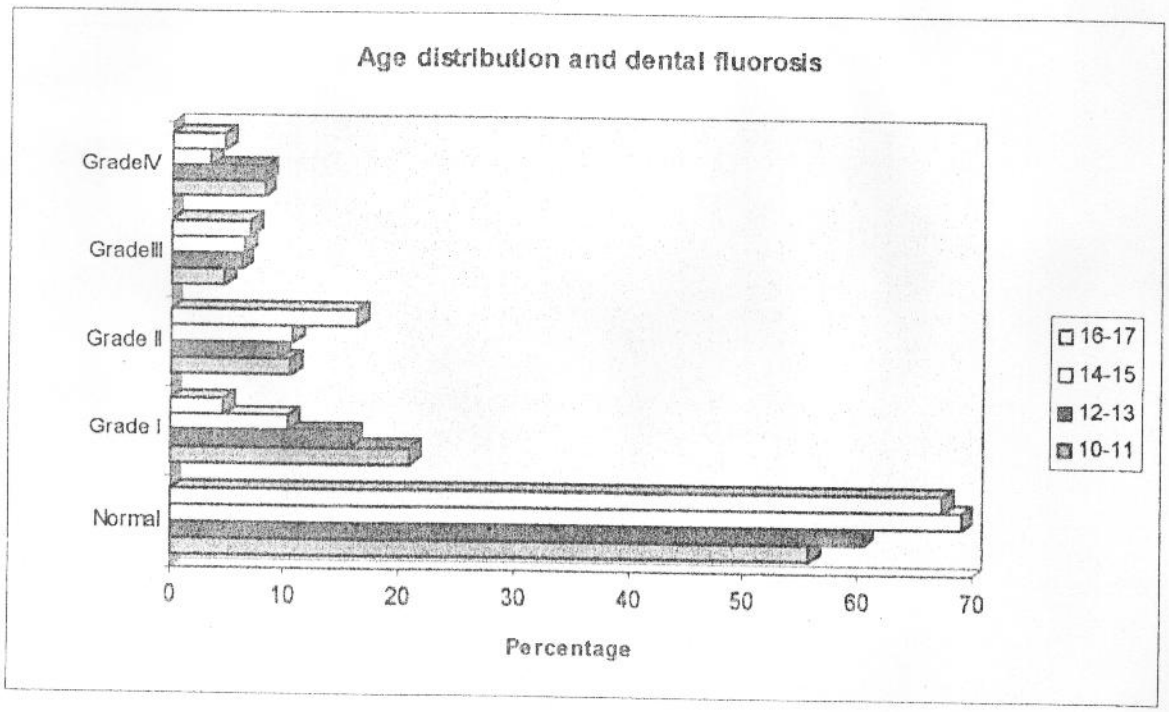
Place

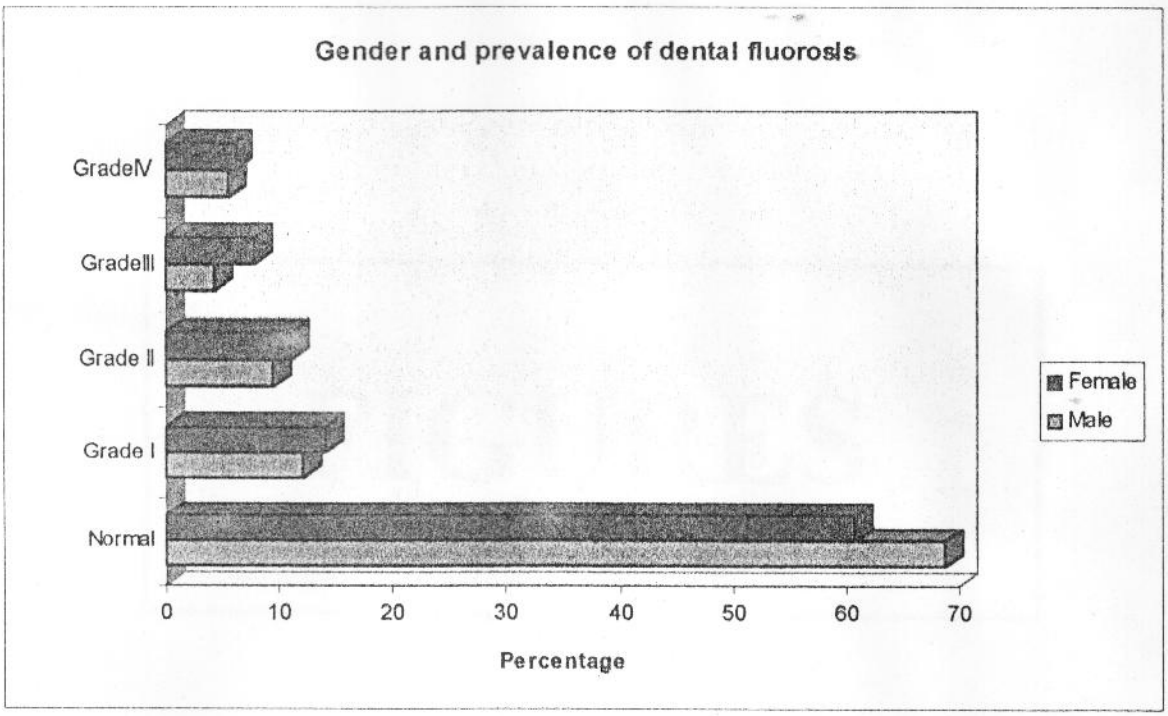
Date

Investigator

GRAPHS

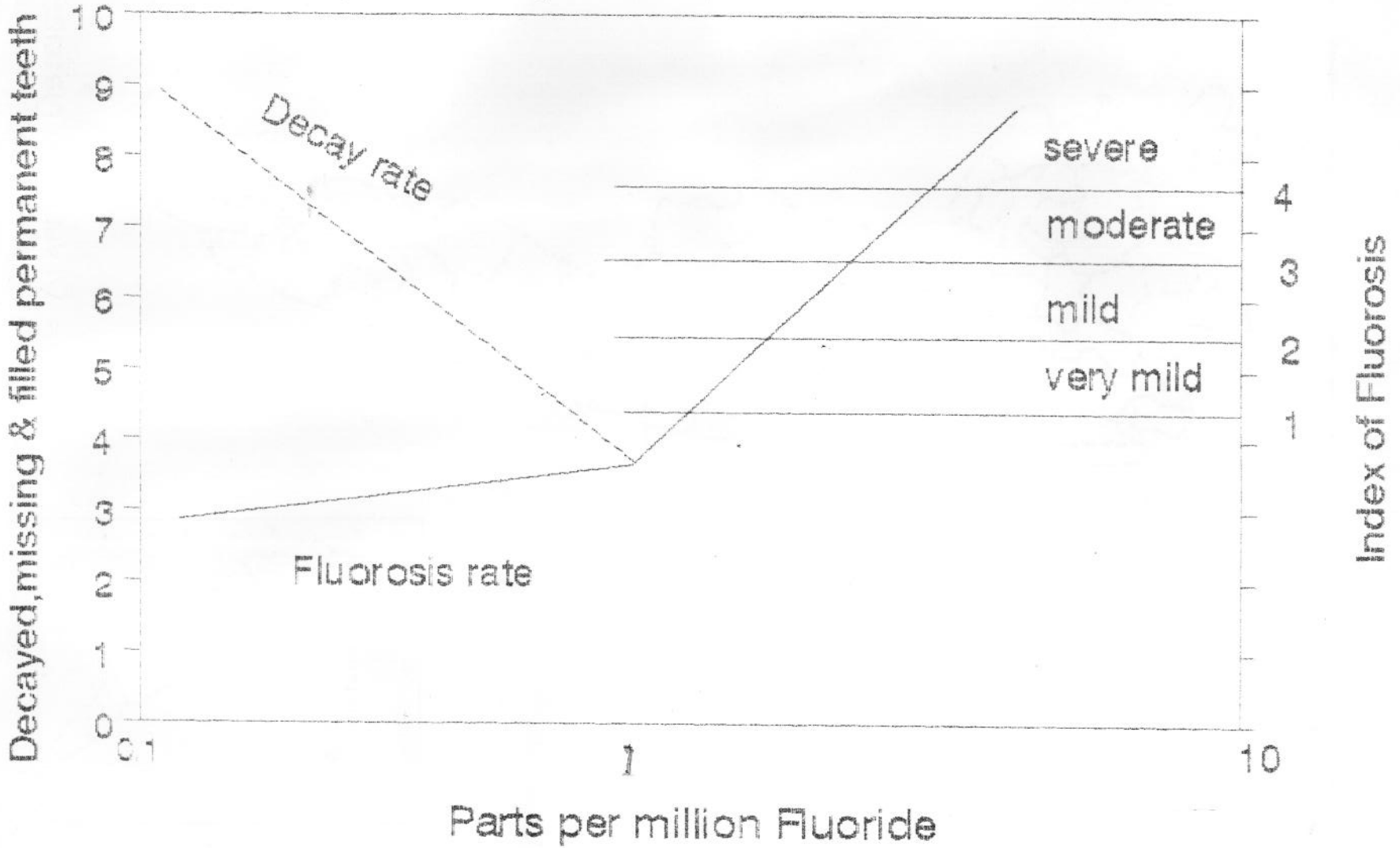

Urban rural differences in Fluorosis
90
80
70
60
50
40
30
20
10
0
Percentage
Normal
Grade I
Grade II
GradeIII
GradeIV
Urban
Rural


Age distribution and dental fluorosis
GradeIV
GradeIII
Grade II
Grade I
Normal
0
10
20
30
40
50
60
70
Percentage
16-17
14-15
12-13
10-11

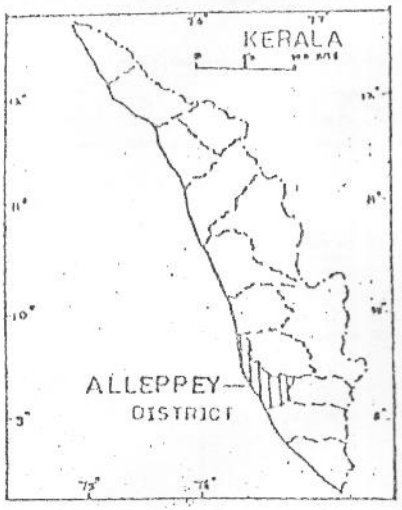

Gender and prevalence of dental fluorosis
GradeIV
GradeIII
Grade II
Grade I
Normal
0
10
20
30
40
50
60
70
Percentage
Female
Male

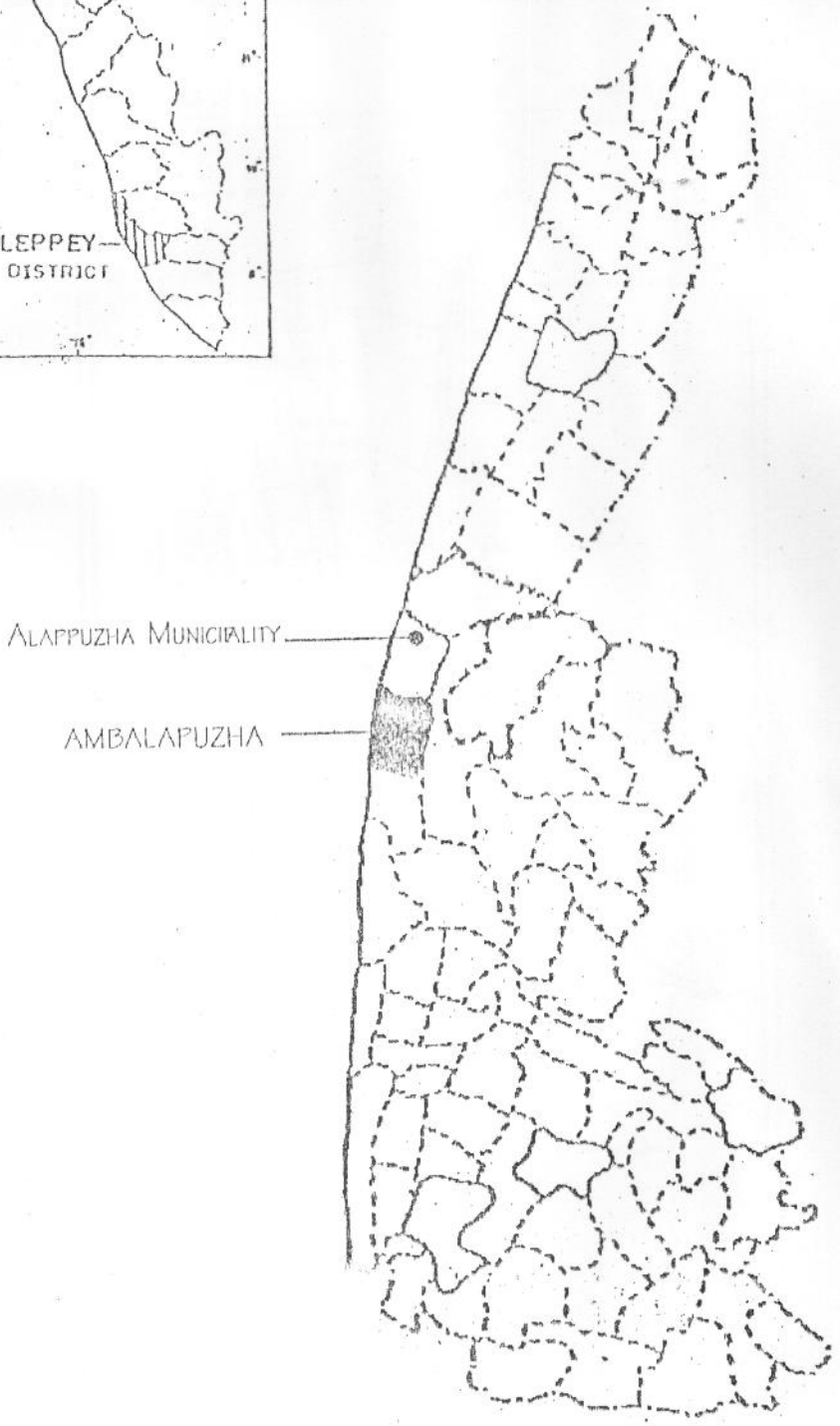
FIGURES

Fig. 1 Relation between DMF teeth(dotted line),severity of dental fluorosis & fluoride concentration of the water (Adopted from Hooge and Smith)



ALAPPUZHA DISTRICT





BLOCK PANCHAYATH MAP