Clinical Article

The Impact of a Dental Program for Maternal and Infant Health on the Prevalence of Dental Fluorosis

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Abstract: Purpose: This study’s purpose was to investigate the prevalence of dental fluorosis in children, whose parents had participated in an oral health program when the children were between zero and three years old, residing in a city with fluoridated water. Methods: Group 1 consisted of 128 eight- to 12-year-olds whose parents had visited a program on at least five occasions when the children were zero to three years old and received education about tooth-brushing and the proper use of fluoridated toothpaste in this young age group. The prevalence of dental fluorosis in the permanent maxillary incisors, using the Thylstrup-Fejerskov index, in Group 1 was compared to that of an age-matched group of children (n=128) whose parents had not participated in the program (Group 2). Results: Group 1 mothers reported higher education levels (P<.05). Group 1 children had a significantly lower prevalence (~42 percent) and severity (P<.05) of dental fluorosis than those in the control group (~61 percent). Conclusion: Children whose parents participated in a dental program that included counselling on the proper amount of fluoridated toothpaste when their children were between zero and three years old presented less frequently with dental fluorosis than a control group when examined at eight to 12 years old. (Pediatr Dent 2013;35:519-22) Received June 18, 2012 | Last Revision October 7, 2012 | Accepted October 8, 2012

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The use of fluoride has contributed substantially to the decline in dental caries. In all countries in which caries have decreased, fluoride has been employed in some manner, demonstrating the necessity of fluoride in maintaining a low prevalence of caries.1 The use of fluoridated toothpaste is considered to be the main reason for the decline of tooth decay in recent decades.2 In individual and population-based preventive programs, however, the caries-controlling qualities of fluoride must be balanced with the risk of inducing dental fluorosis.3

Dental fluorosis is defined as the hypomineralization of enamel due to the retention of proteins (amelogenins) in the matrix during the initial phase of calcification. These proteins are retained because of the high concentration of fluoride that produces an almost neutral pH and inhibits the proteolytic enzymes responsible for reabsorbing the proteins from the enamel matrix. This hypomineralization results in enamel that is more porous and contains more protein and fewer minerals, resulting in the poor formation of hydroxyapatite crystals.4

The occurrence of fluorosis in permanent incisor teeth is most critical in the first years of development. The permanent incisors are very important from an esthetic point of view, and the susceptibility of these teeth to fluorosis is reported to be higher during the first 24 to 30 months of life.5 Parents or guardians of children younger than six years old should be informed of the possible risk of ingestion of fluoride dentifrices that can result from the use of toothpastes designed for children, which often present with a pleasant flavor and color.6 The public should also be educated on the benefits and risks of fluoride intake and the various forms through which it can be ingested (eg, fluoridated water, diet, cooking with fluoridated water, and the ingestion of fluoridated toothpaste by children younger than six years old).7

Different studies claim that dental fluorosis is directly related to the abuse and indiscriminate use of fluoridated toothpaste rather than the fluoridation of public water.67 A recent literature review revealed that the conclusion that fluoridated toothpaste in children younger than 12 months old increases the risk of fluorosis is weak and uncertain; the evidence is equivocal, even in older children.10

Teresina, the capital of the state of Piauí in northeastern Brazil, is a city that has public fluoridated water (0.6 to 0.8 ppm fluoride [F])11 and a high prevalence of early childhood caries.12 The School of Dentistry, Federal University of Piauí (UFPI) in Teresina started a university extension project on April 27, 1997, called the Preventive Programme for Pregnant Women and Babies (PPPWB), which focuses on the recovery and maintenance of the oral health of pregnant women and children from zero to 36 months old. The PPPWB’s activities are developed at the Institute of Social Perinatology of Piauí by students from the undergraduate dental course at UFPI under the supervision and guidance of professors. In this program, parents and guardians are advised to use fluoridated toothpaste in small amounts upon the eruption of the first teeth.1314

The purpose of this study was to investigate the prevalence and severity of dental fluorosis in the permanent maxillary incisors of eight- to 12-year-olds whose parents had participated in a dental program for maternal and infant health when the children were between zero and three years old. The study hypothesis was that individuals who attended a dental education program would have a lower prevalence and severity of dental fluorosis.

Methods
This cross-sectional study was conducted in accordance with the Declaration of Helsinki. It was initiated after approval by the Ethics Committee in Research of UFPI (protocol no. 0120.0.45.000-09).
The legal guardians signed an informed consent form, according to resolution number 196/96 of the National Health Council, which sets standards and guidelines for research involving humans.

**Sample selection.** The sample was selected from August 2009 to July 2010. The participants included eight- to 12-year-old children who were lifelong residents of Teresina and presented with erupted permanent maxillary and mandibular incisors.

**PPPWB considerations.** The PPPWB serves children from zero to 36 months old and provides advice regarding diet (rational use of sugar), harmful oral habits, control of nocturnal feeding, and oral hygiene, which should coincide with personal hygiene habits (bath time and before sleeping). For babies with no erupted teeth, guided hygiene is provided. After the eruption of the primary anterior teeth, hygiene is instructed to be performed using a piece of gauze with a “smear” of fluoridated toothpaste. A toothbrush with a “pea-sized” amount of toothpaste is recommended after the primary molars erupt. In addition, parents are instructed to have children expectorate fluoridated toothpaste after brushing to avoid the chronic ingestion of excessive fluoride. Those responsible for brushing are shown several photographs of teeth with fluorosis to facilitate both their understanding of the provided information and to induce their motivation to adopt the procedures. Donated toothbrushes and toothpaste (F content= 1.000 ppm) are provided to participants. The participants are told that the toothbrush should not be wetted to reduce the amount of foam and help avoid swallowing toothpaste. Those responsible for dental care are taught how to perform oral hygiene and to encourage the children to spit. Return visits are scheduled quarterly.

Children who visit the PPPWB with decayed primary teeth and no complications receive atraumatic restorative treatment; more complex cases are referred to the Children’s Clinic of UFPI. After three years, the children are invited to continue preventive maintenance at the Children’s Dental Clinics of UFPI.

**Group 1.** Group 1 consisted of children whose parents had attended the PPPWB a minimum of five times from 1997 to 2002. By consulting the program files, 590 children were selected who met the following inclusion criteria: began the program without erupted teeth; parents participated in at least five program consultations; and had been lifelong residents of Teresina. Letters were sent to the parents inviting them to bring their children in for a dental health assessment. Fifty-eight letters (-10 percent) were returned to the sender (UFPI) without replies. A total of 24 percent of the letters (representing 128 children) were returned with replies.

**Group 2.** Group 2 consisted of children who went to the Children’s Clinic UFPI for their first access to dental care and had not participated in the PPPWB. Group 2 consisted of 128 children with demographics and a socioeconomic status (SES) similar to those of the study group of children who had sought treatment from public health services. The parents were questioned about the use of fluoridated toothpastes and if children had been lifelong residents of Teresina.

**Study protocol.** The data collection was conducted in the following two phases: (1) via a questionnaire administered to parents; and (2) through a clinical examination of the oral cavity. The questionnaire was designed with closed questions to determine the SES and health practices of each family (beginning of fluoride dentifrice use, frequency of toothbrushing, and use of fluoridated water), and it was administered by two examiners.

Two trained and calibrated examiners blindly examined the children from both groups for the presence of fluorosis (k=0.85 for dental fluorosis). After a prophylaxis with paste and a rubber cup, the examinations were conducted with direct dental field lighting, an air syringe for drying, and a dental mirror and periodontal probe, as recommended by the World Health Organization.

To establish the presence and severity of dental fluorosis, all of the teeth that were directly in the field of study (permanent maxillary incisors) were dried with a stream of air for one minute with the help of relative isolation (cotton roll). The Thylstrup-Fejerskov index (TF) was used to quantify dental fluorosis (TF range=0 [without fluorosis] to nine [most severe grade of fluorosis]).

**Statistical analysis.** The processing of data and statistical analyses were performed using SPSS 18.0 software (SPSS Inc, Chicago, Ill., USA). In a bivariate analysis, the odds ratio was used to measure effects with a confidence interval of 95 percent. To analyze the association between the presence of fluorosis and the independent variables, a Pearson chi-squared test was used, and P-values equal to or less than .05 were considered statistically significant.

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<table>
<thead>
<tr>
<th>Feature</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>65</td>
<td>51</td>
</tr>
<tr>
<td>Female</td>
<td>63</td>
<td>49</td>
</tr>
<tr>
<td>Chi-square= 3.09; ( P = .08 )</td>
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<tr>
<td>Age (ys)</td>
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<td>9.8</td>
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<tr>
<td>Education of mother (ys)</td>
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<td></td>
</tr>
<tr>
<td>&lt;8</td>
<td>33</td>
<td>26</td>
</tr>
<tr>
<td>9-11</td>
<td>86</td>
<td>67</td>
</tr>
<tr>
<td>College</td>
<td>9</td>
<td>7</td>
</tr>
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<td>Chi-square= 10.01; ( P = .00 )</td>
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<td>Family income (minimum wage= US $330 per month)</td>
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<tr>
<td>&lt;1</td>
<td>71</td>
<td>55</td>
</tr>
<tr>
<td>2-3</td>
<td>51</td>
<td>40</td>
</tr>
<tr>
<td>&gt;4</td>
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<td>5</td>
</tr>
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<td>Chi-square= 2.02; ( P = .36 )</td>
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<td>Government assistance</td>
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</tr>
<tr>
<td>No</td>
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<td>48</td>
</tr>
<tr>
<td>Chi-square= 2.70; ( P = .10 )</td>
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</table>

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<table>
<thead>
<tr>
<th>Fluorosis N (%)</th>
<th>Crude odds ratio (95% confidence interval)</th>
<th>Adjusted odds ratio* (95% confidence interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>54 (41)</td>
<td>0.47 (0.28-0.77)</td>
</tr>
<tr>
<td>Group 2</td>
<td>78 (59)</td>
<td>1 .003</td>
</tr>
</tbody>
</table>

* Adjusted for level of education + gender.
were similar between groups; however. Group 1 mothers exhib-
water and fluoridated toothpaste; however. Group 2 parents
through generations, such as tooth decay and periodontal disease.

The aim of the PPPWB is to emphasise the adoption of
healthy oral habits in children, which can prevent and/or control
fluorosis. The prevalence of dental fluorosis was significantly higher in
Group 2), indicated the presence of a greater severity of fluorosis
between Groups 1 and 2 in terms of the severity of fluorosis, with
higher education levels (P<.05). Most of the study families re-
ceived federal aid, which indicated a low SES in the sample.

There was a significant difference in the prevalence of fluo-
rosis between Groups 1 and 2, with Group 1 experiencing less
fluorosis (-42 percent) than Group 2 (-61 percent; P<.05; Table 2). The odds ratio values were adjusted for education and
gender, as these were considered confounding factors for the
study. Additionally, there was a significant difference (P<.05) be-

Table 2). The odds ratio values were adjusted for education and

<table>
<thead>
<tr>
<th>Group 1</th>
<th>TF 0</th>
<th>TF 1</th>
<th>TF 2</th>
<th>TF ≥3</th>
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</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Group 1</td>
<td>74</td>
<td>60</td>
<td>25</td>
<td>43</td>
<td>22</td>
</tr>
<tr>
<td>Group 2</td>
<td>50</td>
<td>40</td>
<td>33</td>
<td>57</td>
<td>30</td>
</tr>
</tbody>
</table>

Chi-square=9.88; P<.02

* TF = Thylstrup-Fejerskov index.

Results

The children examined in both groups had similar demographic
characteristics (Table 1). Group 1 mothers, however, reported
higher education levels (P<.05). Most of the study families re-
ceived federal aid, which indicated a low SES in the sample.

There was a significant difference in the prevalence of fluo-
rosis between Groups 1 and 2, with Group 1 experiencing less
fluorosis (-42 percent) than Group 2 (-61 percent; P<.05; Table 2). The odds ratio values were adjusted for education and
gender, as these were considered confounding factors for the
study. Additionally, there was a significant difference (P<.05) be-

Discussion

This paper describes the impact of a dental program for maternal
and infant health (the PPPWB) on the prevalence of dental fluor-
rosis. The aim of the PPPWB is to emphasise the adoption of
healthy oral habits in children, which can prevent and/or control
the course of plaque-induced oral diseases that are perpetuated
through generations, such as tooth decay and periodontal disease.

As shown in Table 1, the sociodemographic characteristics
were similar between groups; however, Group 1 mothers exhib-
ited higher education levels. In general, the mother is the core of
the family, as she remains at home and has the greatest amount of
interaction with the children, thus influencing their habits
and behaviours. Therefore, mothers must be motivated to acquire
oral health knowledge to influence the well-being of their chil-
dren. The literature shows that higher education levels of
mothers correlate with better oral health for their children. Therefore, PPPWB mothers with more education were more likely to assimilate and employ the provided guidance.

There is a linear relationship between the consumption of
fluoride and dental fluorosis; however, as the prevalence of fluor-

odds ratio adjusted for education and gender, which was considered confounding factors in this study. Addition-
ally, children in both groups were exposed to fluoridated
water and fluoridated toothpaste; however, Group 2 parents
were not advised about the use of fluoride dentifrice and
its relation with fluorosis development. Teresina has a tropical
climate. The minimum temperature rarely drops below 20 degrees
Celsius. February has warmer temperatures, with highs of 32
degrees Celsius and lows of 22 degrees Celsius. Higher tempera-

tures extend from September to December, with an average
temperature of approximately 32.5 degrees Celsius, which
results in a larger intake of water by the population and
increases the exposure to fluoride. Therefore, the sum of
sources using fluoride explains the observed amount of
fluorosis.

The high prevalence of fluorosis found in both groups
can be credited to the accuracy of the tests, which were performed by polishing and drying the targeted teeth be-
fore the examination. These procedures disclose even mild
signs of hypomineralization. This condition, however, is
not often observed in the daily lives of individuals because
the teeth are always moist and mild hypomineralization
does not compromise esthetics. Consequently, the data
were more relevant to the researchers than to the patient
population.

The important role of fluoridated toothpaste in caries con-

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In addition to the prevalence of dental fluorosis, the degree and the severity of fluorosis were analysed. In Group 1, mostly milder degrees of fluorosis were observed, and the higher degrees of severity, TF3 and TF4, indicated the presence of a greater severity of fluorosis in Group 2 (Table 3). These findings may indicate that parents who are taught to be careful about the amount of fluoride their children ingest do, in fact, decrease the fluoride exposure for their children.

Despite the high prevalence of fluorosis in both groups, there was little or no aesthetic impact for nearly the entire sample, as scholars regard only TF3 or greater to be fluorosis with an aesthetic concern. Additionally, a gradual regression of the severity of the milder forms of fluorosis is expected due to the attrition and abrasion of the surface enamel. In public health, minor fluorosis, which would not compromise esthetics (as demonstrated in the literature), is more acceptable than decayed primary teeth. In addition to the prevalence of dental fluorosis, the degree and less severe fluorosis reported significantly higher education levels than control group mothers.

These findings support the recommended advantages of the careful supervision of preschool-aged children in their use of a small smear or a pea-sized amount of toothpaste when tooth-brushing. These results also urge parents to consult with a health professional before introducing fluoridated toothpaste to children younger than 24 months old so that parents can receive counseling on the most up-to-date practices, which have been tailored on the most up-to-date practices, which have been tailored.

Conclusions

Based on this study’s results, the following conclusions can be made:

1. Children whose parents participated in a dental program that included counselling on the proper amount of fluoridated toothpaste when their children were between zero and three years old presented less dental fluorosis and less severe dental fluorosis than a control group when examined at eight to 12 years old.

2. The mothers of children who experienced less fluorosis and less severe fluorosis reported significantly higher education levels than control group mothers.

Acknowledgment

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References


