Fluoride content monitoring of the public water supply of the Northwest area of the state of São Paulo, Brazil: 36-month analysis

Vigilância do teor de flúor nas águas de abastecimento público de municípios do noroeste paulista, Brasil: 36 meses de análise

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Abstract

Purpose: Water fluoridation is a safe, comprehensive, effective and economic means of controlling caries. The responsibilities for monitoring the levels of fluoride in drinking water are set out by the Brazilian Ministry of Health in 2004. The objective of this study was to analyze the fluoride content of the public water supply in eight districts of the northwestern area of the state of São Paulo for 36 months.

Methods: Three major points of collection for each city were chosen, considering that all have unique sources of public water supply. Samples were collected once a month on weekdays at previously established points and were analyzed in duplicate on a monthly basis from November 2004 to October 2007 in the laboratories of the Center for Research in Public Health of the Postgraduate Program in Preventive and Social Dentistry (NEPESCO) of the School of Dentistry of Araçatuba – UNESP, using an ion analyzer attached to an electrode specific for fluoride. The results were sent monthly to the municipalities.

Results: Of the total samples (n = 864), 77.4% had adequate levels of fluoride (n = 669) and 22.6% had inadequate levels (n = 195), of which 19.8% (n = 171) were below and 2.8% (n = 24) were above the recommended level. There was variation in samples collected at the same point of collection over time and between points in the same municipality.

Conclusion: These results highlight the importance of monitoring fluoride levels in public water supplies so that the population can enjoy the benefits of this preventive method.

Key words: Fluoridation; fluoride; systemic fluoridation; oral health

Resumo

Objetivo: A fluoretação da água é um método seguro, abrangente, eficaz e econômico de controle da cárie. As responsabilidades da vigilância dos teores de flúor nas águas de abastecimento são estabelecidas na portaria n0518 de 2004. O objetivo deste trabalho foi analisar o teor de fluoreto das águas de abastecimento público, durante 36 meses, de oito municípios do noroeste do Estado de São Paulo.

Metodologia: Definiram-se três pontos de coleta para cada município, considerando que todos possuem fonte única de abastecimento público. As amostras foram coletadas uma vez ao mês em dias úteis nos pontos previamente estabelecidos e analisadas mensalmente em duplicata no período de novembro de 2004 a outubro de 2007, no laboratório do Núcleo de Pesquisa em Saúde Coletiva do Programa de Pós-Graduação em Odontologia Preventiva e Social (NEPESCO) da Faculdade de Odontologia de Araçatuba – UNESP, utilizando-se um analisador de íons acoplado a um eletrodo específico para flúor, sendo os resultados encaminhados mensalmente aos municípios.

Resultados: Do total das amostras (n = 864), 77,4% apresentaram teores adequados (n = 669) e 42,6% inadequados (n = 195), sendo 87,7% abaixo (n = 171) e 12,3% acima (n = 24) do recomendado. Houve variação no mesmo ponto de coleta ao longo do tempo e entre os pontos em um mesmo município.

Conclusão: Existe variabilidade nas concentrações dos mesmos pontos de coleta em diferentes meses e entre os pontos de mesmo mês, evidenciando a importância da vigilância para que a população usufrua dos benefícios deste método preventivo.

Palavras-chaves: Fluoretação da água; flúor; fluoretação sistêmica; saúde bucal

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Received: February 6, 2009
Accepted: August 26, 2009

Introduction

The role of dentists in health monitoring requires specific technical and scientific knowledge as well as social sensitivity; it requires sharing with other team members the identification of health risks and health hazards, joining planning efforts and taking responsibility for prioritizing and addressing identified problems. In order to do this effectively, dental practitioners must incorporate knowledge from other areas and develop new skills and abilities in order to scientifically justify their daily practice and enhance the credibility of their actions (1).

The practice of health monitoring will achieve its intended goals only with an effective integration of the healthcare team with society and other government sectors. The importance of intersectoral action in solving the problems of collective health is thus recognized. This novel approach to work, government and construction of public policy seeks to overcome the fragmentation of knowledge and social structures and thus produce more significant effects on population health (2).

Given the important role that can be played by the dentist in society about the methods of prevention and health plans, the monitoring of fluoride levels for the prevention of caries becomes a relevant factor to be considered carefully by the Health Service in conjunction with dental professionals.

Fluoridation of water supplies is the most safe, effective, simple and economical method available to control caries, resulting in a significant reduction in the incidence of caries. In Brazil, fluoridation of public water supplies was introduced in 1953 in Baixo Guandu in the State of Espírito Santo. The water supply service was operated by the Foundation of Special Services in Public Health (SESP) of the Ministry of Health (3). In 1975, the adoption of Federal Law No. 6050 established the requirement of fluoridation in public water supplies in areas where treatment plants exist (4); often, however, in some locations, a lack of attentivenessin controlling the levels of fluoride in the water supply is evident.

Ordinance No. 518, issued by the Ministry of Health in 2004, establishes procedures and responsibilities relating to control and monitoring of the quality of water for human use (5). The establishment of the optimal level of fluoride in water depends on the purity and type of salt by means of which fluoride is added to water, the amount of fluoride that already exists in the water and the average annual maximum temperature, which affects the amount of water consumed by the population (6).

Studies by Dean et al. (7) allowed us to conclude that, as the level of fluoride naturally existing in water increases from 0.01 mg F/L (milligrams of fluoride per liter), the number of teeth attacked by decay decreases. When the content exceeds 1 mg F/L, the teeth begin to show signs of fluorosis, which progressively increase with increasing fluoride content. Over 1 mg F/L, the reduction in the number of teeth attacked by caries is not very significant (7,8). Mechanisms that result in the appropriate concentration of fluoride in water are indispensable for the measure to have significant impact on the prevention and control of caries without increasing the prevalence of dental fluorosis (8.9). Some studies have been conducted that link fluoridated water with the occurrence of dental fluorosis. Catani et al. assessed the prevalence of dental fluorosis in seven-year-old subjects in two municipalities in the state of Sao Paulo with different concentrations of fluoride in their public water supplies and found that the prevalence of fluorosis, predominantly mild, was higher in children of the city with better control of fluoride levels in water, compared to the expected levels in locations with appropriate levels of fluoride in drinking water. However, the study did not address associations with exposure to other sources of fluoride (10). Thus, it is important to note the increasing prevalence of dental fluorosis that has occurred in recent decades, both in cities with fluoridated water or not, due to extensive use of other forms of fluoride (11).

In addition to operational control performed by the sanitation company, it is important that national health surveillance or other institutions, public or private, carry out external control. External control is the control and periodic review of fluoridation by an institution other than the controller and water supply (8). In order to be able to achieve the desired results and to prevent unwanted effects by overdose, as well as to avoid underdosing, rigorous process control is required (9). Many small and medium-sized cities encounter difficulties in obtaining information about the content of fluoride in the water supply to the population due to the lack of laboratory infrastructure and technical basis needed to perform periodic reviews.

The objective of this study was to analyze the content of fluoride in public water supplies in eight municipalities using a single water supply system belonging to the northwest of the state of Sao Paulo, by determining whether the added amounts are within the parameters recommended as well as by assessing the existence of variations in the concentrations of fluoride over a period of 36 months.

Methodology

The cities chosen were those in the DRS II (Regional Health Department II), which has a unique system of public water supply, that sent specimens to the laboratory at the Center for Research in Public Health in the Postgraduate Program in Social and Preventive Dentistry (NEPESCO), School of Dentistry of Araçatuba – UNESP during the 36 months of collection. The survey included the municipalities of Alto Alegre, Bento de Abreu, Coroados, Gabriel Monteiro, Lourdes, Piacatu, Sud Mennucci, and Turiúba, located in the northwest area of the state of São Paulo.

According to information provided by those responsible for the public water supply, all the cities included in the study have fluoride added artificially to their public water supplies through the addition of fluosilicic acid. The study covers 36 months of analysis over the period from November 2004 to November 2007. The sampling points were identified according to the number of existing renewable water supply

stations or water treatment plants (WTP), considering the district water distribution maps for the chosen points so that they would be representative and would cover all regions thereof. Three points of collection were defined for each city, considering that all municipalities have chosen a single source of public water supply. The choice of addresses was made by random selection (drawing) of the streets of each city, thereby giving each home an equal chance to participate as a sample point.

Samples were collected once a month on weekdays at previously established points and were analyzed in duplicate on a monthly basis in the laboratory of NEPESCO School of Dentistry of Araçatuba – UNESP; a total of 24 points were analyzed each month. The samples were analyzed by the technical team within a maximum of seven days.

Analysis of fluoride concentration in water was performed using an ion analyzer (Orion Model 710-A, Orion Research Inc., USA) attached to a specific fluoride electrode (Orion model 9609, Orion Research Inc., United States). The calibration of the equipment was performed in triplicate with the aim of reducing the margin of error, taking into account the expected values for the samples with standards ranging from 0.1 to 2.0 mg F/L. For standards, we used dilutions from a standard solution of fluoride at 100 mg/l (Orion, 940907). To a volume of 1 ml of each standard was added 1 mL of "Total Ionic Strength Adjustor Buffer (TISAB II), a buffer, ionic strength and decomplexant widely used in the analysis of fluorine (3). The values obtained in the readings of duplicate samples with added TISAB II (1:1) were transferred to a spreadsheet in Microsoft Excel and converted from mV to mg F/L.

Concentrations of fluoride in water samples were classified according to the average annual temperature. Thus, levels between 0.6 and 0.8 mg F/L were considered adequate, while samples with concentrations above or below these values were considered inadequate (12).

Results

From November 2004 to October 2007, monthly samples from 24 water collection points of eight cities studied (864 total samples) were analyzed. Table 1 shows the number and percentage of samples classified as adequate and inadequate according to the fluoride concentration of the public water supply of each of the cities studied. We note that Gabriel Monteiro was the city with the highest percentage of samples with fluoride levels classified as adequate, 94.4% (n=102), while Turiúba had the lowest percentage, 60.2% (n=65).

Figure 1 shows that of 864 samples analyzed in this study, 77.4% (n=669) had fluoride levels considered appropriate, while 19.8% (n=171) had low values and 2.8 % (n=24) showed fluoride levels above the recommended values.

Figure 2 shows the minimum and maximum concentrations of fluoride (mg F/L) in the water samples analyzed; Gabriel Monteiro was the city with the lowest variation (0.37 mg F/Lwhile Bento de Abreu showed the maximum variation (1.10 mg F/L). No samples below 0.10 mg F/L or above 1.20 mg F/L were found.

Table 1. Conditions of the samples according to the concentration of fluoride in the public water supply. Cities of the northwest of the state of São Paulo/SP, 2008.

Cities	Fluoride concentration						Total	
	Adequate*		Below		Above			
	n	%	n	%	n	%	n	%
Alto Alegre	92	85.2	14	13.0	02	1.9	108	100
Bento de Abreu	77	71.3	27	25.0	04	3.7	108	100
Coroados	92	85.2	08	7.4	08	7.4	108	100
Gabriel Monteiro	102	94.4	04	3.7	02	1.9	108	100
Lourdes	77	71.3	28	25.9	03	2.8	108	100
Piacatu	90	83.3	16	14.8	02	1.9	108	100
Sud Mennucci	74	68.5	33	30.6	01	0.9	108	100
Turiúba	65	60.2	41	38.0	02	1.9	108	100
Total	**669**	*	**171**	*	**24**	*	**864**	*

* Samples with 0.6 to 0.8 mg F/L (5).

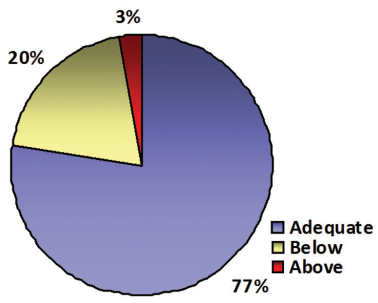

Fig. 1. Percentage distribution of samples according to the fluoride concentrations in the public water supply. Cities of the northwest of the state of São Paulo/SP, 2008.

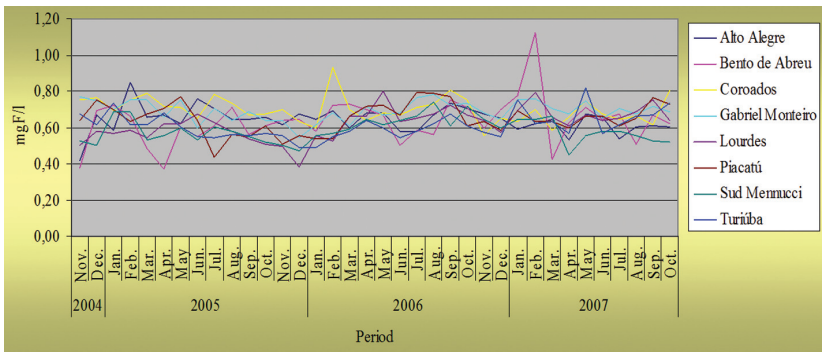

Fig 2. Variation of the fluoride concentration in the public water supply (mg F/L) in the cities of the northwest of the state of São Paulo/SP, 2008.

Discussion

The effect of fluoridation of public water supplies on the reduction of dental caries has been shown in many epidemiological surveys carried out in Brazil. In a study in the Baixo Guandu, the prevalence of caries in permanent residents was lower than in the rest of the Brazilian population; this area showed a DMFT index 82% lower than before the start of fluoridation 52 years ago. We can thus prove that the addition of fluoride to the public water supply was an important ally for improving the oral health of the inhabitants of this city (9). Such findings demonstrate the importance of the fluoridation of public water supply in the control of dental caries and show that this service provides health benefits to the general population. The same can be observed in a large study on the distribution of caries that included 34,550 children in 249 Brazilian cities. In this study, we evaluated differences in caries rates between cities with and without fluoride in the drinking water; the results showed that water fluoridation is associated with better control of dental caries and demonstrated that this is an important strategy that is highly effective in reducing caries rates (13).

Maintaining optimum levels of fluoride in the public water supply is indicated by all researchers as essential to achieving the maximum benefit of the method, and the steady control of fluoridation is very important to ensure that the purpose of fluoridation is reached. Ordinance 1469 of 29 December 2000 states that the control of fluoride levels in the output of each station should be performed daily (14). One study, which covered two years of the fluoridation control program of the public water supply in Pelotas, showed that approximately 50% of the collected did not have optimal levels of fluoride and that there was great variation among the samples (6). In Niterói-RJ, it was verified by means of operational control that the public water supply showed significant variation in fluoride concentration (0.03 to 1.49 mg F/L), with 96% of samples having inadequate amounts. Thus, one can verify that the operational control of water fluoridation has not been adequate to maintain optimal levels of fluoride in public water supplies (15). In graph 2, variation in the concentration of fluoride in public water supplies can also be observed; samples collected in the city of Bento de Abreu showed the most variation, with values between 0.10 and 1.20 mg F/L. In this context, the need for greater effort on the part of health surveillance systems becomes evident, since large variations can be avoided with the fluoridation of public water supply performed safely and reliably. High variability can also be observed in the study carried out in Lages, SC, where it was found that after twelve months of external control, 45.8% of water samples collected had inadequate levels of fluoride (16). The study of Silva et al., which analyzed the fluoridation of water in three cities in Piauí, Brazil over a 12-month period (17), found that only 4.3% of the samples measured had fluoride concentrations considered acceptable. Inadequate fluoride levels were also reported by Barros et al. in a thirteen-year study conducted in Porto Alegre-RS (18). In this study, the percentage of points analyzed with concentrations of fluoride in public water supply is considered adequate in 77.4% (Fig. 1), a fact that reaffirms the need for better monitoring of fluoridation in these towns.

Table 1 shows that, except for the municipality of Coroados and considering only those values considered inadequate, all municipalities have fluoride concentrations lower than the recommended in higher percentage when compared to values considered being higher than recommended. This fact indicates that the population is less exposed to the impact of prevention of dental caries because fluoride levels in the public water supplies of these cities are inappropriate to produce the desired preventive effect.

According to the findings of this study and other findings reported in the literature, it can reasonably be concluded that a considerable number of municipalities do not control the fluoridation of their public water supplies properly, proving the necessity of monitoring and correcting the entire process.

Conclusions

The concentration of fluoride in the public water supply of many of the municipalities analyzed was classified as inadequate and does not offer the desired benefit, exposing the population to the risk of dental fluorosis. There is great variability in the concentrations of fluoride, making it necessary to better control water quality operations in the municipalities, so that people will receive the benefits offered by this preventive method.

Acknowledgments

This study was supported by CAPES – Ministry of Education, Brazil.

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