

# DENTAL FLUOROSIS IN CHILDREN ATTENDING BASIC HEALTH UNITS

## FLUROSE DENTÁRIA EM CRIANÇAS USUÁRIAS DE UNIDADES BÁSICAS DE SAÚDE

Cristiane de Andrade Janene GONINI<sup>1</sup>, Maria Celeste MORITA<sup>2</sup>

1- MsSc in Public Health. Professor of the Discipline of Public Health and Preventive Dentistry of the University of North of Parana.

2- Ph.D. in Public Health/Epidemiology and Assistant Professor of the Discipline of Public Health and Preventive Dentistry of the State University of Londrina and University of North of Parana.

**Corresponding address:** MARIA CELESTE MORITA - Rua Pernambuco, 540. - CEP 86020-070, Londrina- PR - Tel: (043) 3321-2002  
Email: moritamc@sercomtel.com.br

**Received: June 06, 2003 - Returned for modification: August 06, 2003 - Accepted: April 26, 2004**

### ABSTRACT

**O**bjectives: The purpose of this study was to determine the prevalence and severity of dental fluorosis among patients attending basic health units in Londrina. Methods: Five basic health units of the urban area were randomly selected and 434 children attending these units, born between 1986 and 1989 (9 to 12 years of age), were examined. Diagnosis of dental fluorosis was performed by means of the Thylstrup and Fejerskov (TF) Index. Oral examinations were carried out by 5 previously trained dentists with the patients lying in the dental chair, under artificial light, preceded by prophylaxis, isolation with cotton rolls and air-drying of the teeth. Ten percent of the sample was reexamined and an almost perfect agreement on diagnostic criteria was obtained either on the intra-examiner or inter-examiner evaluation ( $K=1.00$ ,  $p<0.0001$ ). Results: The observed prevalence of dental fluorosis was 91.0%, and 87.8% of the individuals were classified as TF grade 2 or less. Conclusions: Despite of the low severity, the high prevalence observed shows the need for regular screening of dental fluorosis in Londrina; establishment of procedures to prevent the overutilization of fluoride both by the professionals and the population; sanitary surveillance of fluoride levels in water supply and also in all sources of fluoride available; besides the need for further studies to understand the factors associated to dental fluorosis among children living in Londrina.

**Uniterms:** Dental fluorosis, epidemiology; Fluoride, adverse effects; Water fluoridation.

### RESUMO

**O**bjctivos: Estabelecer a frequência e severidade de fluorose dentária entre pacientes de clínicas odontológicas da rede de Unidades Básicas de Saúde de Londrina. Materiais e Métodos: Cinco Unidades Básicas de Saúde - zona urbana - foram sorteadas e 434 pacientes das clínicas odontológicas destas unidades de saúde, nascidos entre 1986 e 1989 (9 a 12 anos de idade), foram examinados. O diagnóstico da fluorose dentária foi feito utilizando-se o Índice Thylstrup e Fejerskov (TF). Os exames bucais foram realizados por cinco cirurgiões dentistas previamente treinados, com o paciente deitado, utilizando-se iluminação artificial, tendo-se procedido profilaxia, isolamento relativo e secagem dos dentes. Dez por cento da amostra foi reexaminada, tendo-se obtido concordância quase perfeita nos critérios de diagnóstico, tanto intra-examinador como inter-examinadores ( $K=1.00$ ,  $p<0.0001$ ). Resultados: A frequência de fluorose dentária verificada foi de 91.0%, com 87.8% dos indivíduos classificados como TF grau 2 ou menor. Conclusões: A alta frequência encontrada, embora a severidade tenha sido baixa, aponta a necessidade de monitoramento periódico da fluorose dentária em Londrina, de implementação de medidas que previnam a sobre-utilização do flúor, tanto pelos profissionais quanto pela população, de vigilância sanitária dos teores de flúor na água de consumo público e de todas outras fontes de exposição além da realização de estudos para a compreensão dos fatores associados à fluorose dentária nas crianças londrinenses.

**Unitermos:** Fluorose dentária epidemiologia; Flúor, efeitos adversos; Fluorização da água.

## INTRODUCTION

The availability of fluoride has increased during the last fifty years and its employment has been almost universal. Fluoridated water and fluoride-containing products have been yielding benefits to the oral health of individuals in all age ranges and socioeconomic backgrounds. On the other hand, during the last two decades much attention has been given to the safety and risks associated to its employment. This is mainly due to the evidences demonstrating a possible increase in the prevalence of dental fluorosis in fluoridated and non-fluoridated areas all over the world<sup>18,16,19,27,30</sup>. Even though this increase comprises mainly mild fluorosis, there are indications of a slight increase in the moderate forms of this disturbance.

Some recent reports in Brazil have demonstrated the occurrence of higher levels of dental fluorosis than expected  
6, 7, 9 21, 24, 29

In the city of Londrina, two surveys were conducted during the 90s with a view to detect the prevalence and severity of dental fluorosis among schoolchildren from the urban area of the city<sup>1</sup>. The first study reported a mean prevalence of 39.5% of dental fluorosis, according to the Dean Index<sup>11</sup>, in schoolchildren aged 6 to 12 years old. The second study comprised 12-year-old schoolchildren and found dental fluorosis in 46.7% of the children examined. Both studies scored most of the cases as very mild or mild dental fluorosis, however moderate fluorosis was also observed in 4 subjects evaluated.

The results related to the prevalence and severity of dental fluorosis in Londrina are very similar to those reported by studies conducted in developed countries, where the disease receives more attention from the investigators and authorities, therefore showing the need to better understand the epidemiological profile of this disturbance on the different groups of the child population of Londrina. The aim of this study was to evaluate the profile of dental fluorosis on children aged 9 to 12 years old attending the dental clinics of the basic health units (BHU) of the city of Londrina, determining its prevalence and severity.

## MATERIALS AND METHODS

This study was approved by the Bioethics Committee of the State University of Londrina.

The study population comprised a sample of children attending the BHUs of the urban area of the city of Londrina, born between 1986 and 1989.

The sampling procedures involved selection of the dental clinics of the BHUs and also of the children. For that purpose, it was firstly observed that the city of Londrina had a total of 21 BHUs with dental clinics located at the urban area in the year 1998 assisting the age range of interest. The total number of children enrolled who regularly attended the dental clinics was 9,600 subjects. It was also observed that the number of children did not present large variations among the clinics, what allowed the random selection of

dental clinics of BHU in each area of the city (north, south, east, west and center).

The children selected for the study were those who attended the clinics during the study period. Before accomplishment of the examination, the parents or guardians of each child signed a consent form. All children in the age range of interest attending the clinics were examined until a representative number for accomplishment of the study was reached.

Determination of the sample size considered the total number of patients enrolled on the clinics (N = 9,600), an estimated prevalence of 40%<sup>1</sup>, and a confidence interval of 95% with a margin of error of 5%, adding up to a sample of 355 individuals. This number was increased to 400 children, therefore yielding a minimum number of 80 patients to be examined in each dental clinic.

Data collection involved accomplishment of oral examination for diagnosis of the presence or absence of dental fluorosis and classification of the positive cases according to the Thylstrup and Fejerskov (TF) Index<sup>28</sup>. The TF index was selected because of its higher number of classifications, therefore being more sensitive as to the variation in severity. Five dentists who worked at the randomly selected clinics attended a preparatory course for diagnosis of dental fluorosis (10 hours) and workshops for standardization and calibration of the procedures (12 hours) before performing the oral examinations on the children.

The examinations were performed after professional prophylaxis of the teeth with a brush in low-speed turbine, isolation with cotton rolls, air-drying for one minute, under artificial light and with the aid of a dental mirror number 5. Just permanent teeth presenting at least 2/3 of the clinical crown erupted were included for examination. The buccal and lingual aspects were examined and the teeth were scored as one of the ten categories of the TF Index, according to the aspect that allowed better inspection. Dental elements with extensive restorations and/or fixed orthodontic appliances were excluded from the study. Children presenting chronic systemic alterations or syndromes were excluded from the statistical analysis. The differential diagnosis between fluorosis and non-fluorosis spots was performed by means of the criteria suggested by the authors of the index adopted<sup>28</sup>. Data collection and statistical analysis were carried out from August 1998 up to March 1999.

Ten percent of the sample was reexamined for evaluation of intraexaminer and interexaminer agreement on diagnostic criteria. Agreement on diagnostic criteria was based on the presence or absence of dental fluorosis, by using the Kappa statistical test<sup>17</sup>. Significant agreement was established as a minimum criterion to perform data collection (values between 0.6 and 0.8).

The  $\chi^2$  test of association and the Prevalence Rate were employed to evaluate the differences on the distribution of dental fluorosis in different subgroups. A confidence interval of 95% and a significance level of 5% ( $p < 0.05$ ) were selected.

## RESULTS

The Kappa coefficient values<sup>17</sup> achieved are shown in Table 1.

A total of 434 children were examined, aged 9 to 12 years (mean 10.4 years), being 57.4% (n=249) females and 42.6% (n=185) males.

Dental fluorosis was considered present when the child had at least one pair of homologous permanent teeth classified as TF grade 1 or more. The prevalence registered according to this criterion was 91%.

Concerning the severity of dental fluorosis, it was observed that from the total 8,142 teeth examined, 37.6% were regarded as TF grade 0 or absence of fluorosis, 61.0% as TF grades 1 to 3, 0.4% as TF grades 4 to 5. There were no cases of dental fluorosis scored as TF grades 6 to 9 (Table 2).

The subjects were also classified according to the higher TF value assigned to one or more teeth on the oral cavity. As presented in Table 3, 87.8% of the children were scored as TF grade 2 or less, showing that most cases comprised a mild level of the pathology.

## DISCUSSION

The prevalence of dental fluorosis observed in this study (91%) is much higher than the expected 10% for individuals exposed to fluoridated water with concentrations ranging from 0.7 to 1.2 ppm of fluoride, according to the guidelines of the World Health Organization (WHO)<sup>23</sup>.

Fluoride concentration in water supplies of Londrina, according to the company of water supply, varied from 0.8 to 1.1 ppm, with a mean of 0.87 ppm ( $\pm 0.08$  ppm) between 1986 and 1995. This period comprises the development of the permanent dentition of the children examined and therefore the risk period for development of dental fluorosis. These values are in accordance with the Brazilian legislation<sup>2</sup> for the concentration of fluoride in water. Only 8% of the subjects examined did not live in Londrina during the first six years of life. However, no statistically significant difference was found in the prevalence of dental fluorosis between these subjects and those who had lived in Londrina during their early childhood. Besides the information provided by the water supply company, there were no other data available to check any variation in the fluoride levels

**TABLE 1-** Kappa Coefficient Values before and after data collection

Collection Phase	Exams (N)		Dental Fluorosis Presence and Absence	
	Intra Examiner	Inter Examiner	Intra examiner	Inter examiner
Before	10	10	K* = 0.77 p < 0.0001	K = 0.85 p < 0.0001
After	44	51	K = 1.0 P < 0.0001	K = 1.0 p < 0.0001

\*K = Kappa values

**TABLE 2-** Number of Teeth by TF grades in children attending basic health units in Londrina, 1999

TF Grade	Teeth	Percentage (%)	Cumulated (%)
0	3063	37.6	37.6
1	3963	48.7	86.3
2	930	11.4	97.7
3	155	1.9	99.6
4 to 5	31	0.4	100.0
6 to 9	-	-	-
Total	8142	100.0	100.0

**TABLE 3-** Distribution of TF grades in children attending basic health units in Londrina, 1999

TF	Frequency N	Percentage (%)	Cumulated (%)
0	39	9.0	9.0
1	213	49.1	58.1
2	129	29.7	87.8
3	51	11.8	99.6
4 to 5	2	0.4	100.0
Total	434	100.0	100.0

during the study period.

Concerning severity, scoring of the individuals according to the highest TF value observed in the oral cavity reveals that most cases were scored as the mildest forms of dental fluorosis (TF grades 1, 2 and 3). However, one case of moderate fluorosis (TF grade 4) and another of severe fluorosis (TF grade 5) were also observed.

Comparisons between the present study and other studies should be careful. One should remember that the conditions of examination of the present study were exceptional. Population-based studies are usually performed under natural light without previous air-drying. On the present study, the examinations were performed in the clinics, under artificial light and after prophylaxis and air-drying of the teeth for one minute, as suggested by the authors of the TF Index<sup>28</sup>. Another aspect that should be taken into account is the employment of different indexes with different procedures and diagnostic criteria (Dean Index on the other surveys an TF index on this study). Since the TF Index is a logical extension of the classification provided by the Dean Index, the results presented on this study can be transformed into the scores of the Dean Index for the purpose of comparison, by means of the model of transformation proposed by Granath, et al.<sup>15</sup>, and the data on the studies of Burger, et al.<sup>5</sup> and Mabelya, et al.<sup>20</sup>. The results of this transformation on the study population are presented in Table 4.

According to this classification, the prevalence of dental fluorosis among the children examined would be 41.9% and the Community Fluorosis Index (CFI) would be 0.55. Even after this transformation, the prevalence observed is still high. Compared to the children examined by Dean in Kewanee<sup>5</sup>, the individuals on this study presented a relative risk to develop dental fluorosis 3.4 times higher. The calculated CFI is also higher than that observed by Dean, however it is not higher than the limit of 0.6, which is considered as the threshold from which dental fluorosis would then be regarded as a matter of concern for the study population<sup>23</sup>. However, it should be highlighted that the questionable score was not taken into account for calculation of the CFI observed; therefore the index may be

lower than expected.

In addition to the limitations of the comparisons described, the population of the present study comprised a convenient sample including individuals attending the dental services of the BHU network of Londrina. The characteristics of this population are obviously different, especially regarding the exposure to fluoride sources, considering that the current possibilities of exposure to fluoride are higher and that subjects attending dental clinics may be more exposed to fluoride, since they may be more aware of the importance of oral health control and therefore they may be led to employ caries-preventive methods containing fluoride more frequently.

The prevalence of fluorosis observed among the children attending the dental clinics of the BHUs of Londrina is also higher than the values observed by other authors who worked with population-based data instead of subjects attending clinics<sup>16,19,25,27,30</sup>. These studies concern the prevalence of dental fluorosis in children exposed to fluoridated water with 0.6 to 1.2 ppm of fluoride and range from 13% to 60%. However, recent studies reported levels of prevalence above 60%<sup>8,12,13,18,22,26,32</sup>. Three of such studies employed samples of patients attending dental services and observed high frequencies of dental fluorosis among the individuals examined. One study evaluated a population of patients attending a private pediatric dentistry clinics of North Carolina, United States, and stated that 78% of the evaluated patients aged 5 to 19 years presented signs of dental fluorosis, as measured by the Tooth Surface Index of Fluorosis (TSIF)<sup>18</sup>. Another study included the patients attending the pediatric dentistry clinic of the University of Iowa, United States, and reported a frequency of dental fluorosis of 72%, also through the TSIF Index<sup>26</sup>. Finally, Morgan et al<sup>22</sup> by means of the Dean Index, observed that 69% of the patients attending a pediatric dentistry clinic at the suburb of Boston, United States, demonstrated dental fluorosis.

The data available on the literature as to the prevalence of dental fluorosis in Brazilian cities with fluoridated water are recent, and many of them report levels above the expected 10%<sup>6</sup>. Mendonça, et al.<sup>21</sup> mentioned a prevalence

**TABLE 4**-Comparison between the TF outcomes and Dean index in children attending basic health units in Londrina, 1999

TF	DEAN				
	Normal (0)	Very Mild (1)	Mild (2)	Moderate (3)	Severe (4)
0	39 (9.0%)				
1	213 (49.1%)				
2		129 (29.7%)			
3			51 ( 11.8%)		
4				1 (0.2%)	
5-9					1 ( 0.2%)

of dental fluorosis of 69.3% in one of the six sectors of the city of Belo Horizonte. The data demonstrate that dental fluorosis is much more frequent than the 10% expected for children living in some Brazilian cities where public water supply presents fluoride concentrations within the limits recommended by WHO<sup>23</sup>.

Despite the impossibility to apply the results of the present study to the entire children population of the city of Londrina, they may be in agreement with other reports in the literature. Moreover, they corroborate the outcomes of two other epidemiological surveys of dental fluorosis conducted in the same city some years before, however including schoolchildren<sup>1</sup>. The higher prevalence reported (91%) confirms that the TF Index was more sensitive than the Dean Index for detection of the mildest manifestations of dental fluorosis, especially concerning the grade 1 of the TF Index, which may just be identified after careful cleaning and drying of the teeth, as reported by Fejerskov, et al.<sup>14</sup>. Considering that the cases scored as TF1 could only be detected due to the differentiated conditions for diagnosis, the detected levels of dental fluorosis are maintained stable with a prevalence around 40% on the three studies conducted in the city in the years 1995, 1996 and 1999.

However, part of the difference between the data of the present study and the other surveys conducted on the same city may also be due to the selection of a population attending dental services, as previously mentioned.

Considering the epidemiological status of dental fluorosis observed by the surveys conducted in Londrina and due to the similarity between the local phenomenon and the current findings of the national and international literature, it may be stated that levels of dental fluorosis above the expected have been affecting the children of Londrina. Since the fluoride levels reported by the water supply company of the city indicate fluoride concentrations within the limits recommended by the WHO<sup>23</sup>, there may be two further explanations for this increase in the occurrence of dental fluorosis. The first is related to the likely fluoride intake from other sources available to the population besides fluoridated water, such as fluoride supplements, fluoride dentifrices, topical applications of fluoride and the diet. Particularly considering fluoride dentifrices, it is necessary to remember that since 1989 these products became an important source of fluoride in Brazil, with the creation of specific legislation for the concentration of fluoride in toothpaste<sup>2</sup>. As a consequence of this fact, the proportion of fluoride dentifrices in Brazilian market increased from 25% in the 1988 to 90% in 1990<sup>10</sup>. Therefore, it must be considered that part of the children of the study was exposed to fluoridated dentifrice, besides the fluoridated water, during some of the first six years of life. The second explanation comprises the hypothesis of inadequacy of the fluoride levels in water recommended by the WHO for hot countries, as suggested by the studies conducted in Senegal<sup>4</sup>, Hong Kong<sup>13</sup> and Chile<sup>30</sup>. In tropical countries, the loss of liquid due to transpiration may be high; therefore, the intake of liquids due to the tropical weather may be higher<sup>4</sup>. Moreover, recommendations of fluoride levels in water were established

on a time period on which the main fluoride sources were water and to a lesser extent the diet, different from the current availability of multiple sources of fluoride and the larger possibilities of intake. It has been suggested lately that the fluoride concentration in water supply should now range from 0.5 to 1.0 ppm of fluoride<sup>31</sup>. Even though this measure may not be easily accomplished in short term, since it depends on the government due to the changes required on the federal regulation currently into force, it may be achieved in middle term. In Hong Kong, for example, fluoride concentration in public water supply was adjusted many times until an ideal concentration for the local weather was found, with no damage to prevention of dental caries.

## CONCLUSIONS

Despite the low severity, the high prevalence observed in this survey shows the need for regular screening of dental fluorosis in Londrina; establishment of procedures to prevent the overutilization of fluoride both by the professionals and the population; monitoring of fluoride levels in the water supply and also in all sources of fluoride available; besides the need for further studies to understand the factors associated to dental fluorosis among children living in Londrina.

## ACKNOWLEDGEMENTS

CAPES Financial grants. The present paper was based on the Master dissertation entitled Dental Fluorosis in Children Born From 1986 To 1989, Attending Basic Health Units of Londrina: Frequency, Severity And Associated Factors. State University of Londrina. 1999

## REFERENCES

- 1- Autarquia Municipal de Saúde (ASMS). Resultados preliminares do levantamento epidemiológico de cárie dentária e fluorose – 1995/1996. Londrina: Autarquia Municipal de Saúde. 1996.
- 2- Brasil. Ministério da Saúde. Secretaria Nacional de Vigilância Sanitária. Portaria nº 22 de 20 de dezembro de 1989. DO de 22/12/89, p.241.
- 3- Brasil. Ministério da Saúde. Portaria nº 36. de 19 de outubro de 1990.
- 4- Brouwer ID, Dirks OB, De-Bruin A, Hautvast JG. Unsuitability of World Health Organization guidelines for fluoride concentrations in drinking-water in Senegal. [Abstract n. 8579]. Lancet 1988; 1(sp. Issue):223.
- 5- Burger P, Cleaton-Jones P, Du Plessis J, De Vries J. Comparison of two fluorosis indices in the primary dentition of Tswana children. Community Dent Oral Epidemiol 1987 Apr; 15(2):95-7.
- 6- Cangussu MCT, Castellanos RAF. Meta-análise dos estudos epidemiológicos da fluorose dentária no Brasil 1970-2000. Rev. Bras. Odontol. Saúde Coletiva 2001; 2(2):37-44.

- 7- Cangussu MCT, Narvai PC, Castellanos RAF, Djehizian V. A fluorose dentária no Brasil: uma revisão crítica. *Cad Saúde Pública* 2002 Jan/Fev; 18:7-15.
- 8- Clark DC. Trends in prevalence of dental fluorosis in North America. *Community Dent Oral Epidemiol* 1994; 22:148-52.
- 9- Cortes DF, Elwood RP, O'Mullane DM, Bastos JRM. Drinking-water fluoride levels, dental fluorosis, and caries experience in Brazil. *J Public Health Dent* 1996; 56(4):226-8.
- 10- Cury JA. Dentifricio fluoretado no mercado brasileiro e seu potencial como método preventivo. *Jornal da Associação Brasileira de Odontologia Preventiva* 1998, p.2.
- 11- Dean HT. The investigation of physiological effects by the epidemiological method. In: Moulton R.F., ed. *Fluoride and dental health*. American Association for the Advancement of Science, Washington: 1942.
- 12- Elwood RP, O'Mullane DM. Dental enamel opacities in three groups with varying levels of fluoride in their drinking-water. *Caries Res* 1995; 29:137-42.
- 13- Evans WR, Stamm JW. Dental fluorosis following downward adjustment of fluoride in drinking-water. *J Public Health Dent* 1991; 51(2):91-8.
- 14- Fejerskov O, Baelum V, Manji F, Moller JJ. *Fluorose dentária: um manual para profissionais da saúde*. São Paulo: Santos; 1994.
- 15- Granath L, Widenheim J, Beirke D. Diagnosis of mild enamel fluorosis permanent maxillary incisors using two scoring systems. *Community Dent Oral Epidemiol* 1995; 13(5):273-6.
- 16- Ismail AI, Brodeur JM, Kavanagh M, Boisclair G, Terssier C, Picotte L. Prevalence of dental caries and dental fluorosis in students, 11-17 years of age, in fluoridated and non-fluoridated cities in Quebec. *Caries Res* 1990; 24(4):290-7.
- 17- Kramer M, Feinstein A. *Clinical Bioestatistics.Liv. The bioestatistics of concordance*. *Clin Pharmacol Ther* 1981; 29(1):111-23. erratum 1989. 46(3).
- 18- Lalumandier JA, Rozier RG. The prevalence and risk factors of fluorosis among patients in a pediatric dental practice. *Pediatr Dent* 1995; 17(1):19-25.
- 19- Leverett D. Prevalence of dental fluorosis in fluoridated and nonfluoridated communities: a preliminary investigation. *J Public Health Dent* 1986 Fall; 46(4):184-7.
- 20- Mabeya L, Van't Hof MA, Konig KG, Van Pallestein Helderma WH. Comparison of two indices of dental fluorosis in low, moderate and high fluorosis tanzanian populations. *Community Dent Oral Epidemiol* 1994; 22( 6):415-20.
- 21- Mendonça LL, Kirchner UL, Costa NR, Giovannini JFBG, Pinto MR, Luz MAR. Estudo multicentro da fluorose dental e cárie dental em escolares de 7 e 10 anos de Belo Horizonte - Parte I. *RPG rev. pos-grad* 1998; 5(2):101-9.
- 22- Morgan L, Alfred E, Tavares N, Bellinger D, Needleman H. Investigation of the possible associations between fluorosis, fluoride exposure, and childhood behavior problem. *Pediatr Dent* 1998; 20(4):244-52.
- 23- ORGANIZAÇÃO MUNDIAL DA SAÚDE. *O uso correto de fluoretos na Saúde Pública*. São Paulo: Ed. Santos. 1992. 131p.
- 24- Pereira AC. Comparação entre três índices de fluorose dentária na dentição permanente, observados em escolares de 12 a 14 anos de idade, residentes em áreas com diferentes concentrações de flúor nas águas de consumo. São Paulo; 1996. [Tese de Doutorado – Faculdade de Saúde Pública da USP].
- 25- Selwitz RH, Nowajack-Raymer RE, Kingman A, Driscoll WS. Prevalence of dental caries and dental fluorosis in areas with optimal and above optimal water fluoride concentrations: a 10-year-follow-up survey. *J Public Health Dent* 1995; 55(2):85-93.
- 26- Skotowski MC, Hunt RJ, Levy SM. Risk factors for dental fluorosis in pediatric dental patients. *J Pubic Health Dent* 1995; 55(3):154-9.
- 27- Szpunar SM, Burt BA. Trends in the prevalence of dental fluorosis in the United States: a review. *J Public Health Dent* 1987; 47(2):71-9.
- 28- Thylstrup A, Fejerskov O. Clinical appearance of dental fluorosis in permanent teeth in relation to histologic changes. *Community Dent Oral Epidemiol* 1978; 6(6):315-28.
- 29- Tomita NE, Panighel CPMA, Narvai PC, Lopes ES. Implicações da vigilância à saúde sobre a ocorrência de fluorose dental. *Rev. ABO Nac.* 1995; 3(5):318-23.
- 30- Villa AE, Guerrero S, Villalobos J. Estimation of optimal concentration of fluoride in drinking-water under conditions prevailing in Chile. *Community Dent Oral Epidemiol* 1998; 26(4):249-55.
- 31- WHO. *Fluorides and oral health. Report of a expert of a who expert committee on oral health status and fluoride use*. Geneva: WHO. 1994. 40 p.
- 32- Willians E, Zwemer JD. Community water fluoride levels, preschool dietary patterns and the occurrence of fluoride enamel opacities. *J Public Health Dent* 1990; 50(4):276-81.