

# Impact of dental fluorosis on the quality of life of children and adolescents

*Impacto da fluorose dentária na qualidade de vida de crianças e adolescentes*

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## Resumo

**Introdução:** A fluorose dentária é um distúrbio de alta prevalência decorrente da ingestão de íons fluoretos. Medidas preventivas para evitá-la ainda são controversas. Assim, conhecer o impacto que a fluorose pode causar na qualidade de vida de indivíduos é importante para o planejamento de políticas públicas de saúde. **Objetivo:** Avaliar o impacto da fluorose dentária sobre a qualidade de vida relacionada à saúde bucal (QVRSB) de crianças e adolescentes. **Material e método:** Foram avaliados 300 indivíduos na faixa etária de 8 a 12 anos. O diagnóstico de fluorose foi realizado segundo o índice Thylstrup e Fejerskov e a qualidade de vida foi avaliada utilizando os questionários de Percepção da Criança 8-10 e 11-14. Foram incluídos pacientes com oito incisivos permanentes com coroas totalmente irrompidas excluídos os que apresentavam restaurações extensas, dentes fraturados, outros defeitos do esmalte dentário e os que usavam aparelho ortodôntico fixo. Os dados foram analisados no programa SPSS® (versão 18; Chicago, IL) e realizaram-se os teste Qui-quadrado, Fisher e Mann-Whitney. Foram considerados significantes valores de  $p < 0,05$ . **Resultado:** A prevalência de fluorose foi 64,7%, sendo os graus leve e muito leve responsáveis por 80,3% dos casos. Crianças e adolescentes não tiveram impacto na QVRSB no escore geral e domínios sintomas orais, bem-estar emocional e social ( $p > 0,05$ ). Entretanto, apresentaram impacto no domínio limitação funcional ( $p = 0,039$  e  $0,013$ ) para crianças e adolescentes respectivamente). **Conclusão:** Foi observada associação entre fluorose e qualidade de vida apenas no domínio funcional.

**Descritores:** Fluorose dentária; qualidade de vida; percepção.

## Abstract

**Introduction:** Dental fluorosis is a disturbance of high prevalence caused by the ingestion of fluoride ions present mainly in toothpaste. Preventive measures to avoid it are still controversial. Thus, knowing the impact that fluorosis can cause on the population's quality of life it is important for planning public health policies. **Objective:** To evaluate the impact of dental fluorosis on the quality of life of children and adolescents. **Material and method:** We studied 300 subjects aged 8 to 12 years divided into 4 groups: children (8-10 years) and adolescents (10 to 12 years) with and without fluorosis. The diagnosis of fluorosis was performed according to the index Thylstrup and Fejerskov and quality of life was evaluated using Child Perceptions Questionnaire 8-10 and 11-14. The socio-demographic characteristics of the patients were also evaluated. For inclusion in the sample, selected patients should present eight permanent incisors with crowns fully erupted. Patients who had extensive restorations, fractured teeth, other dental enamel defects and who wore braces were excluded. **Result:** Fluorosis was present in 64.7% of the patients analyzed and in most cases (80.3%) was mild or very mild. In children, the average overall score of the questionnaire was 15.9 for the group without fluorosis and 18.3 for the group with fluorosis ( $p = 0.255$ ). The teenagers' score in the group without fluorosis was 26.1, while the group with fluorosis was 22.7 ( $p = 0.104$ ). **Conclusion:** Dental fluorosis caused impact on the quality of life of the population analyzed only in the functional domain.

**Descriptors:** Dental fluorosis; quality of life; perception.

## INTRODUCTION

Fluorosis is a calcification disorder, which occurs in the enamel due to the chronic ingestion of small amounts of fluoride<sup>1</sup>. Clinically, dental fluorosis is characterized by diffuse hypocalcifications distributed symmetrically on the enamel surface of tooth counterparts. The hypocalcifications are manifested in various degrees according to the total amount of ingested fluoride, exposure time, the subject's age and weight, and nutritional status<sup>2</sup>. In mild or moderate forms, hypocalcifications appear as fine opaque lines, distributed throughout the enamel surface<sup>3</sup>. In more severe forms, the tooth structure becomes completely opaque and porous, allowing it to acquire extrinsic pigments from the diet, so it may become brownish<sup>3</sup>. According to Chankanka et al.<sup>4</sup>, aesthetic changes produced by severe dental fluorosis may trigger social constraints.

The use of fluorides has achieved a reduction in caries prevalence<sup>5</sup>. As a result of the development of various fluoride products for individual and collective use, there has been an increase in the prevalence of dental fluorosis<sup>6</sup>. Among these products, fluoride toothpastes are used by children during tooth development. Fluoride toothpastes have been associated with an increase in fluorosis<sup>3</sup>, but a systematic review showed that the evidence for this association is weak and unreliable<sup>7</sup>. Moreover, a meta-analysis demonstrated that conventional fluoride dentifrices are effective in reducing dental caries in the primary dentition and should be recommended for preschool children<sup>8</sup>. Thus, it is important to evaluate the impact that dental fluorosis has on quality of life.

Studies evaluating the impact of dental fluorosis on the quality of life of children and adolescents have shown conflicting results because perceptions regarding fluorosis depend on aesthetics and the degree of severity<sup>4</sup>. Thus, the present study aimed to evaluate the impact of dental fluorosis on the oral health-related quality of life (OHRQOL) of children and adolescents.

## MATERIAL AND METHOD

The present study was developed with a cross-sectional observational design. The study was initiated after approval by the Federal University of Piauí Ethics Committee (CEP) (Opinion 0123.0.045.000-11).

During the year 2010, 1376 children (8 to 10 year olds) and adolescents (11 to 12 year olds) were treated at the Children's Dental Clinic of Federal University of Piauí (UFPI). To perform the sample size calculation, the StatCalc module of the Epi Info 3.5.2 software was used. The sample size calculation was performed using the formula:  $n = [\partial^2 \times p \times q \times N] / [e^2 \times (N - 1) + \partial^2 \times p \times q]$ , where  $N$  is the population,  $n$  is the sample to be calculated,  $\partial$  is the confidence level,  $e$  is the sampling error, and  $p \times q$  is the percentage by which the phenomenon occurs. The sampling error of the 5% and 95% confidence level was considered. For the sample size calculation, we used a maximum variance of  $p = 0.50$ , margin of error of 5.0, and a confidence level

of 95% ( $\partial = 1.96$ ). Thus, the calculated sample consisted of 300 children and adolescents.

The inclusion criteria were children and adolescents who presented eight permanent incisors with fully erupted crowns. Subjects were excluded if they had extensive restorations, fractured teeth, dental enamel defects, or fixed orthodontic appliances.

The study data were collected from August 2011 to May 2012. The sociodemographic characteristics of the sample were collected using a questionnaire to obtain information on age, gender, family income, parental education, and type of water consumption. These data were then compared with the results obtained in the evaluation of fluorosis.

OHRQOL was assessed using the Brazilian versions of the Child Perception Questionnaire (CPQ<sub>8-10</sub>), which was validated by Barbosa et al.<sup>9</sup>, and the adolescent CPQ (CPQ<sub>11-14</sub>), which was validated by Gourmand et al.<sup>10</sup> These instruments were used to assess the impact of oral health on the quality of life of four groups of subjects: 8–10-year-old children with and without fluorosis, and 11–12-year-old adolescents with and without fluorosis.

Both questionnaires included questions divided into four domains: oral symptoms, functional limitations, emotional well-being, and social well-being. The total score ranged from 0 to 100 for the CPQ<sub>8-10</sub> and from 0 and 148 for the CPQ<sub>11-14</sub>. Higher scores denote a greater impact of oral health on quality of life. The five items in the scale were scored using the following values: 0 = never; one/two times = 1; sometimes = 2; often = 3; and every day/almost every day = 4.

Dental clinical examinations were performed on the upper and lower incisors after toothbrushing. The exams were performed in a conventional dental office under an artificial light (reflector) by a single examiner who was previously trained (kappa 0.805). The examiner used personal protective equipment including goggles, a mask, a cap, and gloves to make the procedures<sup>11</sup>.

The Thylstrup Fejerskov Index (TFI) was used to diagnose dental fluorosis based on the clinical appearance of the anterior teeth. The TFI is a scale scored from 0 to 9, and increasing values denote an increase in the severity of fluorosis<sup>3</sup>. The incisors were isolated with cotton rolls and dried for 30 seconds with compressed air. According to the TFI, each tooth was evaluated and assigned a score ranging from 0 to 9.

A score of 0, representing the absence of fluorosis, was given if the tooth showed normal enamel translucency and the absence of opacity. A score 1 was given when thin opaque lines were observed across the surface of tooth. A score of 2 was assigned when these opaque lines were more pronounced and occurred commonly on the dental surface. A score of 3 was given when the tooth had gray areas due to the fusion of originally distinct and separate lines. A score of 4 was assigned when increasingly intense opaque areas were distributed throughout the tooth surface forming a limestone white surface. A score of 5 was given when enamel loss and altered staining were observed and round depressions with diameters less than 2 mm were visible. A score of 6 was assigned when these depressions are fused to form a band. A score of 7 was given when the bands were larger and more pronounced. A

score of 8 was given when half of the tooth surface had irregular depressions. A score of 9 was assigned when there was extensive loss of enamel, with a change in the anatomical surface of the tooth<sup>3</sup>.

In the present study, scores of 1 and 2 were considered to represent very mild and mild fluorosis, respectively. Scores of 3, 4, and 5 were considered moderate fluorosis, and scores above 5 were considered severe fluorosis. A score of 0 was considered to represent the absence of fluorosis<sup>4</sup>.

Data were analyzed with SPSS (version 18, Chicago, IL) statistical software. We conducted a descriptive analysis of teeth with fluorosis distributed according to the TFI. The indices of fluorosis were dichotomized as either the presence of fluorosis (TFI scores 1–9) or no fluorosis (TFI score 0) and associated with sociodemographic variables by performing the chi-square test and Fisher’s exact test. The overall mean and domain scores of the CPQ<sub>8-10</sub> and CPQ<sub>11-14</sub> were compared between the groups with and without fluorosis using the Mann-Whitney test.

**RESULT**

The final sample consisted of 300 children and adolescents who were divided into four groups, based on age (children 8 to 10 years old and adolescents 10 to 12 years old) and the presence or absence of fluorosis. The CPQ<sub>8-10</sub> and CPQ<sub>11-14</sub> were administered to the groups as shown in the flow chart in Figure 1.

When performing the association analysis between fluorosis and the sociodemographic variables, an association was observed between fluorosis and family income ( $p = 0.017$ ) (Table 1).

Fluorosis was observed in 64.7% ( $n = 193$ ) of the total population. In 80.3% ( $n = 155$ ) of these cases, the fluorosis was diagnosed as mild or very mild. The remaining fluorosis cases ( $n = 38$ ) received TFI scores between 3 and 5. No patient exhibited severe fluorosis. The teeth most affected by fluorosis were the maxillary central incisors, which also showed a higher disease severity (Figure 2).

With the exception of the functional domain, no association between fluorosis and quality of life (Tables 2 and 3) was observed.

**DISCUSSION**

This cross-sectional study assessed the impact of fluorosis on the OHRQOL in children and adolescents. A sensitive index was used to diagnose fluorosis. The TFI recommends that teeth be dried before the examination for the diagnosis of the early stages of fluorosis. In contrast, Dean’s index, which is used in most studies, does not require that teeth be dried for diagnosis, and consequently it can only be used to diagnose advanced stages of fluorosis<sup>12</sup>.

The incidence of dental fluorosis in this study was 64.7%, and most cases had mild or very mild fluorosis. This result was higher than those reported in other studies, which obtained values ranging between 29.2% and 36%<sup>13,14</sup>, and the results reported by SB Brazil 2010<sup>15</sup>, which showed that the prevalence of fluorosis at age 12 was 16.7%. However, our results are similar to those of an epidemiological study in Teresina<sup>16</sup>. These differences can be attributed to the type of index used to measure fluorosis. The

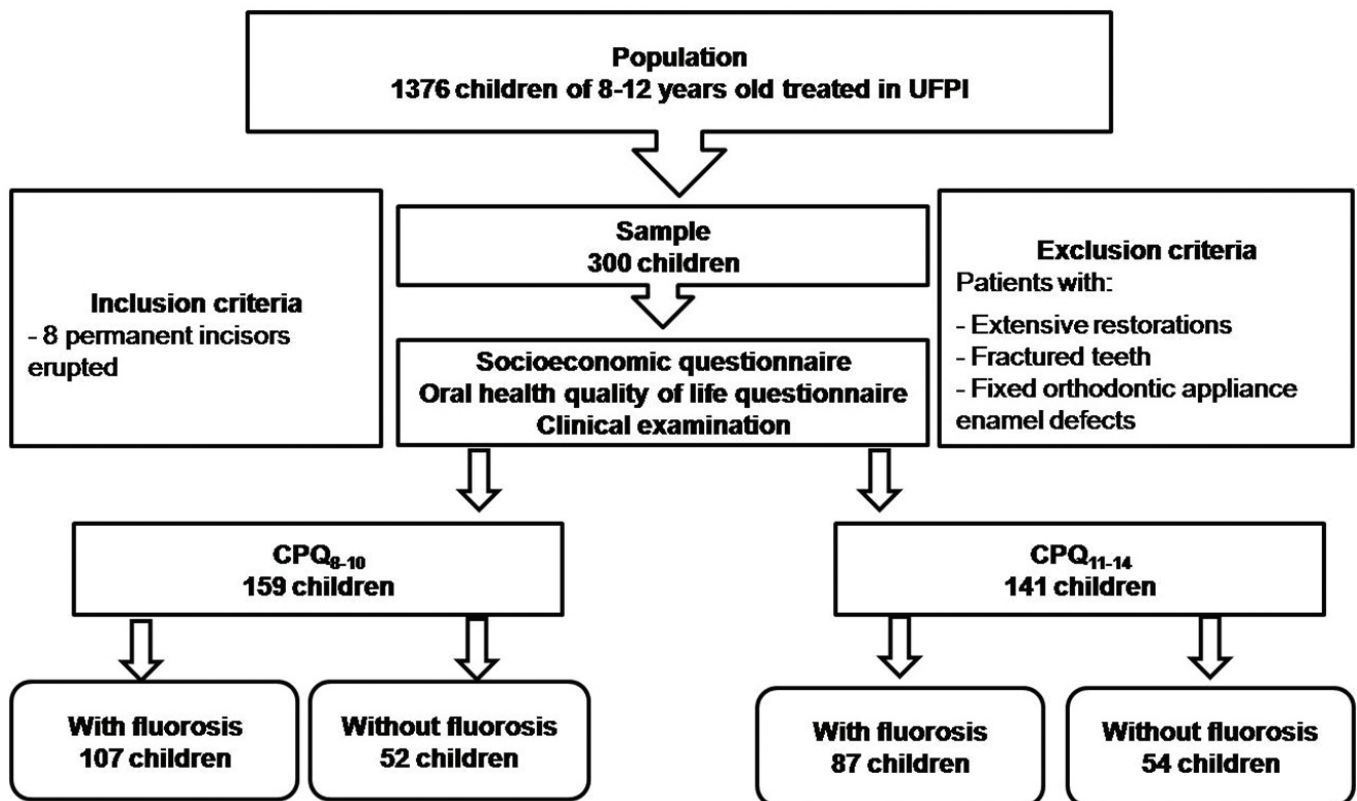
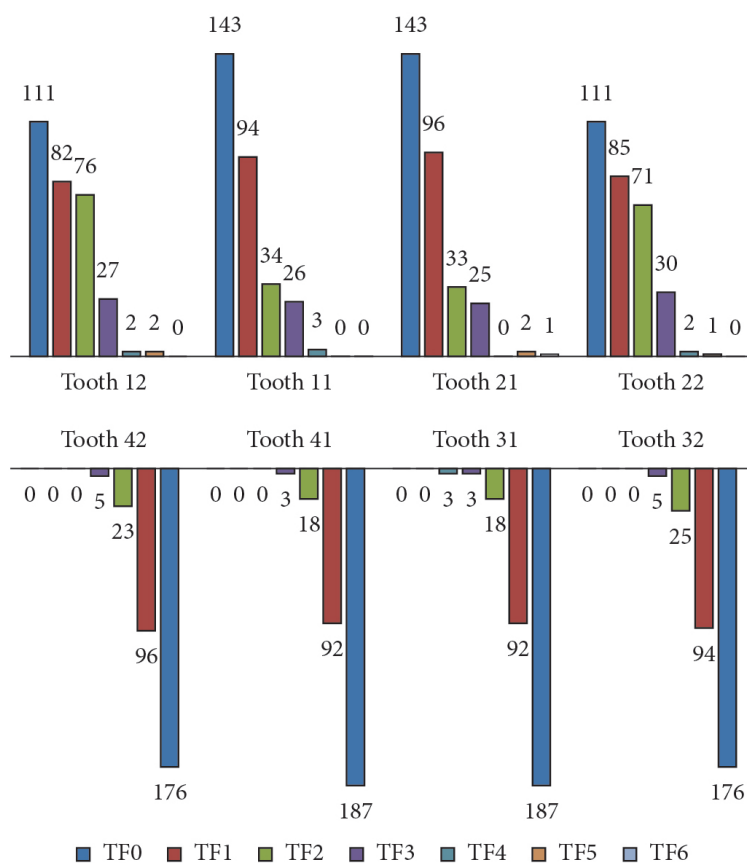


Figure 1. Flow chart of the study design.

**Table 1.** Distribution of sociodemographic variables according to the presence or absence of dental fluorosis

Variables	Fluorosis		Total	p-Value
	Yes N (%)	No N (%)		
<b>Sex</b>				
Male	80 (41.2%)	45 (42.5%)	125 (41.7%)	0.467*
Female	114 (58.8%)	61 (57.5%)	175 (58.3%)	
<b>Family income</b>				
<2 MW	145 (74.7%)	66 (62.3%)	211 (70.3%)	0.017*
≥2 MW	49 (25.3%)	40 (37.7%)	89 (29.7%)	
<b>Mother schooling</b>				
<8 years	83 (43.2%)	43 (41.0%)	126 (42.4%)	0.399*
≥8 years	109 (56.8%)	62 (59.0%)	171 (57.6%)	
<b>Father schooling</b>				
<8 years	81 (43.8%)	53 (53.0%)	134 (47.0%)	0.086*
≥8 years	151 (56.2%)	50.3 (47.0%)	151 (53.0%)	
<b>Piped water</b>				
Yes	190 (97.9%)	103 (97.2%)	293 (97.7%)	0.476**
No	4 (2.1%)	3 (2.8%)	7 (2.3%)	

\*Chi-square Test; \*\*Fisher Test.



**Figure 2.** Distribution of teeth according to the degree of fluorosis. TF: Thylstrup Fejerskov Index score.

**Table 2.** Relationship between dental fluorosis and quality of life in 8- to 10-year-old children

	Fluorosis	Mean	Median	p*
CPQ <sub>8-10</sub>	No	15.9	13.0	0.255
	Yes	18.3	17.4	
Oral Symptom	No	6.0	6.0	0.955
	Yes	6.0	6.0	
Functional Limitation	No	2.7	2.0	0.039
	Yes	3.7	2.5	
Emotional Well-being	No	3.4	2.0	0.375
	Yes	4.1	3.0	
Social Well-being	No	3.8	2.0	0.562
	Yes	4.5	3.0	

\*p-value Mann-Whitney Test.

**Table 3.** Relationship between dental fluorosis and quality of life in 11- to 12-year-old adolescents

	Fluorosis	Mean	Median	p*
CPQ <sub>11-12</sub>	No	26.1	25.0	0.104
	Yes	22.7	19.0	
Symptom Oral	No	6.4	6.0	0.078
	Yes	5.3	5.0	
Functional Limitation	No	7.8	8.0	0.013
	Yes	6.4	6.0	
Emotional Well-being	No	6.3	5.0	0.403
	Yes	6.0	4.0	
Bem Estar Social	No	5.7	5.0	0.358
	Yes	5.0	3.0	

\*p-value Mann-Whitney test.

studies reporting a low prevalence used Dean's index to measure fluorosis<sup>12</sup>.

Oral health problems can have a significant impact on the physical, social, and psychological well-being of the population, and they have drawn the attention of public policy managers focused on the quality of life of individuals<sup>4</sup>. According to the World Health Organization (WHO)<sup>17</sup>, quality of life can be defined as "an individual's perception of their position in life in the context of culture and value systems in which they live and in relation to their goals, expectations, standards and concerns". The OHRQOL assesses the impact of oral diseases on aspects of a person's everyday life or their values and beliefs<sup>18</sup>.

It is especially important to measure the impact of disease and disease treatment on the social and psychological aspects of children<sup>19</sup>. These subjective aspects complement the clinical

symptoms to provide a comprehensive view of children's health<sup>19</sup>. The use of validated questionnaires allows for objective assessment of the impact of fluorosis on OHRQOL<sup>7,20,21</sup>, so this type of questionnaire was used in this study.

Historically oral health has been addressed using only clinical criteria<sup>22</sup>. However, oral problems can cause pain, discomfort, limitations, and aesthetic changes that affect diet, exercise, daily activities, and social well-being. These changes may affect the quality of life of individuals<sup>17</sup>.

In most children and adolescents in this study, dental fluorosis did not have a significant adverse effect on appearance, emotional and social well-being, and oral symptoms. This result can be explained by the very low severity of fluorosis observed in our sample. Mild fluorosis (TFI score of 1) is characterized by fine white opaque lines crossing the surface of the tooth, which can only be clearly observed when the tooth surface is clean and dry. Under regular dental conditions, when the enamel is covered by plaque and saliva, this level of dental fluorosis does not characterize an aesthetic problem<sup>21</sup>. Chankanka et al.<sup>4</sup> and Michel-Crosato et al.<sup>23</sup> reported that mild or very mild fluorosis had little or no effect on OHRQOL.

There was an effect of fluorosis on the functional domain in both groups, as measured by the CPQ<sub>8-10</sub> and CPQ<sub>11-14</sub>. This domain examines issues mainly relating to chewing, which is the process of breaking and crushing of food using the posterior teeth (premolars and molars). These teeth were not evaluated in this study, which is a limitation of this research.

These results were unexpected because usually fluorosis is associated with aesthetic implications and not with functional implications<sup>21</sup>. Moreover, mild and very mild fluorosis is not a condition that triggers pain or clinical signs<sup>22</sup>. Similar results were observed in a study that evaluated the relationship between enamel defects and quality of life in schoolchildren between 11 and 14 years of age<sup>24</sup>. This result was also observed in individuals with caries, malocclusions, and temporomandibular disorders<sup>25-27</sup>. However, these data were not collected in this study, constituting a limitation of this research, because these factors can be confounding variables. Thus, we suggest further studies to verify the incidence of these problems in children or teenagers with fluorosis.

Another important result is that fluorosis presented an influence on OHRQOL in most children and adolescents, namely, the CPQ scores were not zero. This result underscores the importance of not limiting treatment plans to clinical conditions. The investigation of other factors, with an emphasis on psychosocial and environmental aspects, and a review of current concepts of health and disease is needed because a solely normative perception may be overestimating their actual needs.

Although fluorosis has shown little or no impact on oral health, recent studies on the impact of dental caries have shown just the opposite. Acharya and Tandon<sup>28</sup> found that children with caries have a lower quality of life when compared to children

without the disorder. In addition, Cunnion et al.<sup>29</sup> reported that children with caries are more likely to experience negative effects on their physical, mental, and social functioning.

From this perspective, the benefits of using fluoride dentifrice in a country like Brazil, which has a high prevalence of caries, may be preferable because the population has a low prevalence of fluorosis and carious lesions.

## CONCLUSION

In this study, we conclude that dental fluorosis has no effect on the quality of life related to oral health. Dental fluorosis affected the functional domain of the OHRQOL; however, confounding factors such as caries and malocclusions should be evaluated in subjects with fluorosis to verify this association.

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## CONFLICT OF INTEREST

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The authors declare no conflicts of interest.

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