Dental caries and related factors in Brazilian children from fluoridated and non-fluoridated areas

Cárie dentária e fatores relacionados em crianças brasileiras de região com água fluoretada e não fluoretada

Abstract

Purpose: To compare the caries prevalence, saliva buffering capacity (SBC), oral hygiene (OH), dietary habits, family income (FI) and frequency of visits to a dental office (Do) between Brazilian children living in areas with and without fluoridated public water supply.

Methods: Forty-six 5-7-year-old preschoolers were selected in Itatiba, SP, Brazil; 19 were from a fluoridated area, and 27 were from a non-fluoridated area. The caries index was determined according to the World Health Organization criteria, and the SBC was assessed by titration with hydrochloric acid. The FI, frequency of OH and visits to Do were estimated by questionnaire. The dietary habits were assessed with a diet chart. The differences between the groups were analyzed with Mann-Whitney-U tests ($\alpha=0.05$).

Results: Children from the non-fluoridated area showed significantly higher dmft/DMFT than those from the fluoridated area, but they showed significantly lower SBC, OH frequency and FI. No significant differences were observed between the areas for dietary habits and visits to Do.

Conclusion: Children from fluoridated areas showed higher salivary buffering capacity, family income and oral hygiene frequency as well as lower caries prevalence, supporting the beneficial effect of fluoride in the tap water for caries prevention.

Key words: Dental caries; fluoride; diet; saliva; buffers

Thaís Manzano Parisotto [a]
Luciana Maria P. da S. R. Fernandes [b]
Fabíola Galbiatti de Carvalho [c]
Eliete de Oliveira Coelho [d]
Marinês Nobre-dos-Santos [a]
Olga Maria M. de Faria Oliveira [e]
Sandra Regina Pombeiro Sponchiado [e]

[a] Department of Pediatric Dentistry, Piracicaba Dental School, University of Campinas, Piracicaba, SP, Brazil
[b] Department of Stomatology, Faculty of Dentistry of Bauru, University of São Paulo, Bauru, SP, Brazil
[c] Department of Dental Materials, Piracicaba Dental School, University of Campinas, Piracicaba, SP, Brazil
[d] City Hall of Itatiba, Itatiba, SP, Brazil
[e] Department of Biochemistry and Chemical Technology, Araraquara Chemical Institute, State University of São Paulo, Araraquara, SP, Brazil

Resumo

Objetivo: Comparar prevalência de cárie, capacidade tamponante da saliva (CTS), higiene bucal (HB), hábitos dietéticos, renda familiar (RF) e frequência de visita a consultórios odontológicos (Co) entre crianças brasileiras residentes em áreas de água de abastecimento público fluoretadas e não fluoretadas.

Metodologia: Quarenta e seis crianças entre 5-7 anos foram selecionadas em Itatiba-SP-Brasil, sendo 19 pertencentes à área fluoretada e 27 à área não fluoretada. O índice de cárie foi determinado de acordo com o critério da Organização Mundial de Saúde e a CTS foi medida por titulação com ácido clorídrico. A RF, frequência de HB e visita ao Co foram estimadas por questionário. Os hábitos dietéticos foram avaliados com diário de dieta. As diferenças entre as variáveis foram analisadas pelo teste de Mann Whitney ($\alpha=0,05$).

Resultados: As crianças da área não fluoretada apresentaram significativamente maior ceod/CPOD que àquelas da área fluoretada, porém significativamente menor CTS, HB e RF. Com relação a hábitos dietéticos e visitas ao Co, não foi observada diferença significativa entre as áreas.

Conclusão: As crianças da área fluoretada apresentaram maior capacidade tamponante da saliva, renda familiar e frequência de higiene bucal, assim como menor prevalência de cárie, reforçando o efeito benéfico do flúor nas águas de abastecimento para prevenir a cárie.

Palavras-chave: Cárie dentária; flúor; dieta; saliva; tampão

Introduction

Dental caries is an infectious-contagious disease that affects a large part of the world population. Together with fluorosis, periodontal disease and occlusal disorders, it is one of the main public health problems in Brazil (1).

The etiology of dental caries is multifactorial and mainly associated with cariogenic biofilm, inadequate diet and deficient oral hygiene (2). Socioeconomic and cultural factors (3) as well as saliva buffering capacity (4) are also involved in the process. Caries occurs when there is an imbalance between demineralization and remineralization of dental tissues. To prevent the pH from decreasing to a critical level, saliva contains specific buffer mechanisms such as bicarbonate, phosphate and some protein systems, which have a buffering effect that neutralizes the acids produced by bacteria and also have the ability to automatically eliminate certain bacterial components that require a very low pH to survive (5). Additionally, a high saliva buffer capacity may result in an elevated surface pH on the enamel interface, resulting in favorable conditions for mineral uptake (6) and consequent reduction in caries susceptibility.

The use of fluoride in tap water and toothpastes has led to a decline in caries prevalence and also to a nonuniform distribution of this disease, resulting in a polarization of caries prevalence such that many children do not have any caries, while a smaller group has a very high caries prevalence (7).

The population can be provided with fluoride in many ways: public water supply, topical application, mouth rinses, toothpastes and supplements. Fluoridation of the public water supply (tap water fluoridation) is one of the most effective public health measures related to caries prevention (8-10). Since 1974, tap water fluoridation has been mandatory in Brazil, but it has only been progressively implemented since the mid-1980s. Today, nearly one hundred million people in Brazil, more than 50 % of the entire population, drink fluoridated water (11).

There are many studies available in the scientific literature that compare dental caries prevalence in fluoridated and non-fluoridated tap water areas (12-14). However, few of them have considered caries-related factors that could also influence the oral health conditions in these areas, such as the buffer capacity of saliva, family income, oral hygiene, diet and visits to a dental office. The identification of factors associated with caries risk is very important to guide the implementation of effective public health preventive procedures. In this context, the purpose of this study was to compare the prevalence of caries, saliva buffering capacity, oral hygiene frequency, dietary habits and family income of Brazilian children living in areas with and without fluoridated tap water.

Methods

This study was approved by the Ethical Committee of Research of Piracicaba Dental School (Protocol number 015/2006), Piracicaba, SP, Brazil, in accordance with the ethical principles of the Helsinki declaration of the World Medical Association. In addition, informed consent was obtained from the children's parents.

Subjects

Forty-six children of ages 5 to 7 years living in Itatiba, SP, Brazil, were included. Children from this age range were chosen because an adequate volume of saliva without stimulation could be collected to perform the salivary buffering capacity analysis. The convenience sample consisted of children from the largest public school in the fluoridated area (urban) and the two largest schools in the non-fluoridated area (rural). All children of this age range were invited to take part in this research, but only those whose parents had signed the informed consent form were included. Among the 70 invited children, 35 were from the fluoridated area, and 35 were from the non-fluoridated area. Four children were not included because it was not possible to collect their saliva. Among the remaining 66 children, only 46 filled out the questionnaire and diet chart completely. Thus, the final number of the sample was 46 children, 27 from the non-fluoridated area (13 boys and 14 girls) and 19 from the fluoridated area (8 boys and 11 girls).

Caries assessment

To determine the number of decayed, missing and filled deciduous and permanent teeth (dmft/DMFT), each child, seated on a chair, was examined by one Public Service dentist from Itatiba, under natural light, with a mouth mirror and ball-ended probe, in accordance with the World Health Organization (WHO) criteria (15). Prior to the beginning of the study, theoretical discussions using clinical photographic slides were held to inform the examiner about the use of the criteria and the examination method. Then, training exercises were performed and replicate examinations were carried out on a random sample of 12 preschoolers, within one week. The intra-examiner reliability was calculated using Kappa scores and recorded as 0.92.

Collection of saliva

Approximately 5 mL of saliva was collected without previous stimulation in disposable plastic cups. Afterwards, it was transferred to glass tubes using disposable pipettes. These tubes were sealed and maintained in refrigerated boxes (4ºC) until the analysis was performed, in order to prevent the release of carbon dioxide, which could affect the pH measurements.

Analysis of salivary buffering capacity

Saliva buffering capacity (SBC) was assessed according to Ericsson's (16) (1949) method, by titration with 0.02 M hydrochloric acid until reaching approximately pH 4, as measured by a digital pH meter (Orion Analyzer Model 420A, USA). The SBC values were expressed as the total amount of hydrochloric acid (mL) consumed in the titration extrapolated to 100 mL of saliva.

Questionnaire/diet chart

The children's parents were asked to complete a standardized questionnaire to collect information about visits to a dental office and the daily frequency of their child's oral hygiene. Income data were obtained with the question, "How much is the family income per month?", and the values were expressed in Brazilian currency (1 real=half dollar). In order to determine the children's dietary habits, such as daily frequency of sweets (candies, cookies, chocolates), soft drink, fruit and vegetable consumption, the mothers were asked to fill out a diet chart for three consecutive days. Using this chart, the daily frequency of sweets, soft drink, fruit and vegetable consumption was calculated.

Statistical analysis

The data were tabulated, and scores were calculated for some of the quantitative and qualitative variables (oral hygiene frequency, dietary habits and visits to a dental office). The scoring scheme is shown in Table 1. Additionally, the mean and standard deviations were calculated for the dmft/DMFT index, SBC and family income data. The Mann-Whitney U test was performed in order to compare all the above variables between fluoridated and non-fluoridated areas, with a significance level of 0.05.

Results

Table 2 presents the dmft/DMFT index, family income and salivary buffering capacity of children from non-fluoridated and fluoridated areas. The data showed that the dmft/DMFT index in children from the non-fluoridated area was significantly higher compared with children from fluoridated area ($P<0.05$). Moreover, there was also a statistically significant difference between the children from the two areas regarding family income and salivary buffering capacity ($P<0.05$), with lower values in children from the non-fluoridated area (Table 2). As can be seen in Figure 1, about 19% of children from the non-fluoridated area were caries free, in comparison with 58% of those from the fluoridated area.

Table 1. Criteria for scoring qualitative variables used in this study.

Variables	Score 0	Score 1	Score 2	Score 3
Oral Hygiene	Unanswered question	1x/day	2x/day	3-4x/day
Sweets consumption	Less than 1x/day	1x/day	2-3x/day	4x/day or more
Soft drink consumption	Less than 1x/day	1x/day	2-3x/day	4x/day or more
Fruit consumption	Less than 1x/day	1x/day	2-3x/day	4x/day or more
Vegetable consumption	Less than 1x/day	1x/day	2-3x/day	4x/day or more
Visits to dental office	Unanswered question	No	yes	not determined

Table 2. Mean and standard deviations for the dmft/DMFT index, SBC and family income data in fluoridated and non-fluoridated areas.

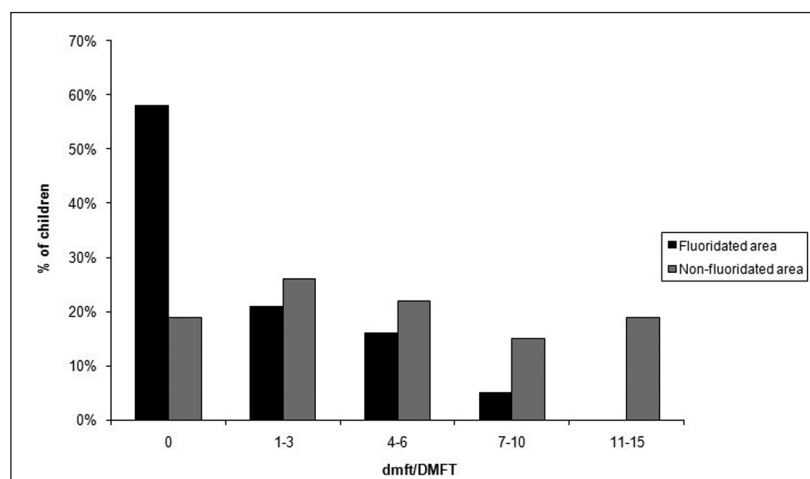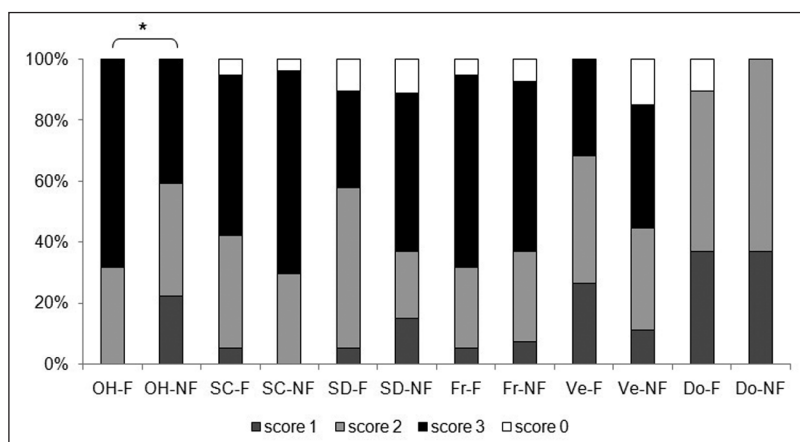| Variables	Fluoridated area mean±SD	Non-fluoridated area mean±SD	*P*-value
dmft/DMFT	1.6±2.4	5.2±4.7	0.004*
Family income (reais)	1126.3±946.8	566.3±397.4	0.032*
Saliva Buffering Capacity (mL HCL/100 mL saliva)	121.1±31.9	90.4±37.8	0.007*

* Statistically different values (*P*<0.05)

Fig. 1. Distribution (%) of the dmft/DMFT index for the children from fluoridated and non-fluoridated areas.

Fig. 2. Score percentages for oral hygiene (OH), sweets consumption (SC), soft drink consumption (SD), fruit consumption (Fr), vegetable consumption (Ve) and visits to dental office (Do) data in fluoridated (F) and non-fluoridated (NF) areas.

* Statistically different values (P<0.05).

Figure 2 summarizes the data related to daily frequency of sweets, soft drink, fruit and vegetable consumption, oral hygiene and visits to a dental office. The results confirmed that the oral hygiene frequency in the fluoridated area was significantly higher (*P*=0.047) than in the non-fluoridated. Moreover, there was no statistically significant difference (*P*>0.05) between the two areas concerning visits to a dental office and dietary habits.

Discussion

This study was conducted in Brazilian children from Itatiba-SP, Brazil. In this community, the water supply in the urban area has been optimally fluoridated since 1980 and its heterocontrol verified that the levels of fluoride ranged from 0.6 to 0.8 ppm during the present research. In contrast, the rural area is still deprived of water fluoridation, which may have contributed to the high dmft/DMFT index among children living in this area (Fig. 1). This result is in line with previous studies carried out in Brazilian and other communities demonstrating that children from fluoridated tap water areas have a lower caries index compared to children from areas with low or no fluoride concentration in the public water supply (8,9,13,17-19) (Table 2).

The difference in socio-economic status in fluoridated and non-fluoridated areas has already been reported in the literature. Peres et al. (3,9) verified that low income people in non-fluoridated towns were about 40% more prevalent, which is in agreement with our findings. It is also important to highlight that a significantly higher caries index was found in children from the non-fluoridated area, as well as a significantly lower family income (Table 2). In general, areas with a higher caries prevalence also have a lower income and lower human/child development index (3). Furthermore, Stephenson et al. (20) recently found that socio-economic class and fluoridation status were the strongest predictors of primary caries. Still, there are specific demographic aspects in the Itatiba non-fluoridated area, such as the geographic mobility of families during the harvest

time, that could lead to children's moving from one school to another, thus promoting conditions that are unfavorable to the implementation of self-care procedures. This lack of self-dental care may also have contributed to the higher caries index in the non-fluoridated area.

Concerning the saliva properties, although the salivary buffering capacity is inherent to each individual, the present study found significantly higher SBC values in children from the fluoridated area (Table 2). These children also showed a higher frequency of oral hygiene practices (*P*<0.05 – Fig. 2). The relationship between a higher frequency of oral hygiene practices and caries prevalence has already been verified (21). Regarding SBC, whereas some studies showed no relationship between SBC and dental caries (22,23), others demonstrated that there is an association between them (24,25). However, SBC in Brazilian children with different dmft/DMFT index values from fluoridated and non-fluoridated areas had never been tested before. The present investigation showed significant differences in SBC values and in the frequency of oral hygiene practices between children from the two areas (Table 2). This suggests that not only fluoride but also other factors inherent to the individuals should be considered for evaluating caries susceptibility. Because this was a preliminary study, further studies are necessary to confirm our findings.

Despite the fact that the availability of fruits and vegetables is higher in the non-fluoridated (rural) area and the access to sweets such as candies, chocolates and soft drinks is favored in the fluoridated area (urban), the urbanization process provides the development of local markets, leading to dietary changes. For this reason, the present study did not show significant differences in the daily frequency of sweets consumption between the two areas (Fig. 2).

In relation to visits to a dental office, there was no statistically significant difference between the two areas (Fig. 2). Although it is easier for people to visit a dental office in the fluoridated (urban) area, the Oral Health Department offered a mobile dental unit for dental assistance in the non-fluoridated area before this research began, which could

explain the lack of a statistically significant difference in visits. Moreover, the Itatiba Oral Health Program includes preventive procedures in schools of both regions.

The present results showed that water fluoridation may still be a relevant public health measure in the Brazilian rural population, where oral hygiene practices are poor and the lifestyle results in high caries prevalence. The results of this investigation may also be able to contribute to the strategic planning of the Oral Health Program in Itatiba and to guide oral health actions in children who do not have the benefit of fluoridated tap water.

One of the limitations of this study is that it was cross-sectional. Therefore, it did not consider the child's response to a specific factor during the disease development. In addition, the sample size may not be representative of the studied population and future studies should be conducted with a high number of children to reaffirm our findings.

Conclusions

In conclusion, the present study showed that children from the fluoridated area had higher salivary buffering capacity, family income and frequency of oral hygiene practices as well as lower caries prevalence. These results support the beneficial effect of fluoride in the tap water for caries prevention. This study was the first to show that there was a significant difference between the salivary buffering capacities of children living in fluoridated and non-fluoridated areas.

Acknowledgments

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