



Fluoride levels in public water supplies in districts of Maranhão, Brazil

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Abstract

Objective: To evaluate fluoride concentration in public water supply in locations of Maranhão State that, according to agency responsible, presents regular water fluoridation.

Methods: Water samples were collected from public schools. According to National Health Foundation (FUNASA), Water Treatment Station (WTS) of 14 rural cities and 03 WTS from Sao Luiz are supplied by the water supply system of state. The fluoride content of the analysis was performed using a specific electrode for fluoride. Three samples from each school were collected, totaling 42 samples of the rural cities and 45 samples from the capital.

Results: Most samples were below the optimal concentration, and only 14.28% of samples collected in the municipalities and 6.67% in Sao Luiz, had acceptable values of fluoride (0.6 to 0.8 ppmF).

Conclusion: Fluoridation of public water supplies (FPWS) is uncontrolled and therefore no preventive effect on caries. It is important to emphasize the need to implement control measures to ensure the ongoing effectiveness of FPWS in Maranhão State.

Key words: Fluoridation; Water supply; Water quality control

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Fluoretação da água de abastecimento público em municípios do estado do Maranhão, Brasil

Resumo

Objetivo: Avaliar as concentrações de flúor na água de abastecimento público em localidades do Estado do Maranhão cujos órgãos responsáveis consideram a fluoretação da água de abastecimento público regular.

Métodos: As amostras foram coletadas em escolas da rede pública de ensino. De acordo com a FUNASA, estações de tratamentos de água (ETAs) em 14 municípios do interior do estado do Maranhão e 03 ETAs da capital, São Luís, possuem água de abastecimento público fluoretada. As análises do teor de flúor foram realizadas utilizando-se um eletrodo específico para fluoretos, totalizando 42 amostras dos municípios do interior e 45 amostras de São Luís, coletadas no primeiro semestre de 2011.

Resultados: A maioria das amostras ficou abaixo da concentração ideal. Apenas 14,28% daquelas coletadas nos municípios do interior e 6,67% na cidade de São Luís apresentaram valores aceitáveis de flúor (0,6 a 0,8 ppmF).

Conclusão: A fluoretação da água de abastecimento público (FAAP) no estado do Maranhão precisa de ajustes para que possa garantir o efeito do controle da doença cárie nessa população. Esses dados justificam a necessidade de implementação de medidas de controle permanente para garantir a eficácia da FAAP no Maranhão.

Palavras-chave: Fluoretação; Abastecimento de água; Controle da qualidade da água

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Introduction

Water fluoridation is recognized as an important factor in decline of the prevalence of dental caries [1-3]. It has better cost-benefit as public health measure [3-5] in addition to be a democratic means in controlling the disease, since its effect transcends race, ethnicity, religion and socioeconomic differences [2,4].

Several studies show a significant reduction in both prevalence and severity of dental caries after controlled fluoridation of the public water supply [3,4,6-9].

A Brazilian Federal Law was created in 1974 to make compulsory water fluoridation in public water supply systems in the country [10]. The limits of fluoride ion concentration in the water supply should be an average of the maximum air temperatures, being that the fluoride levels considered “great” for the prevention of dental caries should have, for the most part of Brazil, 0.7 ppm F [11].

Water fluoridation should be monitored so that the fluoride content remains within the appropriate standards for the control of caries [2,5,12]. It is noteworthy that so there is reduction of dental caries, it is necessary that fluoridation is uninterrupted [5,13].

Another aspect to be observed in water fluoridation is that your excess is a risk factor for fluorosis [14-16]. This disturb occurs during the formation of dental enamel leading to staining due to the continuous intake of fluoride [14]. The prevalence of fluorosis according to the last National Oral Health Survey (SB Brazil 2010) is around 16.7%, although its manifestation is in very light (10.8%) to slight levels (4.3%) [17], which would have little aesthetic relevance [16].

An external control study of fluoridation of public water supply (FPWS) in 29 cities of Sao Paulo showed that the number of the samples with uneven amount of fluoride was too high [14].

The wide range of fluoride concentration in samples of Water Treatment Stations (WTS) and municipalities reinforces the importance of external monitoring of FPWS. This facilitates operational control in cities and contributes to the promotion of oral health and increased quality of life for residents [12].

Maranhão has an annual average temperature around 86 F, which makes it necessary, by regulation, a concentration ranging from 0.6 to 0.8 mg of fluoride per liter of water to be effective in caries prevention [11].

The São Luiz Island is fueled by six different WTS: Italuís, Paciência, Sacavem, Olho D’Água, Cururuca and System of São José de Ribamar, with only the first three would be fluoridated [18] (Table 1). Studies by Carmo (2007) [18] and Paredes (2009) [19] found that FPWS in São Luiz Island needed adjustments, particularly in the suburbs.

Maranhão has, besides the capital, 14 another municipalities with fluoridation of the public water supply, according to the National Health Foundation (FUNASA) [20].

For the sake of comprehensiveness and efficiency offered by the preventive method of adding fluoride in the public water supply, mainly in underdeveloped socioeconomically regions, it is essential to know the present situation of FPWS in Maranhão. In addition to previous studies showing a deficit in fluoride levels in the capital, there are no external control studies of fluoride levels in other municipalities within the state.

The purpose of this study was to evaluate the fluoride concentrations in drinking water in 15 municipalities of Maranhão – Brazil which, according to the responsible agencies, have fluoridated water supply.

Methods

In order to perform the fluoride levels of external control in the public water supply of the São Luiz – MA, a sample stratified was applied. The first pre-stratification referred to the supply systems; the second, participants neighborhoods of each WTS. Fifteen different districts of the city was selected to check the fluoride concentrations: Angelim, Apicum, Camboa, Centro, Cohama, Cohab I, Cohab II, Cohab III, Cohafuma, Jaracati, João Paulo, Madre Deus, Monte Castelo, Renascença II e Turu.

In each of the 14 municipalities in the state that, according to FUNASA, distribute fluoridated water for the population, was randomly selected a school in the public system to external control.

Table 1. Water treatment plants that supply the city of Sao Luiz with their neighborhoods and fluoride level reported by Water Company and Sewage (CAEMA).

System of supply	Neighborhood	Fluoride level reported by CAEMA
WTS Italuís	Sao Francisco, Ponta da Areia, Ponta do Farol, Renascença I, Renascença II, Vinhais, Bequimão, Angelim, Cohama, Altos do Calhau, Maranhao Novo, Ipase, Recanto dos Vinhais, Cohafuma, Ilhinha, Porto do Itaqui, Jaracati, Olho D’água, Turu, Vila Luizão, Sol e Mar, Araçagi.	0,7 mg/L
WTS Paciencia	Cohab I, II, III e IV; Cohatrac I, II, III e IV.	0,7 mg/L
WTS Sacavem	Centro, Madre Deus, Goiabal, Retiro Natal, Monte Castelo, Joao Paulo, Liberdade, Floresta, Alto da Boa Vista, Vila Passos, Camboa, Diamante, São Pantaleao, Macauba, Coreia, Tome de Sousa, Vila Bangu e Apicum.	0,7 mg/L

A sample was collected every month for a quarter, respecting rigorously predetermined points. It used the following collection protocol: I) The vials with samples of water were properly identified (place, date of collection, collector's name) and transported through the mail, in case of samples from the countryside cities; II) Each school had its collaborator responsible for collect from a faucet attached directly to the water meter to the public water supply of the supply reservoirs Company, without going through water tanks or cisterns; III) The samples were placed in bottle hermetically sealed and transported for analysis at the Laboratory of Oral Biochemistry, Federal University of Maranhão.

We used the Orion electrode (Thermo Scientifics, Beverly, Massachusetts, USA) specific to the fluoride ion coupled to ORION 4-Star analyzer (Thermo Scientifics, Beverly, Massachusetts, USA) to determine the concentration of this ion in water. After made up a calibration curve with standard solutions 0.04 to 0.5 ppmF, the reading of the samples was analyzed in mV and transformed to ppm through Excel spreadsheet software (Microsoft, Redmond, Washington, USA).

Samples containing fluoride concentration between 0.6 and 0.8 ppmF were considered appropriate; those with levels below 0.6 ppmF or with a concentration above 0.8 ppmF were considered inadequate. The samples that showed much lower fluoride 0.1 ppmF were considered non-fluoridated.

Results

The results are shown in Tables 2 and 3. From the samples of São Luis Island, only one district (Jaracati) fueled by WTS Italuís, was within the acceptable range of fluoride concentration (0.6 and 0.8 ppmF). The six districts that receive water from the WTS Sacavem (46.63%) and the three who receive water from the WTS Paciência (20%) showed levels of fluoridation inadequate (<0.6 ppmF). No one São Luiz WTS presented fluoride concentrations greater than 0.8 ppmF (Table 2).

Compared to other cities analyzed, it was observed that only Barreirinhas and Caxias (14.28%) had optimal fluoride concentration (0.73 and 0.69 ppmF, respectively). Arari, Itapecuru Mirim, Pedreiras and Pinheiro presented inadequate samples (28.57%). It was also observed that samples of two municipalities (Bacabal and Vitoria do Mearim) had fluoride concentrations above the appropriate. The other municipalities (42.85%) – Barão de Grajau, Barra do Corda, Carolina, Colinas, Imperatriz e Timbiras – showed fluoride concentrations less than 0.1 ppmF, content considered as the absence of fluoride (Table 3).

Discussion

A direct relationship between the low purchasing power of the population and the risk of dental caries has been shown in the literature [21-23].

Table 2. Fluoride concentration (ppm) in the water supply in the fifteen districts evaluated in Sao Luiz (mean±SD).

Treatment Station	Collection Site	Mean ppm (±sd)
ITALUÍS	Renascença II	0,25 (±0,33)
	Angelim	0,13 (±0,32)
	Cohama	0,28 (±0,43)
	Cohafuma	0,54 (±0,01)
	Jaracati	0,67 (±0,06)
	Turu	0,23 (±0,21)
PACIENCIA	Cohab I	0,30 (±0,05)
	Cohab II	0,10 (±0,13)
	Cohab III	0,32 (±0,08)
SACAVEM	Centro	0,35 (±0,08)
	Madre Deus	0,17 (±0,20)
	Joao Paulo	0,49 (±0,15)
	Monte Castelo	0,22 (±0,27)
	Apicum	0,47 (±0,30)
	Camboa	0,46 (±0,04)

Table 3. Fluoride concentration (ppm) in the water supply in fourteen municipalities evaluated in Maranhao, Brazil (mean±SD).

Municipalities	Mean ppm (±SD)
Arari	0,35 (±0,03)
Bacabal	0,95 (±0,29)
Barao de Grajau	0,05 (±0,01)
Barra do Corda	0,01 (±0,05)
Barreirinhas	0,73 (±0,09)
Carolina	0,06 (±0,01)
Caxias	0,69 (±0,15)
Colinas	0,07 (±0,02)
Imperatriz	0,07 (±0,01)
Itapecuru Mirim	0,30 (±1,02)
Pedreiras	0,57 (±0,02)
Pinheiro	0,32 (±0,02)
Vitoria do Mearim	0,87 (±0,16)
Timbiras	0,05 (±0,00)

According to the SB Brazil 2010 [17], the average DMFT index in Northeast was 2.63 while in the Southeast this value dropped to 1.72. Also according to this study, in São Luiz the DMFT index in 12 years was 2.66. The lowest rate in the country was found in Florianópolis, corresponding to 0.77.

From 2005 to 2007, the Maranhão State had the second worst brazilian HDI [24]. Considering the low levels of human development and high DMFT index of Northeast Brazil, FPWS presents itself as an ideal way to promote oral health in the region.

In accordance with the results of the SB Brazil 2010, this research observed in samples of São Luiz, a high percentage of inadequacy (93.33%) according to the established criteria.



This result confirms previous studies that also showed high percentage of inadequate samples in the state capital [18,19]. The results of this study demonstrate that FPWS in São Luiz remains inadequate.

Two WTS (Paciência and Sacavem) did not have minimum levels of fluoride in the water in any of samples. These stations supply outskirts of the capital. The result of unsatisfactory fluoridation extends to twelve of the fourteen municipalities located in State included in study. The fluoridation of drinking water is an important mechanism for the prevention of caries, especially for populations with low purchasing power [5], often has no access to toothpaste or dental care.

The results relative to other municipalities showed that the lack of fluoride levels in the state is widespread. Only two municipalities (Barreirinhas and Caxias) presented samples with fluoride within appropriate levels for the prevention of caries [11]. The municipalities that presented above adequate fluoride concentration also require adjustments to avoid dental fluorosis [14].

Conclusion

After assessing the fluoride content of the PWS in municipalities in Maranhão State, it is possible to state that FPWS need adjustments to ensure the effect of the control of caries in this population.

It is hoped that knowledge of these results motivate social control of this measure in state, emphasizing the importance of preventive method for public health dentistry in order to monitor and ensure a right guaranteed in Brazil by Law since 1975.

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