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Comparison of a dietary survey and the duplicate plate method for determining dietary fluoride ingested by young children: a pilot study

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Background. Investigators have attempted to establish the diet's contribution to the total body burden of fluoride in response to a reported trend towards an increase in fluoride intake.
Aim. The aim of this study was to compare the suitability of two methods to collect dietary data for fluoride intake assessment.
Design. Assessments were made in 12 children using the duplicate plate and dietary diary methods following a randomized cross-over design. Foods and beverages were analysed for fluoride, and total fluoride intake per day was calculated. Results from each method were compared.
Results. Mean beverage fluoride intake was estimated at 316 ± 120 and 422 ± 195 μg/day utilizing the diary and duplicate plate methods, respectively. Mean food fluoride intake was estimated at 188 ± 48 μg/day using the diary, whereas it was 130 ± 41 μg using the duplicate plate method. Total fluoride intake was 504 ± 138 and 552 ± 192 μg/day utilizing the diary and duplicate methods. Large variations in daily fluoride intake from both beverages and food were observed between and within children.
Conclusions. Both methods had inherent shortcomings and sources of error. The duplicate method was more labour intensive and costly; however, the diary method required a large number of assumptions. A combination of both methods seems to be most suitable to obtain reliable data.

Introduction

The use of public water fluoridation as a means of preventing dental caries is one of the most important public health measures ever initiated and has resulted in dramatic reductions of the disease in children and adults. Because of these reductions, fluoride has been incorporated into a number of delivery systems including dentifrices, mouth rinses, supplements, restorative materials, milk, and salt as a means of controlling dental caries in large populations around the world. However, concerns have been raised that fluoride exposure from multiple sources has potentially exceeded the level needed to optimally prevent dental caries[1–3]. Multiple studies conducted in places as varied as Brazil, Colombia, Japan, Mexico, New Zealand, and the United States have evaluated dietary and total fluoride intake by young children, and have found that the estimated daily intake is very close to or in many cases above the recommended optimal intake range[4–10]. This range has been set at 0.05–0.07 mg of fluoride (mg F)/kilograms of body weight (kg bw)/day, although several investigators have indicated this has never been determined scientifically and could be much lower[11].

Recognizing the need for continued fluoride research, several international conferences have been convened to emphasize this need and to prioritize research relating to fluoride exposure[11,12]. Total fluoride intake and exposure in both established market economy (EME) countries[13], and non-EME countries[14] have not been fully established for all ages. The relative contribution of various fluoride sources to total body burden in any age group has yet to be established. Although this is currently being investigated[2–4], continued research is needed to further our understanding of total fluoride intake and body burden. Recent reports have

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aimed at establishing the relative contribution of each source to total body burden of fluoride, especially as it relates to the diet of young children[2–10]. This is especially important as it is preschool children who are at the susceptible age of risk for the development of dental fluorosis[15].

Few studies are available concerning the diets of preschool children[16]. Assessment of the diet of preschool children is difficult and poses a number of significant problems[16,17]. Preschool children tend to eat smaller amounts but more frequently during the day. Estimates indicate that most children this age eat 5–7 times/day but can eat up to 14 times/day. In addition, they cannot answer questions so any collected data are dependent on the recollections and biases of the caregiver who may be caring for several different individuals during any given day. With children eating numerous meals away from home[18] or being cared for by caregivers other than their parents, the likelihood of obtaining accurate information concerning children's diets from multiple sources and individuals becomes less likely.

All dietary assessment methods have inherent shortcomings and sources of error[19–24], and work continues to refine the tools currently being used. Aside from the methodologies, the panelist's physical and psychological characteristics may play an important role in the assessment[22]. Further, with repeated measurements, the likelihood for misreporting increases[22]. The duplicate plate and the dietary diary are two methods that have been used previously by investigators to determine nutrient intake in various study populations. The majority of previous studies using dietary surveys have estimated fluoride ingestion from foods and beverages on the basis of food consumption tables, dietary diaries, and/or dietary recall[1–5,9]. It has been suggested, however, that more accurate data concerning an individual's consumption of a particular item in the diet can be obtained if duplicate samples of the foods and beverages actually consumed are collected and analysed[25], and more recent studies have tended to favour the use of a duplicate plate method[6–8,10].

The duplicate plate has been used by other investigators to determine fluoride ingestion in children[6–8,10]. The duplicate plate method is considered the 'gold standard'[25] by which all other measures are compared. This is because it is considered 'practical, economical, independent of the subject's memory and can provide unbiased information'[23]. However, it is labour intensive and involves extensive training of study monitors, as well as parents and/or guardians of the children participating in the study in order to ensure accurate estimates of the actual foods and beverages consumed. In addition, if the data are collected by more than one individual, then these monitors should be calibrated and an assurance of agreement must be obtained[24].

In order to conduct studies on fluoride intake, fluoride metabolism, and dental fluorosis development, investigators must first determine which method of recording food and beverage intake in this age group is likely to be the most reliable, valid, and cost-effective to determine fluoride ingestion at an individual level. In large part, the choice of methodology is dependent on the objectives and goals of the investigation and the particular nutrient or non-nutrient of interest[20]. It seems justified; therefore, to compare the data obtained using several methods specifically for the purpose of calculating dietary fluoride intake. The purpose of this pilot investigation was to compare two methods: the duplicate plate and dietary diaries, which have been commonly used to collect dietary data as to their suitability to assess fluoride ingestion from food and beverages[1–10]. Specific objectives of this pilot study were to make comparisons to determine if the methods resulted in comparable data regarding dietary fluoride ingestion, to determine which method was more cost-effective, and to determine which method had a higher level of compliance.

Materials and methods

Panelist recruitment and acceptance criteria

Twelve panelists were recruited for this study. All children in the study, who attended day-care, attended the same centre. Prior to the initiation of the investigation, copies of the protocol and all supporting documents were submitted to the Indiana University Medical Center Institutional Review Board (IRB) for their review

and approval. Initial contact with the parents was done by telephone to answer questions and establish the child's initial acceptance. A small monetary compensation was provided to participants to cover the costs of food used for the duplicate plate and to enhance participation; parents were informed of this IRB-approved compensation during this initial call. An informational letter of consent and medical history/residency questionnaire were mailed to interested parents with a postage paid return envelope.

In order to meet acceptance criteria, parents needed to: (i) have a child 15–30 months-of-age at the time of recruitment; (ii) be willing to complete a medical history/residency questionnaire related to the child and, in particular, document that the child had no dietary restrictions; (iii) agree to attend training regarding the procedures to perform the duplicate plate collection of foods and beverages, as well as how to complete the daily dietary diaries; and (iv) be available to conduct these two procedures in random order. At the time of acceptance into the study, each child was issued a two-digit, randomly assigned study number. This number was subsequently used to identify all duplicate plate samples and diary information.

Collection of dietary samples and dietary information

Dietary assessments were made using both the duplicate plate method and a dietary diary. The duplicate method used in this study followed similar procedures as those reported in previous investigations by our group[6,7], whereas the dietary diary procedure used for this study was developed after review of the literature[16–24]. No technique to determine the validity of either method was used in this study, and no comparison with standards was attempted; therefore, intake values were considered estimates and only compared between methods.

The parents performed each method in random order in a cross-over study design. Each data collection period was of 3 days duration during the spring time. Panelists were assigned to follow each procedure in random order as determined by a randomization table for a two-leg study. To verify the fluoride content of the families' water supply, all panelists were given a collection kit to obtain a sample of water from their home for analysis. Water samples were also collected and analysed from the day-cares the children attended and from fountains and other water sources within the community of Indianapolis, IN, USA. The public water supply of Indianapolis has an adjusted fluoride concentration of 1 p.p.m.

Parents met with the study coordinator just prior to the start of each food or diet information collection period. At this meeting, parents received written and hands-on training in the use of the 3-day duplicate plate method and in completing the 3-day food dietary diary depending on their assignment leg. Written copies of the instructions for each method were also provided. This training meeting was repeated at the initiation of the second leg to assure consistency in the collection method.

The two study legs were conducted 1–2 weeks apart. Each time, the collection period included two weekdays and one weekend day. Because some families and the day-care centres served particular foods on particular days (i.e. Friday night is pizza night each week), the days of collection were identical in each leg. Collections were not performed during holiday periods due to the variability of the diet from normal at these times. All collections were completed within a 5-week period.

Duplicate plate food collection. If a child attended the day-care centre, the study personnel performed the collection of the duplicate plate samples of the meals and snacks eaten at the centre. Additional fluoride-free containers and jugs were given to the parent for collecting foods and beverages that were consumed outside the centre or at home. If a child did not attend a day-care centre, the parent received sufficient plastic jugs and containers for the 3-day collection period. Each container or jug was labelled with the collection day (day 1, day 2, and day 3) and the child's unique identifying number. Parents were instructed to keep food and beverages separate, and to include foods and beverages, including water, ingested between meals.

For each meal or snack, the on-site coordinator at the day-care or the parent at home prepared a 'duplicate plate' with similar amounts of the

foods served to the child at that meal. Once the child had finished eating, the amount of food remaining on the child's plate was visually determined. Food was removed from the child's duplicate plate sample to match the amount of food left on the plate. The amount of food that was removed from the plate represented the food actually consumed by the child. This food was placed in the labelled container and saved for fluoride analyses. For the beverage collections, duplicate cups were prepared and a similar procedure to that followed for the foods was followed. All foods and beverages collected on a given day were saved in the appropriate container and were refrigerated until they could be delivered to the analytical laboratory.

Completion of daily dietary diary. Detailed instructions describing how to complete the 3-day dietary diary were provided with the diary. These instructions included pictures of amount of foods and their calculated sizes (i.e. half a cup of pasta, or one cup of rice) as well as two complete diaries that could be used as examples. Pictures of some processed and home-prepared meals were also included in this package with detailed explanations as to how to record them (i.e. diary entry of: 'pasta/store-bought Chef Boyardee dinosaurs meatball brand 7.5 oz can', or diary entry of: 'pasta/homemade – Kroger enriched thin spaghetti 1–16 oz package cooked in tap water with one teaspoon of iodized Morton table salt and prepared with two tablespoons of Kroger salted butter'). Parents and/or the on-site coordinator were instructed to record the dietary information for meals and snacks on specific data collection days. In addition to recording the types and brand names of the foods and beverages their child consumed, the estimated quantity of these items was also recorded. Parents were instructed to be as accurate as possible when recording the data. For example for, 'Jell-O brand sugar free strawberry one 2 oz snack pack' was recorded as opposed to 'one container of Jell-O'. The volume of water consumed by each child was also recorded, and an entry was made as to the use of bottled or tap water. Parents and/or day-care workers who completed the diet diaries were given containers to provide a sample of the child's drinking water for subsequent fluoride analysis.

Analyses of samples

Following each 3-day assessment, the parents returned their duplicate plate kits or diaries to their day-care centre or to the central site for collection. The kits were examined, and their contents logged and the reasons for missing collections (i.e. illness, 'just didn't eat', etc.) were recorded in a data collection book. The collected foods and beverages were transported in coolers to the laboratory for analyses. Diaries were reviewed for completeness and any questions regarding entries were discussed with the parents or day-care coordinators at the time of retrieval of the sample or during a follow-up telephone call. Upon receipt of the questionnaires, study personnel made a follow-up telephone call to the parents to clarify any questionable parent recordings and fill any incomplete questionnaire items.

Duplicate plate sample processing. A laboratory technician weighed the food collected for each child and recorded the data by day of collection. The foods were then thoroughly homogenized using a commercial-grade blender, and aliquots of each homogenate were placed into vials labelled with the child's identifying number and the day of collection. This process was repeated for food collected on each of the three study days. For every fifth homogenate, duplicate homogenates were collected for repeat analyses.

The volume of pooled water and beverage samples for each day was measured. An aliquot of each beverage mixture (approximately 5–10 mL) was placed into a vial, labelled with the child's identifying number and the day of collection. As with the food homogenates, duplicate aliquots of each beverage mixture were collected. All food and beverage aliquots were frozen until the time of fluoride analyses.

Dietary diary food samples. Information obtained on the dietary diaries regarding food and beverage types and quantities was tabulated. The study coordinator and assistants purchased these food and beverage items for analyses of their fluoride content in the laboratory. As with the duplicate plate samples, all foods were homogenized prior to analyses, and aliquots of the homogenates were frozen for later analyses.

Fluoride analyses of food and beverage samples. All foods and beverages were analysed on the basis of weight using a modification of the hexamethyldisiloxane diffusion procedure[6,7]. Fluoride content of all foods and beverages was calculated as μg fluoride/g food or beverage. For the duplicate plate method, the daily intake of fluoride from foods and beverages was calculated by multiplying the μg fluoride/g food or beverage by the total weight or volume consumed, respectively. For the dietary diary method, the amount of fluoride ingested by each child was calculated by multiplying the μg fluoride/g food or beverage by the quantitative intake information provided on their individual diaries (fluoride/gram of food or beverage × the recorded weight or volume of the food or beverage consumed).

Statistical analysis

Intraclass correlation coefficients (ICCs) were used to assess the within- and between-technician repeatability of the diffusion analyses for food and beverage fluoride. The statistical analysis for this study involved two parts. Initially, we used ICCs and computed within- and between-child variability estimates for food, beverage, and total fluoride intake per day. Because the two methods were not used simultaneously, within-subject differences could be caused by both temporal changes and method differences. However, the variation was considered important in comparing the methods.

The second analysis used a mixed-model analysis of variance to compare the fluoride intake assessment methods and accounting for repeated observations within a subject. The analyses were performed after using a logarithmic transformation of total fluoride intake (in μg F). From this analysis, we were able to test for differences in mean values between the methods and to determine if there was a measurement bias for one method relative to the other, and also estimated and compared the variance within each method.

Results

The standard deviation between technicians for the beverage sample diffusion measurements was 0.04 μg F/g beverage, with an ICC of 0.96. The standard deviation for foods was 0.02 μg F/g food, with an ICC of 0.95. The within-technician ICCs for the food and beverage sample diffusion measurements were 0.91 and 0.89, respectively, indicating excellent repeatability of the analysis. Ninety-seven different types of food samples and 19 different types of beverages were reported through the dietary diary, whereas 68 beverage and food pooled samples were collected through the duplicate plate method. Twelve children were recruited and completed the study. Five children had incomplete collections for 1 day of one or two legs each. Age, gender, and weight of the children are presented in Table 1.

We calculated compliance based on the number of samples or collection points missed while following each of the methods. Compliance while using the dietary diary method was lower. This method had many more missing collection point/samples than the duplicate method. Fifteen per cent of the children did not provide water samples. For the duplicate plate leg, four children had incomplete collections for 1 day, whereas for the dietary diary leg 35% of the children did not record food intake for a day. Forty per cent of the questionnaires were returned incomplete. All questionnaires were later completed through follow-up telephone calls to the parents.

Mean total fluoride intake per day per subject is presented in Table 2. When calculated using the dietary diary, children in the study ingested a mean of 316 ± 120 μg F/day from beverages, whereas the duplicate plate method estimated

Table 1. Age, gender, and weight of the children.

Subject	Age (months)	Gender	Weight (kg)
1	21	F	12.3
2	21	F	11.6
3	19	M	11.4
4	24	M	13.2
5	25	F	12.7
6	23	M	11.6
7	18	M	13.2
8	27	F	13.6
9	30	F	12.7
10	23	M	12.3
11	20	M	12.5
12	24	M	14.1

F, female; M, male.

Table 2. Estimates of total μg of dietary fluoride ingested per day (mean ± SD) by method (*N* = 12).

Sample	Method	Day 1 Mean μg F ± SD	Day 2 Mean μg F ± SD	Day 3 Mean μg F ± SD	Mean days 1–3 Mean μg F ± SD
Beverages	Diary	307 ± 240	331 ± 143	311 ± 146	316 ± 120
	Plate	474 ± 256	393 ± 166	398 ± 243	422 ± 195
Food	Diary	219 ± 102*	189 ± 84	155 ± 91	188 ± 48
	Plate	129 ± 65*	143 ± 73	118 ± 64	130 ± 41
Total	Diary	526 ± 313	520 ± 120	466 ± 166	504 ± 138
	Plate	603 ± 279	536 ± 173	516 ± 221	552 ± 192

*Diary method recorded significantly higher food fluoride intake than the duplicate plate method ($P = 0.0013$).

Table 3. Dietary fluoride ingested in mg/day and mg/kg bw/day (mean ± SD) by subject and method.

Subject	Diary mg F/day	Diary mg F/kg bw/day	Duplicate plate mg F/day	Duplicate plate mg F/kg bw/day
1	0.42 ± 0.04	0.03 ± 0.003	0.45 ± 0.04	0.04 ± 0.003
2	0.61 ± 0.05	0.05 ± 0.004	0.50 ± 0.14	0.04 ± 0.012
3	0.35 ± 0.06	0.03 ± 0.005	0.67 ± 0.13	0.06 ± 0.011
4	0.56 ± 0.19	0.04 ± 0.014	0.86 ± 0.07	0.06 ± 0.005
5	0.61 ± 015	0.05 ± 0.011	0.51 ± 0.11	0.04 ± 0.009
6	0.46 ± 0.13	0.04 ± 0.011	0.55 ± 0.11	0.05 ± 0.009
7	0.39 ± 0.03	0.03 ± 0.002	0.40 ± 0.14	0.03 ± 0.010
8	0.79 ± 0.54	0.06 ± 0.039	0.47 ± 0.15	0.03 ± 0.011
9	0.55 ± 0.17	0.04 ± 0.013	0.88 ± 0.12	0.07 ± 0.009
10	0.30 ± 0.16	0.02 ± 0.013	0.70 ± 0.38	0.05 ± 0.0.031
11	0.54 ± 0.13	0.04 ± 0.010	0.27 ± 0.004	0.02 ± 0.0003
12	0.43 ± 0.13	0.03 ± 0.009	0.36 ± 0.06	0.02 ± 0.004

Table 4. Fluoride intake variability within and between children.

Sample	σ_b Diary method	σ_w Diary method	ICC diary method	σ_b Duplicate plate method	σ_w Duplicate plate method	ICC duplicate plate method
Beverages	76.59	160.86	0.18	178.30	138.73	0.62
Food	78.95	93.58	0.09	16.48	64.25	0.06
Total	77.50	197.77	0.13	171.32	151.25	0.56

σ_b, standard deviation between children; σ_w, standard deviation between days within child.

this intake to be 422 ± 195 μg F. From foods, when calculated using the dietary diary, children in the study ingested a mean of 188 ± 48 μg F/day, whereas the duplicate plate method estimated this intake to be 130 ± 41 μg F. Finally, total fluoride intake per day was estimated at 504 ± 138 μg F and 552 ± 192 μg F for 24 h utilizing the dietary diary and duplicate plate methods, respectively. Children in this study ingested from 0.30 ± 0.16 to 0.88 ± 0.12 mg F/24 h. Results of total dietary mg F ingested per day and μg F ingested per kilogram of body weight per day are presented in Table 3.

The variability between and within child, as well as the ICCs for both methods conducted independently, is presented in Table 4. Comparisons between the duplicate method and the diary method demonstrated that the diary method calculated significantly higher food fluoride intake than the duplicate plate method ($P = 0.0013$). No significant differences were found between the diary and

duplicate plate methods for fluoride intake from beverage ($P = 0.11$) or total fluoride intake ($P = 0.55$).

Discussion

It must first be stated that no single method of dietary assessment is 'best' and that all dietary assessment methods have inherent shortcomings and sources of error[19–24], and work continues to refine the tools currently being used. In this investigation, the validity of neither of the methods studied was assessed through established validation techniques; therefore, comparisons with standards were not possible. For this reason, caution should be exercised when generalizing our intake estimates. Our results support previous reports which have postulated that the assessment of the diet of preschoolers is difficult and poses a number of significant problems[16,17]. During the course of our investigation, we observed that children eat numerous meals away from home and they eat frequently during the day. Furthermore, the observations we made during the conduct of our study support the fact that with repeated measurements, the likelihood for misreporting increases[22].

The duplicate plate and the dietary diary, the two methods we investigated in this study, have been used previously by investigators to determine nutrient intake in various study populations. The majority of previous studies using a dietary surveys have estimated fluoride ingestion from foods and beverages on the basis of food consumption tables, dietary diaries, and/or dietary recall[1–5,9]. The results we obtained for mg of fluoride ingested per body weight using the dietary diary methods are similar to those found by a large, longitudinal study conducted in the same area (0.035 mg F/kg bw/day at 12 months and 16 months, and 0.043 mg F/kg bw/day from 20 months to 36 months), which seems to support the validity of our results. The duplicate plate method, which has been purported to produce more accurate data concerning an individual's consumption of a particular item in the diet because duplicate samples of the foods and beverages actually consumed are collected and analysed, has also been used by other investigators to determine fluoride ingestion in children[6–8,10]. The estimated mean values for food and beverage fluoride intake by one of those investigations that was conducted in the same community in which we conducted our study[6], fell within the range of our results for total fluoride ingested per day (0.219–0.403 mg F/day) and are similar to those of other investigations conducted using the duplicate plate technique communities with similar levels of fluoridation.

Our results are also in agreement with others that have found individual variation in dietary fluoride intake to be great[1,9]. A recent study[1] found that there were large variations in fluoride intake, which were linked to age and even seasonal variation. A second study by Levy and co-workers[9] concluded that there was considerable variation in fluoride intake across ages and among individuals. Our comparisons between the duplicate method and the diary method found no significant differences between methods for total fluoride intake, whereas the variability between and within child was similarly high. It needs to be further taken into account that the variability between children in our study may be an underestimation, because all children were recruited from a single day-care and had identical breakfast and lunch menus for the weekdays.

Although in our investigation, the 'duplicate plate' proved to be very labour intensive and time consuming, as previously reported by other investigators, and therefore was comparably more costly than the dietary diary[26], the use of the diary also presented a number of problems. There were large numbers of different types of foods and beverages reported by the parents. The analysis of these foods made this method also labour intensive and could potentially raise costs to values similar to those of the duplicate plate if a large number of food and beverage items are reported. The instructions provided by the investigators were not followed on many occasions. For example, amounts ingested were recorded as 'bites', 'sips', teaspoons, cups, etc., making it difficult to calculate amounts. In addition, in many cases, brand names were not provided and upon questioning, parents were not able to recall the names so, again, the investigators had to assume which brand of an item to choose from the database.

In addition, while comprehensive diaries used to determine dietary fluoride intake have indicated that, in general, the fluoride content of most individual food items is low[1,4,5,7,9,26,27], research conducted in Brazil, India, Japan, New Zealand, and the United States has indicated that infant juices and juice drinks, dairy beverages, infant cereals and foods, teas, and certain ethnic foods could contain substantial amounts of fluoride depending on the site of manufacture and method of processing[4,5,9,26,27]. It could be assumed that if any of the foods consumed by the children for whom a parent failed to report the brand name were one of those exceptionally high in fluoride items, this would have a great impact on the dietary fluoride intake calculations for that child.

Recently, a Nutrition Data System for Research software was modified to assess total fluoride intake, including: fluoride values for foods, beverages, dentifrice, mouth rinse, and supplements; fluoride retention factors for foods prepared with water[28]. This software collects data, via interview, to assess the total amount of fluoride ingested by individuals from dietary sources (food, water, beverages). Values for dietary sources are calculated using national and regional data values published in the recently released US Department of Agriculture National Fluoride Database[29]. It also collects data from non-dietary sources (toothpaste, mouth rinses, and supplements) and integrates assayed fluoride values from directly collected samples of water and water-based beverages used by study participants. Our results seem to support the approach taken by the software developers, who propose to utilize a combination of diary/structured interview procedure in addition to direct laboratory calculations of samples from beverages, which present the greatest variability. A standardized interview procedure may also alleviate the problem encountered in our study with parent's self-reporting of the amounts ingested by the children.

Based on our results, we concluded that although the duplicate plate was initially more labour intensive and costly, the diary method required a large number of assumptions regarding the amount and type of specific foods consumed, due to the inability of some parents and/or caregivers to recall those details. Therefore, the data obtained with the duplicate plate technique appear to be more reliable. Use of the diary in any investigation may lead to greater expense for buying samples of items for fluoride analysis that were reported as consumed, if the numbers were large, and parents would need to be very careful in maintaining the diary and in recording the amounts, as well as the kinds of foods and beverages consumed. The utilization of a combination duplicate plate technique and standardized questionnaire/diary would appear to provide a reliable and cost-effective approach. A duplicate plate technique for beverages and a dietary diary for foods appear to be the most sensible approach.

During the investigation, the following observations were also made: (i) the participants' compliance while acceptable in this study could be enhanced with more careful and thorough monitoring; (ii) according to a follow-up questionnaire, most parents thought the instruction sheet for performing the duplicate plate was understandable; (iii) a majority of participants believed that a monetary compensation would be necessary to maintain compliance; and (iv) collections performed in the day-care facilities were labour intensive, and it may not be appropriate to ask day-care personnel to perform this task. Further inquiries are planned to determine the duration most desirable for a collection period and how these should be performed during a year.

What this paper adds

- This is the first study that compares two methods (duplicate plate and dietary diary) used as a measurement tool for gathering data concerning fluoride ingestion, which is essential information to continue optimizing the beneficial effects of fluoride while decreasing its detrimental effects.
- The results of the study indicated that values obtained using both methods are comparable; however, the use of dietary diary required estimation of portion sizes and brand names used, which may lead to biased results.
- The results of our study determined that both methods have inherent problems and sources of error. A combination of both methods seems to be most suitable to obtain reliable data, and a combination of both may be the best suited to maintain compliance, and obtain reliable, valid information in a cost-effective manner.

Why this paper is important to paediatric dentists

- Paediatric dentists will obtain information regarding two tools used for gathering data concerning fluoride ingestion, a relevant topic in their practices or research projects.

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