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Total fluoride intake in children aged 22–35 months in four Colombian cities

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Abstract – Objective: To obtain information on the level of total fluoride intake from food, beverages and toothpaste by children at the age of 22–25 months of low and high socioeconomic status (SES) in major Colombian cities. *Methods:* Daily fluoride intake was assessed by the duplicate plate method and by recovered toothpaste solution during a 3-day period and afterwards analysed by the microdiffusion method. *Results:* Mean daily fluoride intake was 0.11 (±0.10), 0.14 (±0.12), 0.10 (±0.07) and 0.07 (±0.06) mg/kg body weight (bw)/day in Bogotá, Medellín, Manizales and Cartagena, respectively. The total fluoride intake was higher in low-SES subjects in the cities of Medellín and Bogotá. In the high-SES children of the four cities, the average intakes ranged from 0.06 to 0.09 mg F/kg bw, whereas, the low-SES children in three cities had intakes between 0.11 and 0.21 mg F/kg bw (Cartagena, 0.07). Toothpaste (containing 1000–1500 ppm F, with 1500 ppm F being more common) accounted for approximately 70% of total fluoride intake, followed by food (24%) and beverages (<6%). More than half the children had their teeth brushed by an adult, on average twice a day, using 0.22–0.65 g of toothpaste. *Conclusion:* Children from three Colombian cities have a mean total daily fluoride intake above the 'optimal range'. Health authorities should promote an appropriate use of fluoridated dentifrices discouraging the use of dentifrices containing 1500 ppm F in children younger than 6 years of age and promoting a campaign of education of parents and oral health professionals on adequate toothbrushing practices.

Key words: children; dietary fluoride; fluoride intake

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In 1998, the mean DMFT of 12-year olds in Colombia was 2.3 (1), a reduction of 2.5 since 1978 (2). At the same time, the prevalence of dental fluorosis was reported to be 25.7% in 6–7-year olds which is consistent with recent reports from other countries such as Mexico, Saudi Arabia, Chile and USA (3–6). These trends have prompted some institutions to recommend further investigations on the total fluoride exposure of children under 8 years of age (6–8).

Traditionally, the estimation of the mean total daily fluoride intake (TDFI) has been achieved through the calculation of fluoride in the average diet (9–14). Currently the 'duplicate plate' method is considered to be the most accurate (15–17).

It has been suggested that the 'optimal dose range' of fluoride intake is 0.05–0.07 mg F/kg bw/day although several authors have indicated that it could be lower (8, 18). Moreover, although many studies have found that the majority of children ingest amounts of fluoride within this optimal range, a substantial proportion of children exceed it (19–21).

Fluoridated toothpastes were first introduced in Colombia in the 1970s and a salt fluoridation programme in 1989. The most common fluoridated dentifrices in Colombia are sold over the counter and their fluoride concentrations are in the range of 1000–1500 ppm F. The target F concentration of salt lies in the range of 180–220 mg F/kg (22–23). Fluoridated mouth rinses were used massively in school programmes between 1980 and 1995; currently they are available commercially but most of the population does not have access to them because of its costs; among high socioeconomic status (HSES) population which has access to them, they are not used at such an early age. Dietary fluoride supplements on the other hand are not available and are not recommended.

This study was performed in order to assess the total mean fluoride intake from foods, beverages and toothpaste in children aged 22–35 months, from the cities of Bogotá, Medellín, Manizales and Cartagena.

Materials and methods

Subjects

Prior to initiating this study, institutional approval from the Bioethics Committee of the Health Sciences Institute (CES) was obtained. The study population consisted of 118, 22–35-month-old healthy children with similar, low-F drinking water supplies, both genders, from low socioeconomic status (LSES) and HSES, attending either the Colombian Family Well-being Day-care Centers (DCC) (LSES) or private DCC (HSES) in the cities of Bogotá, Medellín, Manizales and Cartagena. The parents were informed of the project and gave their consent for their children to participate.

For the LSES, the sample was probabilistic, clustered and stratified: probabilistic, because each child from the studied universe had a known selection probability; clusters constituted by the children concentrated in a limited number of DCC, in order to reduce costs, admitting a slight increase in the sample error; and stratified, by the geographical localization of the DCC in the cities according to SES and age. A randomized final selection was made based on a listing of the centres in each city. For HSES, the type of sample was non-probabilistic (convenience), given that data collection required high cooperation from parents, which is not usual in the HSES of this country. In order to improve the representativeness, HSES centres were selected based on criteria such as tuition costs, family income and geographical location.

Study cities

Four cities were selected for this study. In Bogotá, the average drinking water fluoride concentration is 0.08 ppm. Medellín is the only city which preserves an annual oral health prevention programme based on education and fluoridated mouth rinses in public schools since 1981, and its drinking water contains an average F concentration of 0.05 ppm. Manizales, like Medellín is located in the Central Andes, and is characterized by an unusual and unexplained high prevalence of dental fluorosis (72% in school aged children between 8 and 11 years, with a Thylstrup-Fejerskov Index (TFI) = 1–4) (1), although the drinking water F concentration is 0.08 ppm. Cartagena is located in the coastal region of Colombia, presenting one of the highest average temperatures in the country and its drinking water has an average F concentration of 0.08 ppm.

Field studies

In order to determine the fluoride intake from foods and beverages through the duplicate plate technique, a duplicated sample from all the ingested foods and beverages at DCC, homes, restaurants or homes of relatives, was collected over 3 days (two weekdays and one weekend day). The collection was done for each participating child by auxiliary personnel in the DCC and by their parents or the person in charge in the child's house, both with previous training which consisted of a demonstration of the procedure followed by supervision of the first duplication done at home.

In order to determine the fluoride intake from toothpaste the following steps were followed: (i) the amount of toothpaste used was assessed weighing the toothbrush and then the toothbrush with toothpaste; (ii) the amount of fluoride of the toothpaste used was determined by microdiffusion analysis from a toothpaste sample used by each child; (iii) the amount of noningested fluoride was calculated from the recovered rinsing solution which included toothpaste remnants from the face and clothes which was recovered with a facial tissue. This facial tissue was added to the rinse solution; (iv) the amount of recovered fluoride was subtracted from the amount of fluoride used; the result was assumed to be the ingested amount; (v) the amount ingested was multiplied by the number of tooth brushings per day in order to estimate the daily F intake from this source. Foods, beverages and recovered toothpaste solutions collected each day were separately stored in plastic containers at −15°C. The fluoride intake for each child is expressed as the total amount (mg F/day) and the ingested amount (mg F/kg bw/day).

A questionnaire was applied to children's parents or person in charge. It included questions on social–demographical data, oral hygiene habits, fluoride-use habits and the instructions adults have received for the children's oral care.

Chemical analyses

The analyses of all samples of food, beverage, recovered solution and toothpaste were performed by the micro-diffusion method using hexamethyldisiloxane saturated with H_2SO_4 (3NHMDS/H_2SO_4) (63178®; Sigma Chemical Co, St Louis, MO, USA) as previously described by Taves (24) as modified by Rojas-Sanchez (19). The F concentrations were determined on the processed samples using a combination fluoride electrode (Orion no. 96-909-00, Orion Research Inc., Beverly, MA, USA) and a pH ion meter EA 940 (Orion®).

The reliability of the analytical results obtained in this study was confirmed by comparing the results of random samples with those obtained on the same samples at a well-known external laboratory (Oral Health Research Institute, Indiana University School of Dentistry, Indianapolis, IN, USA) by means of intraclass correlation coefficients and ANOVA tests.

Recovery experiments using standard fluoride solutions were carried out in approximately 5% of each type of samples in order to assess the reliability of the analytical procedures. In all cases recovery results were in the range of 93–103%.

Data analysis

To control for the skewed distribution of the results from all variables (Shapiro–Wilk test) a logarithmic transformation of the data was performed, obtaining a normal distribution, which facilitated the other statistical inference tests. The differences in the total fluoride intake and those from each of the different sources (foods, beverages and toothpaste) (for SES) were compared with either the Mann–Whitney test or *t*-test for independent samples. The values of fluoride intake for food, beverages and toothpaste solutions were used to compare the four cities using either the ANOVA or Kruskal–Wallis test. The four cities were compared for differences in the percentages of children with total fluoride intake below and above the fluorosis threshold using chi-square tests. The chi-square test also was used to compare the questionnaire data between cities and SES. The averages presented in Tables 2–5 are common numerical averages and the transformed data was used only for the statistical tests.

Results

The reproducibility of fluoride assessments on samples of beverages, foods, toothpastes and dentifrice recovery solutions of random samples ($n = 40$ at least) were measured by The Oral Health Research Institute at The Indiana University School of Dentistry. Intraclass correlation coefficient values for each type of samples were equal or higher than 0.87.

Table 1 presents the sample distribution according to age and weight. Two children from Manizales had to be removed from the study because of lack of parental cooperation. The mean age of the children was 29.1 (SD 4.2) months and their mean body weight 12.9 (SD 2.1) kg. There were no significant differences among the four cities.

The estimated mean total daily fluoride intake (TDFI) was 0.11 ± 0.09 mg/kg bw as indicated in Table 2. Children in Medellín had the highest TDFI (0.14 ± 0.12 mg/kg bw) and this was significantly different ($P < 0.01$) when compared with Cartagena (0.07 ± 0.06 mg/kg bw). In Medellín and Bogotá, LSES children had a significantly higher TDFI than HSES children, with LSES children ingesting two to three times as much fluoride as HSES children. Results presented in Table 2 also show that in the four cities under study, the total average value of TDFI of the LSES children was significantly higher ($P < 0.001$) than that of the HSES children.

An analysis of the TDFI by SES revealed that 71.7% of LSES children had a mean total intake above the 'optimal dose range'. Among LSES children, the majority in each city other than Cartagena was above this level, as indicated in Table 3. Almost 94% of LSES children in Medellín presented a mean total intake above the 'optimal dose range'.

Table 4 presents the estimated mean daily fluoride intake from beverages, which was 0.004 and 0.005 mg/kg bw in LSES and HSES children, respectively. The daily fluoride intake from foods was of 0.032 and 0.023 mg F/kg bw in LSES and HSES children, respectively. There were no significant differences in the fluoride intake from diet (beverages and foods) among the cities. The mean

Table 1. Sample distribution according to mean values ± SD of age and weight (kg)

			Weight (kg)		
City	n	Age (months)	LSES	HSES	Total
Bogotá	30	29.2 ± 3.8	13.0 ± 2.1	12.4 ± 1.9	12.7 ± 2.0
Medellín	30	28.1 ± 4.5	12.9 ± 2.2	12.2 ± 1.4	12.6 ± 1.9
Cartagena	30	29.6 ± 4.5	11.5 ± 1.4*	14.3 ± 1.7*	12.9 ± 2.1
Manizales	28	29.6 ± 4.0	13.0 ± 1.8	14.0 ± 2.9	13.5 ± 2.4
Total	118	29.1 ± 4.2	12.6 ± 2.0	13.2 ± 2.2	12.9 ± 2.1

*$P < 0.001$.
LSES, low socioeconomic status; HSES, high socioeconomic status.

Table 2. Total fluoride intake (±SD) (mg F/kg bw/day and mg F/day) according to SES

	Fluoride intake (mg F/kg bw/day)			Fluoride intake (mg F/day)		
City	LSES	HSES	Total	LSES	HSES	Total
Bogotá	0.16 ± 0.12*	0.07 ± 0.03*	0.11 ± 0.10	1.99 ± 1.34	0.87 ± 0.47	1.43 ± 1.14
Medellín	0.21 ± 0.13**	0.06 ± 0.02**	0.14 ± 0.12*	2.80 ± 1.83**	0.72 ± 0.28**	1.79 ± 1.68*
Cartagena	0.07 ± 0.04	0.08 ± 0.07	0.07 ± 0.06*	0.77 ± 0.52	1.05 ± 0.91	0.91 ± 0.74*
Manizales	0.11 ± 0.08	0.09 ± 0.06	0.10 ± 0.07	1.46 ± 0.88	1.23 ± 0.99	1.36 ± 0.93
Total	0.14 ± 0.10**	0.07 ± 0.05**	0.11 ± 0.09	1.78 ± 1.44**	0.97 ± 0.73**	1.38 ± 1.21

*$P < 0.01$; **$P < 0.001$.
LSES, low socioeconomic status; HSES, high socioeconomic status.

Table 3. Percentage distribution of children under, within or over the 0.05–0.07 mg F/kg bw fluoride intake in the four cities according to SES

	Fluoride intake (mg F/kg bw)					
	<0.05		0.05–0.07		>0.07	
City	LSES	HSES	LSES	HSES	LSES	HSES
Bogotá	13.3	33.3	13.3	20.0	73.3	46.7
Medellín	–	33.3	6.2	46.7	93.8	20.0
Cartagena	33.3	46.7	26.7	20.0	40.0	33.3
Manizales	14.3	35.7	7.1	7.1	78.6	57.1
Total	15.0	37.3	13.3	23.7	71.7	39.0

LSES, low socioeconomic status; HSES, high socioeconomic status.

fluoride intake from the diet represented 34% of the total fluoride intake in the HSES and 24% in the LSES children.

As shown in Table 4, toothpaste was the main source of daily fluoride intake, averaging 0.045 mg/kg bw in the HSES and 0.107 mg/kg bw in the LSES children ($P < 0.01$). The fluoride intake from toothpaste accounted for 66% and 76% of the mean total fluoride intake in HSES and LSES children, respectively. In Bogotá, Medellín and Manizales, the mean fluoride intake from toothpaste was >0.07 mg/kg bw/day in LSES children. In Bogotá and Medellín, the fluoride intake from toothpaste was significantly higher ($P < 0.01$) in LSES than in HSES children.

The mean amount of toothpaste used per toothbrushing was 0.52 g in the LSES and 0.36 g in the HSES children, as described in Table 5. The highest value was 2.3 g and the lowest 0.1 g (data not shown). In Bogotá and Medellín, the amount of toothpaste placed on the toothbrush was significantly higher ($P < 0.01$) in the LSES than in the HSES children.

Table 5 also reveals that the estimated percentage of toothpaste ingested by LSES (69%) and HSES (72%) children during toothbrushing, was not significantly different ($P > 0.05$). However, in LSES children of Bogotá and Medellín, the concentration of F in the toothpaste (1277 and 1758 ppm, respectively) was significantly higher ($P < 0.001$) than in HSES children (976 and 1142 ppm, respectively).

Table 6 presents responses of parents to the questionnaire regarding their children's oral hygiene habits. All the participating children used fluoridated dentifrice. Only 6.7% LSES children from Bogotá and 7.1% HSES children from Manizales brushed their teeth without parental help. In the HSES children, there were no significant differences in the frequency of toothbrushing. Medellín had the highest percentage (94%) of LSES children who claimed to brush their teeth twice or more times per day, although this proportion is not significantly higher than the corresponding values in Bogotá and Manizales. A significantly higher percentage of LSES children from Cartagena

Table 4. Fluoride intake (±SD) (mg F/kg bw/day) according to fluoride source

	Beverages		Foods		Toothpaste	
City	LSES	HSES	LSES	HSES	LSES	HSES
Bogotá	0.004 ± 0.003	0.006 ± 0.009	0.040 ± 0.02	0.026 ± 0.01	0.117 ± 0.12*	0.037 ± 0.03*
Medellín	0.005 ± 0.003	0.007 ± 0.005	0.040 ± 0.03	0.023 ± 0.01	0.170 ± 0.14*	0.030 ± 0.02*
Cartagena	0.005 ± 0.004	0.004 ± 0.002	0.014 ± 0.01	0.019 ± 0.01	0.051 ± 0.04	0.053 ± 0.07
Manizales	0.003 ± 0.002	0.004 ± 0.003	0.034 ± 0.02	0.023 ± 0.02	0.078 ± 0.07	0.059 ± 0.06
Total	0.004 ± 0.003	0.005 ± 0.006	0.032 ± 0.02	0.023 ± 0.01	0.107 ± 0.11*	0.045 ± 0.05*

*$P < 0.01$.
LSES, low socioeconomic status; HSES, high socioeconomic status.

Table 5. Mean estimated amount (g) of toothpaste used, percentage of ingested toothpaste and mean fluoride concentration of toothpastes

	Amount of toothpaste used		Percentage of toothpaste ingested		Toothpaste F concentration (μg F/g)	
City	LSES	HSES	LSES	HSES	LSES	HSES
Bogotá	0.63 ± 0.29*	0.27 ± 0.16*	71 ± 20**	88 ± 11**	1277 ± 309*	976 ± 278*
Medellín	0.59 ± 0.50*	0.23 ± 0.17*	72 ± 21	76 ± 13	1758 ± 130*	1142 ± 436*
Cartagena	0.46 ± 0.15	0.64 ± 0.39	69 ± 18	55 ± 19	1273 ± 343	1002 ± 585
Manizales	0.39 ± 0.20	0.33 ± 0.22	63 ± 15	72 ± 23	1273 ± 341	1220 ± 439
Total	0.52 ± 0.33	0.36 ± 0.30	69 ± 19	72 ± 20	1408 ± 357*	1090 ± 452*

*$P < 0.001$; **$P < 0.05$.
LSES, low socioeconomic status; HSES, high socioeconomic status.

Table 6. Children's oral hygiene habits according to city and SES

	Bogotá		Medellín		Cartagena		Manizales	
	LSES (15%)	HSES (15%)	LSES (15%)	HSES (15%)	LSES (15%)	HSES (15%)	LSES (14%)	HSES (14%)
Age in which children's toothbrushing began								
<1 year	33.3	60.0	33.0	80.0	34.5	47.0	35.7	71.4
1–2 years	66.7	40.0	67.0	20.0	65.5	53.0	64.3	28.6
Person in charge of children's toothbrushing								
Parent	93.3	100	100	100	100	100	100	92.9
The child	6.7	–	–	–	–	–	–	7.1
Number of daily toothbrushings								
1	13.3	13.3	6.0	26.7	50.0	20.0	14.3	14.3
2	86.7	86.7	94.0	73.3	50.0	80.0	85.7	85.7
Expectoration after toothbrushing								
Yes	93.3	80.0	100	100	93.3	80.0	100	100
No	6.7	20.0	–	–	6.7	20.0	–	–
Use of toothpaste								
Yes	100	86.7	100	100	93.0	93.0	100	100
No	–	13.3	–	–	7.0	7.0	–	–

–, Frequency zero.
LSES, low socioeconomic status; HSES, high socioeconomic status.

($P < 0.05$) were reported to brush their teeth once a day compared with the other three cities. In Bogotá and Cartagena, 6.7% LSES children and 20.0% HSES children did not expectorate after toothbrushing. In Bogotá, 13.3% of the HSES children and in Cartagena 7% of HSES and LSES children did not use toothpaste for toothbrushing.

Discussion

The average total daily F intake (daily intake per bw) for the whole sample was 0.11 ± 0.09 mg F/kg bw (1.38 ± 1.21 mg F/day). It is difficult to compare these values with those from previous reports because of differences in the age of children in various studies (16, 17, 20, 21, 25) and in the methods used for assessing dietary fluoride intake. A number of earlier studies were based on the estimation of fluoride ingestion from foods and beverages through food consumption tables, dietary surveys and/or dietary recall (13, 14, 26–29). Most of these latter studies reported average daily F intakes lower than the values found in this work.

The 'duplicate plate' method (16, 17, 19) was used for the assessment of F ingestion from food and beverages of each participating child and individual determination of the fluoride swallowed from dentifrice was also accomplished. Thus, the results can be compared with a recent study on 16- to 40-month-old children carried out in communities with negligible and optimally fluoridated water (19). In the present study, the average total, daily fluoride intake (0.11 ± 0.09 mg F/kg) is higher than the 0.070 ± 0.038 mg F/kg/day obtained for the optimally water-fluoridated area of Indianapolis, Indiana (19). Fluoride intake from food and beverages is similar (approximately 0.04 mg F/kg/day) to that in Indianapolis and in toddlers from fluoridated areas in Canada (13). The main difference is in the magnitude of F from toothpaste which comprised 44% of the total F intake value in Indianapolis (19) and 70% in the present study.

When comparing the mean TDFI of the four communities, the average value for Cartagena (0.07 ± 0.06 mg F/kg/day) was significantly lower than the corresponding values determined for Manizales (0.10), Bogotá (0.11) and Medellín (0.14). The reason for this difference is probably that the daily frequency of brushing, the proportion of dentifrice swallowed are lower in Cartagena than in the other three cities (Tables 5, 6).

The importance of F ingestion from dentifrice in the present study is also illustrated when the mean TDFI of children in the LSES and HSES is compared in the four communities. In Bogotá and Medellín, the mean TDFI of HSES children (0.07 and 0.06 mg F/kg/day, respectively) was significantly lower than the mean TDFI of LSES children (0.16 and 0.21 mg F/kg/day, respectively) ($P < 0.01$ for both comparisons). It is evident that a substantially lower amount of toothpaste is dispensed on average, onto the toothbrush of the HSES children than the corresponding amount used by the LSES children in Bogotá and Medellín. As the proportion of dentifrice swallowed is similar for both SES groups in these two cities, the total amount of F ingested from dentifrice is much higher in LSES than in HSES children. As more than 80% of the participating children, regardless to which SES they belong, brushed their teeth two or more times per day the lower mean TDFI of HSES children when compared with LSES children could possibly be attributed to a better education of their parents on the appropriate oral hygiene techniques (small amount of dentifrice placed onto the toothbrush) provided by the dentist. Moreover, the mean TDFI of the HSES children residing in Bogotá and Medellín are comparable with the values reported for the optimally water-fluoridated area of Indianapolis (19).

In contrast, the mean TDFI values for children residing in Cartagena and Manizales are not significantly different for both LSES and HSES groups. Again, the most likely explanation for this finding might be the amount of dentifrice placed onto the toothbrush. The amount of dentifrice used by HSES and LSES children from Cartagena and Manizales were similar, and in the city of Cartagena this value is higher for the HSES children. This may explain the lack of difference in the TDFI values found in children belonging to both SES in Cartagena and Manizales. However, the information available from the questionnaires (Table 6) does not allow us to suggest why there appears to be a different behaviour in relation to the amount of dentifrice placed on the toothbrush by HSES children from Bogotá and Medellín compared with the HSES children from Cartagena and Manizales. Further studies will be necessary to elucidate this issue.

When the different sources of F intake were analysed, it was found that F intake from beverages was very low (4.7% of the TDFI), a fact consistent with the low natural F concentrations of the drinking water in these cities. The average contribution to the TDFI from foods was approximately 25%, i.e. a value ≤0.04 mg/kg/day, which appears comparable to the values reported for fluoridated areas in Indianapolis (19) and Richmond (30). Unfortunately, recent data of F intake in German children (21), some of whom were using fluoridated salt, were reported in such a way that a direct comparison with the present data is not possible. The results from this study suggest that F ingestion from dentifrices contributes 70% of the TDFI in these young children, even recognizing that according to the parents' answers to the questionnaires almost all brushing was carried out under their guidance. These data support the consensus of other investigators that fluoride dentifrices are a major source of fluoride for children residing in both optimally and negligibly fluoridated communities (18, 19, 31, 32). It must be borne in mind that during this project all commercially available dentifrices in the country had a fluoride concentration of 1000–1500 ppm, with the most commonly used brand containing 1500 ppm F. Although market distribution of either type is unknown, it is estimated that a higher percentage of 1500 ppm F toothpaste was used in the population given its lower cost and that it could be used by the entire family, while 1000 ppm F toothpastes were less accessible.

Although the appropriateness and origin of the so-called optimal F intake (mg F/kg/day) have been previously discussed (10, 18), it is generally accepted that the range 0.05–0.07 mg F/kg/day is an adequate limit for safe fluoride exposure for young children (10). For most of the children in this study (55%, Table 3), mean TDFI exceeded the upper estimated threshold of 0.07 mg/kg/day. The proportion of LSES children that exceeded the latter value was 71.7% and in three of the four cities, the average TDFI was ≥0.10 mg/kg/day. These findings suggest that the young children in the population studied are at risk of developing dental fluorosis in their permanent teeth, and an assessment of fluorosis will be made in the permanent teeth of the same cohort of children after their eruption.

This paper presents the findings from the first study to assess the mean total daily fluoride intake in very young Colombian children. The magnitude of the experimental effort currently involved and some economic and technical restrictions did not allow us to include more frequent sampling of foods, beverages and more accurate data on the proportion of swallowed dentifrice. As it was reported in recent publications (19, 33), the amount of fluoride consumed by participating children in this study on a day-to-day basis varied greatly from one day to another (results not shown) in the same child. More frequent sampling would contribute to a more accurate assessment of average daily F intake among young children.

The contribution of F from solid foods and beverages to the mean TDFI is comparable with that reported in previous studies in optimally water-fluoridated areas. This provides additional support as to the appropriateness and safety of the salt fluoridation programme in this country. However, under the conditions prevailing in the four cities that were studied young children residing in these communities are exposed to two major sources of systemic ingested fluoride, e.g. fluoridated salt and fluoride dentifrices. To minimize this risk, it seems appropriate to recommend that the national health authorities and the manufacturers of fluoride toothpastes agree on several previously suggested measures such as: an intense public educational campaign to emphasize that dentifrices containing 1500 ppm F should not be used by children younger than 6-years-old, recommend parents the use of very small amounts ('pea-size') of dentifrice for each brushing, to encourage and teach young children to expectorate as much as possible of the toothpaste used, and to market dentifrices containing F concentrations ≤500 ppm, for use in children younger than 6 years.

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