Patterns of Fluoride Intake from 36 to 72 Months of Age

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Abstract

Objectives: *This paper reports on estimated daily fluoride intake from water by itself, beverages, selected foods, dentifrice, and dietary supplements, both individually and combined (mg and mg F/kg bw), among 785 children in the Iowa Fluoride Study from 36 to 72 months of age.* ***Methods:*** *Children were recruited in 1992–95, with questionnaires sent at four- to six-month intervals. Dietary fluoride intake estimates used community and individual water fluoride levels and average fluoride levels of beverages and foods prepared with water. Descriptive statistics and generalized linear models (GLM) assessed levels and associations with demographic factors.* ***Results:*** *There was substantial variation in fluoride intake, with some individuals' intakes greatly exceeding the means. Daily water fluoride intake estimates (in mg) increased with age, fluoride intake from other beverages and dentifrice both decreased slightly, and combined intake was quite consistent. For combined intake per unit body weight (mg F/kg bw), there was a steady decline with age. Therefore, the percentages with estimated intake exceeding possible thresholds for dental fluorosis also declined with age.* ***Conclusions:*** *Daily mean fluoride intakes from single and combined sources are relatively stable from 36–72 months of age among these children. [J Public Health Dent 2003;63(4):211-20]*

Key Words: fluoride, fluoride ingestion, fluoride intake, dentifrice, fluoride supplements, water, beverages, and foods.

Studies of fluoride ingestion were originally driven by efforts to better understand fluoride's role in preeruptive caries prevention, as it was believed that "the addition of fluorine to children's diets during the first seven or eight years of life offers great promise of reducing the prevalence of dental caries" (1). In more recent times, studies of fluoride ingestion have focused on the timing of ingestion relative to the development of dental fluorosis. Most studies of the timing of fluorosis development have focused on the esthetically most important maxillary central incisors, which appear to be most susceptible to fluorosis during the first 2½ years of life (2-4). Thus, most studies of fluoride ingestion have focused on infancy and early childhood. These studies have been extensively reviewed in recent years (5,6), and a common finding was considerable variation and complexity in fluoride ingestion patterns.

While studies have suggested the most critical time for fluorosis development may be during the first 2½ years of life during the transition between the late secretory and early maturation stages of enamel formation (7), fluorosis also can occur with exposure to fluoride only during the postsecretory (maturation) phase of enamel formation (8). An early study of the timing of fluorosis of the maxillary central incisors suggested that the most critical time for fluoride ingestion was between 35 and 42 months of age (9). Thus, it is important to consider fluoride ingestion beyond 2½ to 3 years of age. Moreover, fluorosis can raise esthetic concerns in teeth that develop later, particularly the maxillary canines, as all maxillary anterior teeth may play a role in esthetic perceptions (10).

As described previously, most studies of fluoride ingestion have focused on younger children, but a few have included children up to 8 years of age. McClure (1) estimated that 4- to 6-year-olds consumed 0.56–1.11 mg of fluoride from optimally fluoridated water and diet, or about 0.023 to 0.085 mg F per kilogram body weight. However, it must be remembered that at the time of these estimates, fluoride from dietary sources was limited, no therapeutic fluoride products were available, and the study used "market basket" estimates of fluoride intake rather than actual, individual determinations. Schamschula et al. (11) used 7-day diet records to assess dietary fluoride intake among 67 Hungarian children with a mean age of 3.9 years. The authors reported that mean fluoride intakes from food, beverages, and water was greater in areas of higher water fluoride concentrations, with mean fluoride intakes for low (≤0.11 ppm), moderate (0.5–1.1 ppm), or high (1.6–3.1 ppm) water fluoride levels of 0.22 mg/day, 0.72 mg/day, and 1.11 mg/day, respectively. Brunetti and Newbrun (12) used a duplicate diet approach to assess dietary fluoride intake in 10 3- and 4-year-old children living in an optimally fluoridated area. Their study assessed children's diets for 2–4 consecutive days and reported the mean fluoride intake of 0.33 mg/day. More recently, Guha-Chowdhury et al. (13) also used a duplicate diet approach to assess total fluoride among a group of 3- to 4-year-old New Zealand children. For this study, fluoride intake from diet and toothpaste were used to estimate "total" fluoride intake. The study found that children's mean fluoride intakes were 0.49 mg/day and 0.68 mg/day in nonfluoridated and fluoridated areas,

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respectively. In terms of per body weight, the mean daily fluoride intake values were 0.027 mg F/kg body weight in nonfluoridated areas and 0.036 mg F/kg body weight in fluoridated areas. When only dietary sources were considered, fluoride intake was 0.15 mg/day (0.008 mg/kg) in nonfluoridated areas, and 0.36 mg/day (0.019 mg/kg) in fluoridated areas. The authors also estimated that use of fluoride supplements for children in nonfluoridated areas potentially could increase their mean fluoride intake to levels higher than for children in fluoridated areas.

In addition to studies of total fluoride intake, other studies have focused on fluoride intake solely from beverages. Pang et al (14) estimated fluoride intake from beverages among 79 4–6-year-olds and 89 7–10-year-olds in North Carolina. For this study, specific beverages including soft drinks, fruit juices, and fruit drinks that were consumed by study participants were assayed for fluoride. Their study found mean fluoride intakes from beverages of 0.54 mg and 0.60 mg for 4–6-year-olds and 7–10-year-olds, respectively. A study of 213 sixth grade children reported by Clovis and Hargreaves (15) used 3-day beverage records and found that fluoride intakes varied considerably among individuals and that nonwater beverages could contribute substantially to fluoride intake, particularly among children in nonfluoridated areas. Lastly, an estimate of fluoride intake from water alone, assuming water fluoride concentration of 1.0 ppm, found that fluoride intake decreases with age beginning at about 9 months of age (16). The estimated fluoride intake from optimally fluoridated water alone ranged from 0.070 mg/kg for 3- to 3½-year-olds to 0.057 mg/kg for 5½- to 6-year-olds to less than 0.050 mg/kg for children aged 7½ years and older.

TABLE 1
Characteristics of Sample at Baseline (*n*=785)

Variable/Category	Percentage
Sex	
Male	49.4
Female	50.6
Mother's age (years)	
<20	3.3
20–24	17.1
25–29	31.5
30–34	30.3
≥35	17.8
Father's age (years)	
19–24	8.8
25–29	28.8
30–34	34.2
≥35	28.2
Mother's education	
Up to high school	20.9
Some college	34.0
College graduate/ more	45.1
Father's education	
Up to high school	28.5
Some college	27.9
College graduate/ more	43.5
Family income	
<$20,000	14.8
$20,000–$39,000	36.2
≥$40,000	49.0
Race	
White	94.0
Other	6.0
First child	
Yes	45.0
No	55.0

FIGURE 1
Estimated Median, Mean, 75th, and 90th Percentiles of Fluoride Intake from Water by Itself (mg F)

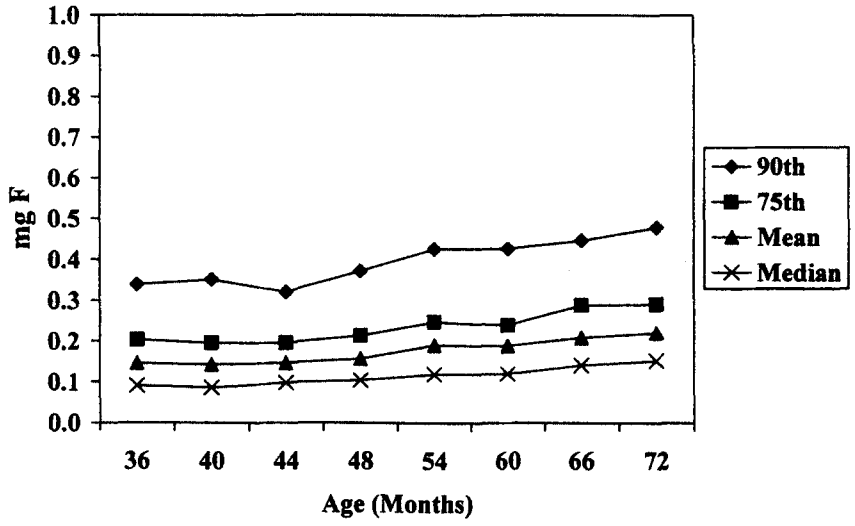


FIGURE 2
Estimated Median, Mean, 75th, and 90th Percentiles of Fluoride Intake from Other Beverages (mg F)

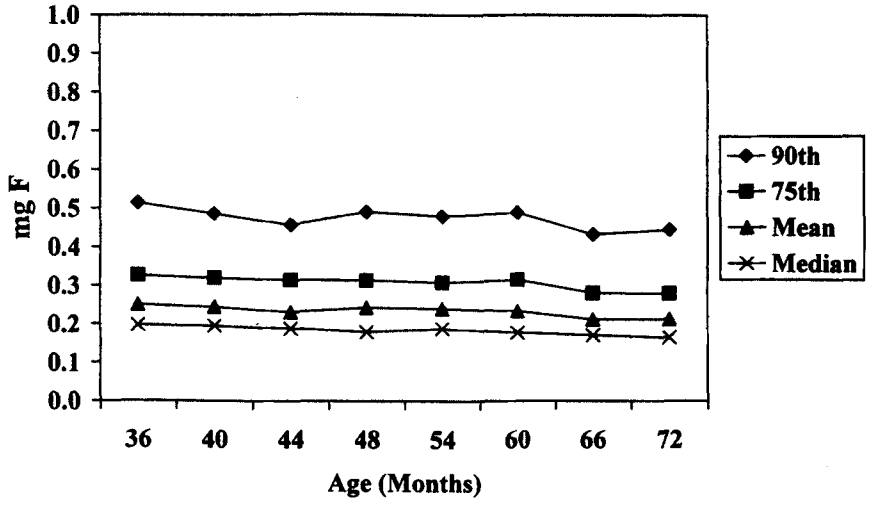


FIGURE 3
Estimated Median, Mean, 75th, and 90th Percentiles of Fluoride Intake from All Beverages (mg F)

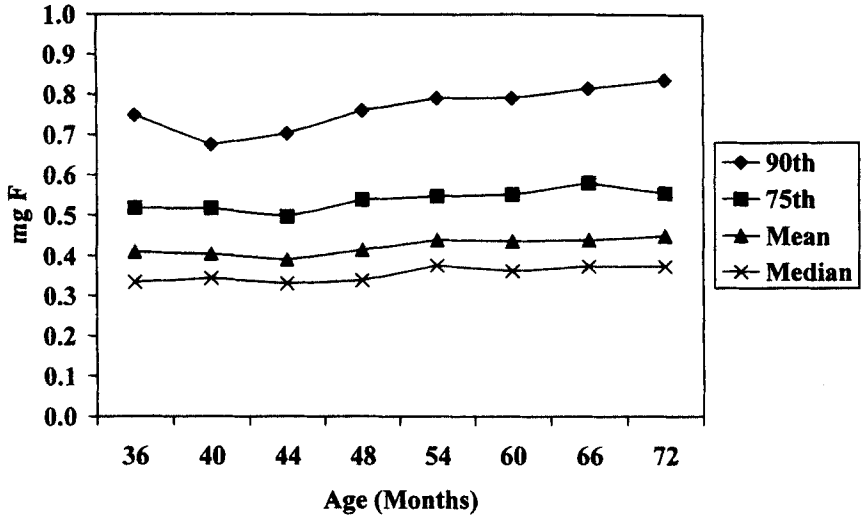
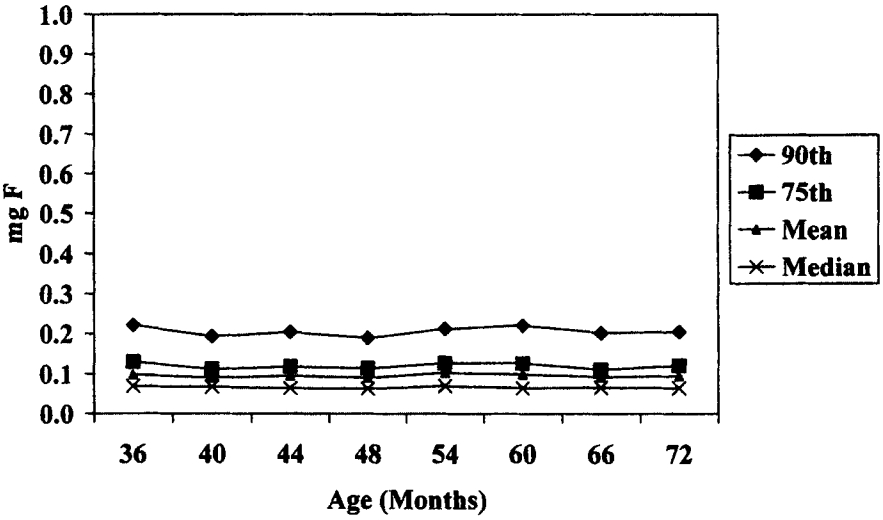


FIGURE 4
Estimated Median, Mean, 75th, and 90th Percentiles of Fluoride Intake from Selected Foods Prepared with Water (mg F)



The purposes of this paper are to report the distribution of estimated fluoride intake to 72 months of age from water, beverages and selected foods, dentifrice, dietary fluoride supplements and combined, and to assess demographic factors associated with levels of combined fluoride intake from 36 to 72 months of age. We previously reported estimated fluoride intake from birth to 36 months of age from water, dentifrice, and dietary fluoride supplements individually and combined (17), but here include also beverages (e.g., juices, soft drinks) and selected foods. For birth to 72 months, we also present mean percentages of the combined fluoride intake from each source.

Methods

Data were collected from participants in the Iowa Fluoride Study, a longitudinal study of fluoride intake among a birth cohort recruited from March 1992 to February 1995 (18-20). Study methodologies have been described in detail previously (17), so here we provide a more streamlined summary. After approval by the University of Iowa Institutional Review Board, mothers and newborns were recruited from eight Iowa hospital postpartum wards, informed consent administered, and baseline information obtained concerning age, education, and family income. Questionnaires were sent at 1.5- to 4-month intervals to 36 months of age and 4- to 6-month intervals from 36 to 72 months. Nonrespondents were contacted again after 3 and 6 weeks. All returned questionnaires were assigned a "return age" closest to the age at which they were filled out (36, 40, 44, 48, 54, 60, 66, or 72 months) to simplify presentation.

Questionnaires included a series of items concerning the children's fluoride exposures and ingestion during the previous time period from dietary and nondietary sources. A modified food frequency questionnaire assessed numbers and sizes of daily servings of different categories of beverages and foods made with water (18). Categories included water by itself (21), beverages with water added to frozen or powder concentrate (21), selected foods (e.g., instant cereals, pasta, rice, concentrated soups, Jello®) (18), and ready-to-drink beverages (22,23). Individual well water sources and those using filtration were assayed for fluoride using ion-specific electrode, and were reassayed annually and when water sources changed. Monthly state health department data on water fluoride levels were used for nonfiltered public water sources. Ready-to-drink beverages (i.e., juices, soft drinks, bottled waters) were assigned average fluoride levels from our extensive analyses by category. Information about the main nondietary sources, dentifrice (19) and dietary fluoride supplements (20), was gathered from items included in the questionnaires, as described previously. Using these sources of information, separate estimates were made for daily fluoride intake in mg from these individual categories and combined (17). Parent reports of children's body weights were used to allow calculation of estimated daily combined fluoride intake per unit body weight (mg F/kg bw).

Seasonal variation in both fluoride intake and body weight made an adjustment necessary when estimating combined fluoride intake divided by body weight. Least-square means adjusted by age were used to model a seasonal component. Generalized linear models (GLM) (24) were used to model trends in fluoride intake as well

FIGURE 5
Estimated Median, Mean, 75th, and 90th Percentiles of Fluoride Intake from Dentifrice (mg F)

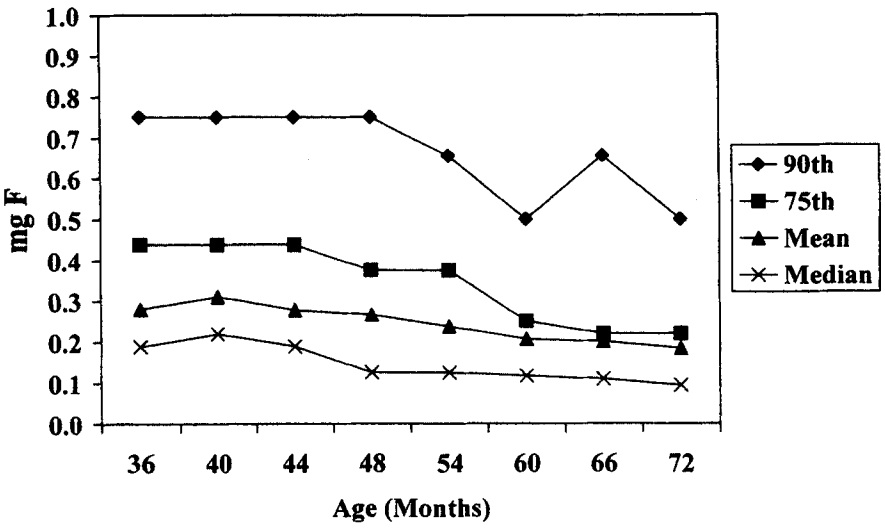


TABLE 2
GLM Analysis of Fluoride Intake per Kilogram Body Weight (Fluoride from Ingested Dentifrice, Supplements, Water, Other Beverages, Selected Foods)

Parameter	Estimate	Standard Error	95% Confidence Limits Low	High	Z	Pr>|Z|
Intercept	0.052	0.008	0.036	0.067	6.61	.0001
Seasonal adjustment	0.504	0.174	0.163	0.844	2.90	.004
Age (months)	–0.0006	<0.0001	–0.0006	–0.0005	–17.13	.0001
Mother not high school graduate	0.010	0.005	0.0003	0.019	2.02	.05
Family income <$20,000	0.008	0.003	0.002	0.014	2.58	.01

as to assess associations with demographic factors.

Parental responses were not validated, but reliability was assessed about 7–10 days later for selected questions from approximately 200 questionnaires at ages 36–72 months. Percentage agreements were 95.5 percent concerning water filtration status (kappa=0.82) and 80 percent concerning toothbrushing frequency (weighted kappa=0.81).

Results

Seven hundred eighty-five subjects returned at least one questionnaire from 36 to 72 months of age. Approximately 600 responses were received at each time point from 36 to 72 months (605 at 36 months, 607 at 48 months, 623 at 60 months, and 587 at 72 months). One hundred seventy subjects had 8 responses from 36 to 72 months, 236 subjects had 7 responses, 114 had 6 responses, 77 had 5 responses, 72 had 4 responses, and 116 had 1 to 3 responses.

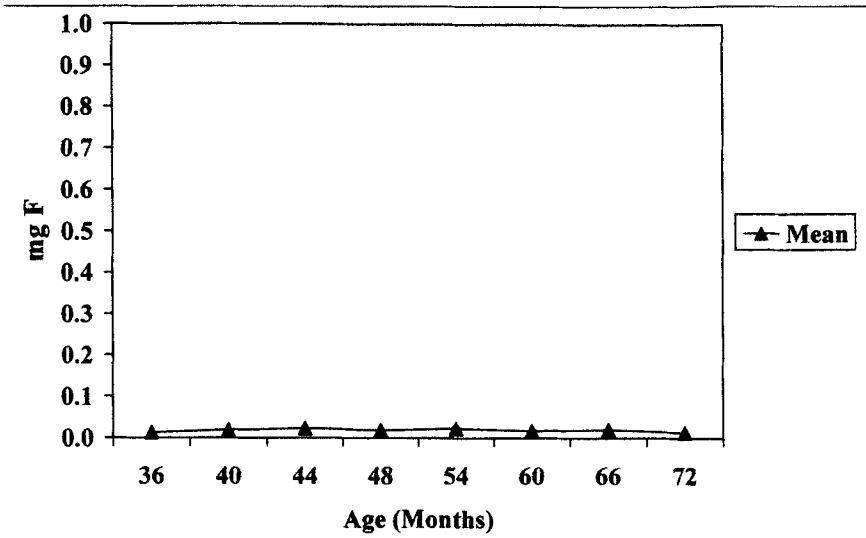
Table 1 summarizes demographic characteristics at birth for the 785 respondents. Families were of generally high socioeconomic status (SES), with about 75 percent of parents having some college education and 85 percent having family incomes in 1992–95 of $20,000 or greater. Most mothers (80%) were aged 20–34 years and over 90 percent of fathers were aged 25 years or older at baseline.

Figures 1–7 present selected results (mean, median, 75th, and 90th percentiles) from individual sources of fluoride in mg. Estimated daily mg of fluoride ingested from water by itself (Figure 1) increased about 50 percent with increasing age from 36 to 72 months, while there was a slight decline (about 15%) in mg fluoride from other (non-water) beverages (Figure 2). Figure 3 shows there was a slightly higher level of beverage fluoride intake from 54–72 months of age compared with 36–48 months. Estimated fluoride intake from selected foods prepared with substantial water is shown in Figure 4, with relatively consistent intake over time. Figure 5 shows that estimated fluoride intake from dentifrice declined (approximately one-third) from 36 to 72 months of age. Estimated mean fluoride intake from dietary supplements was consistently quite low, because fewer than 10 percent of children during each time period were using supplements (Figure 6). Figure 7 shows simultaneously the mean levels of intake from each of the individual sources and combined.

Figures 8 and 9 present means and selected percentiles from all sources combined in both mg and mg/kg bw from 1.5 months to 72 months. Figure 8 shows that estimated daily combined fluoride intake in mg from water, beverages, selected foods made with water, supplements, and dentifrice was quite consistent from 36–72 months of age, and generally higher than prior to 36 months. Estimated combined fluoride intake per unit body weight (mg F/kg bw) is summarized in Figure 9. With increasing body weight, the stable absolute fluoride intake results in a steady decline of about one-third from 36 to 72 months of age. In Figures 1–9, substantial variation among individuals is evident. Fluoride intake distributions were all positively skewed, with 90th percentiles approximately twice as high as the median levels at each age. (Appendices 1 and 2 provide detailed information, including interquartile ranges for combined fluoride intake.)

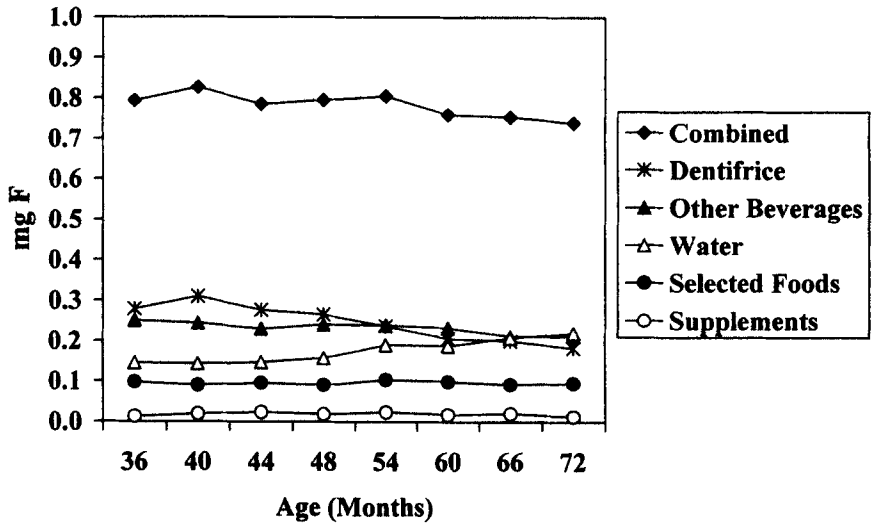
Figure 10 shows the mean percentages of combined intake that were from each of the individual categories from 1.5 to 72 months. From 1.5 to 12 months, the majority of estimated daily fluoride intake was from beverages other than water by itself—primarily infant formula. The largest single category thereafter remained beverages other than water, constituting

FIGURE 6
Estimated Mean* Fluoride Intake from Supplements (mg F)



*Median, 75th, and 90th percentiles were all 0 (less than 10% using supplements).

FIGURE 7
Estimated Mean Fluoride Intakes from Water by Itself, Other Beverages, Selected Foods Prepared with Water, Supplements, Dentifrice, and Combined (mg F)



about 35–45 percent, with juices the major contributor. Water by itself increased from less than 10 percent of intake through 9 months, to nearly 20 percent from 12 to 48 months, and to nearly 30 percent at 72 months. Dietary fluoride supplements declined from about 15 percent at 1.5 months to about 5 percent at 9 months to about 2 percent from 20 months and thereafter. Percentage from dentifrice increased from about 5 percent at 12 months to about 35 percent from 32 to 40 months, with a decline thereafter to about 22 percent at 72 months. Declines in proportion of dentifrice that was ingested outweighed increases in brushing frequency and amount of dentifrice used per brushing to cause an overall decrease in fluoride ingestion from dentifrice after 40 months. Fluoride from selected foods made with water increased from about 2 percent at 3 months to about 15 percent from about 9 months on.

Figure 11 shows all the individual data points from the whole distribution of fluoride intake per unit body weight from 36 to 72 months. Substantial variation within individuals is demonstrated by the lines connecting results longitudinally for a random selection of 5 boys and 5 girls.

Figure 12 shows that the percentages of subjects with daily intake in mg F/kg bw at each questionnaire point exceeding the intake levels of 0.03, 0.04, 0.05, 0.06, and 0.07 mg F/kg bw declined with increasing age. For example, the percentage exceeding 0.05 mg F/kg bw declined from about 46 percent at 36 months to 33 percent at 54 and 17 percent at 72 months. Similarly, the percentage exceeding 0.07 mg F/kg bw declined from 23 percent (36 months) to 15 percent (54 months) to 6 percent (72 months).

The appendices summarize in greater detail estimated daily fluoride intake from individual sources and combined, with results in mg in Appendix 1 and in mg/kg bw in Appendix 2.

Generalized linear models were used to model fluoride intake per kg body weight by age. Fluoride intake per kg body weight generally declined with age, showing a significant linear effect ($P<.0001$). Nonlinear effects were negligible ($P=.45$), so only a linear age effect was used to further explore the relationships between fluoride intake and other demographic information, including sex, whether the subject was the first child for the family or not, mother's educational level, mother's age, mother's race, and family income. Since fluoride intake levels and body weight vary seasonally, a seasonal adjustment was also added to the model.

Depending on the month in which the questionnaire was filled out, a seasonal adjustment factor was assigned to each response using least-squares means of fluoride intake (per kg body weight) adjusted by the age of the child. The least-squares means indicated that fluoride intake per kg body weight was highest in the summer months (when water consumption is high) and lowest in April, November, and December (when weight is high).

Using a backward elimination procedure, nonsignificant model effects ($P>.05$) were dropped from the model one at a time, starting with the variable having the highest P-value. The final model, presented in Table 2, includes a seasonal adjustment, a linear age effect, a mother's education effect, and an income effect. When the mother had not graduated from high school,

FIGURE 8
Estimated Mean, Median, 75th, and 90th Percentiles of Combined Fluoride Intake (mg F) from Dentifrice, Supplements, Water, Selected Foods, & Beverages

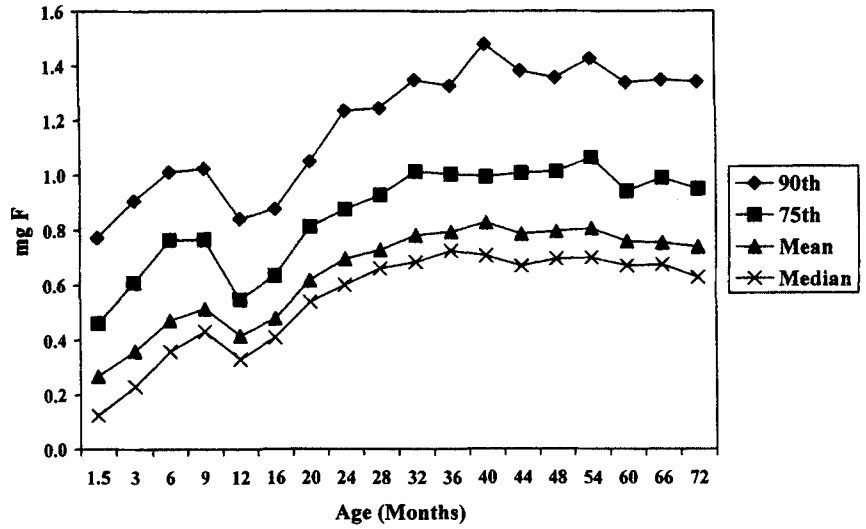
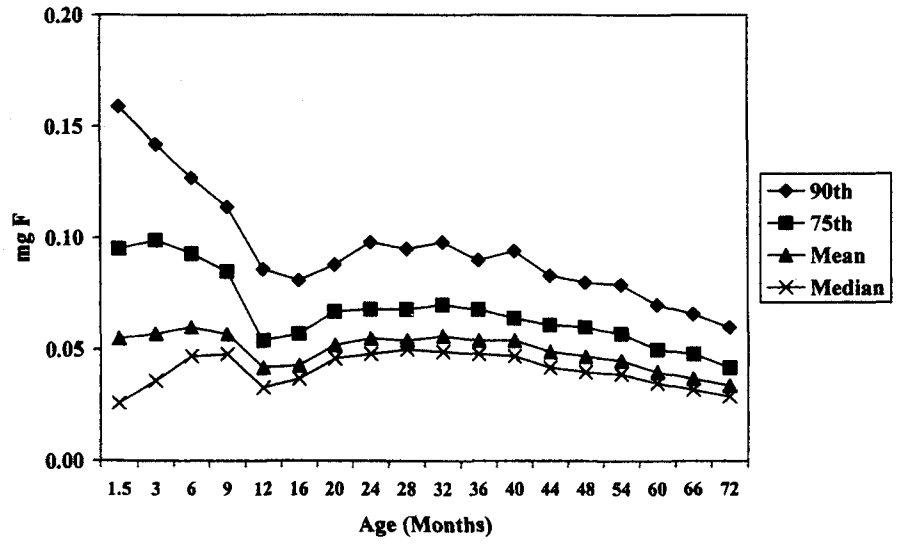


FIGURE 9
Estimated Mean, Median, 75th, and 90th Percentiles of Combined Fluoride Intake from Dentifrice, Supplements, Water, Selected Foods, and Beverages per Unit Body Weight (mg F/kg bw)



fluoride intake was higher and when the family income was below $20,000 per year, the intake was also higher. Fluoride intake per kg body weight in general declined with age.

Discussion

Patterns of fluoride intake (in mg) are relatively stable from 36 to 72 months of age from individual (Figures 1–6) and combined (Figure 8) sources. This is especially true for the means and medians, while there is more fluctuation in the upper percentiles (e.g., 90th). These patterns are quite different from those found previously from birth to 36 months in the same cohort (17). There we found that, although dietary fluoride supplement intake was low and stable, (1) dentifrice fluoride increased substantially from 6 to 24 months and then generally leveled off; and (2) total water fluoride (from water by itself and added to foods/beverages) and combined fluoride intake generally increased to 9 months, dropped at 12 months, and increased thereafter to 36 months. The levels of fluoride intake from 36 to 72 months are stable probably due to the relative stability of the diets during these ages. Unlike during the ages from birth to 36 months, from 36 to 72 months there are relatively few new foods added to the diet or that are no longer part of the diet. In addition, toothbrushing behaviors and the use of fluoride dentifrice have become well established. Because combined fluoride intake is stable while body weight increases with increasing age, fluoride intake per unit body weight (mg F/kg bw) declines on average (Figure 9).

Despite the generally stable overall group patterns of fluoride intake from individual sources and combined from 36 to 72 months, there was substantial individual variation at each age with fairly wide interquartile ranges (see Appendices 1 and 2).

Such individual variation is consistent with previous studies (5,6,15). Although it is difficult to compare the results of the present study to previous ones because of the different methods used to assess fluoride intakes, the results seem to be generally consistent with those from previous studies. For example, the mean fluoride intake per day (about 0.8 mg as in Figure 8) and mean fluoride intake per kilogram body weight (about 0.05 mg/kg as in Figure 9) found in the present study are approximately in the middle of the range suggested by McClure (1)—0.56–1.11 mg and 0.023–0.85 mg/kg, respectively—for 4–6-year-olds. In comparing the present study findings to results of studies of younger subjects (11-13,17), the mean amount of fluoride ingestion per day was slightly higher, likely due to greater age and body weight.

The period from 36 to 72 months is generally considered beyond the time of substantial risk for dental fluorosis of the permanent incisors and first molars (2,3,7), but it could have substantial importance in risk of development of fluorosis of the later-erupting canines, premolars, and second molars. Although the maxillary incisors are most prominent esthetically, the later-erupting teeth—especially maxillary canines and premolars—could be noticeable esthetically. Therefore, it is worthwhile to consider the percentages of children with estimated combined fluoride intake per unit body weight exceeding designated levels

FIGURE 10
Mean Percentages of Combined Fluoride Intake (mgF) by Category (6 Weeks to 6 Years)

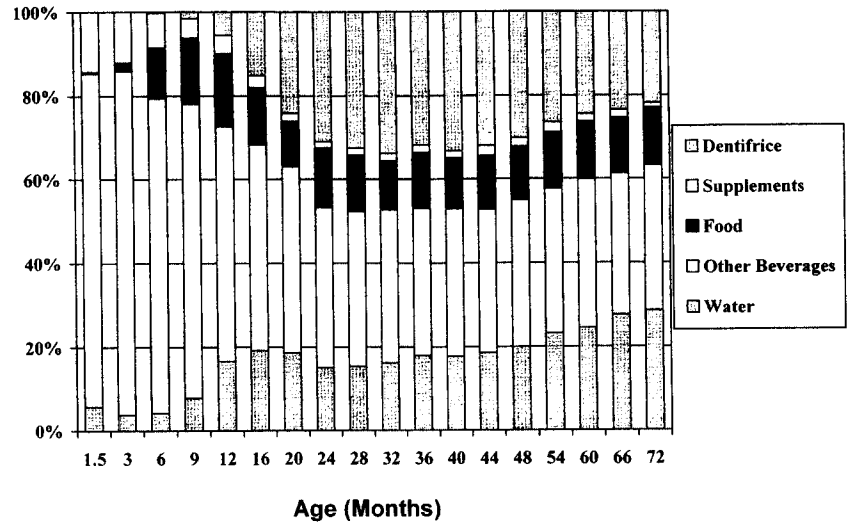
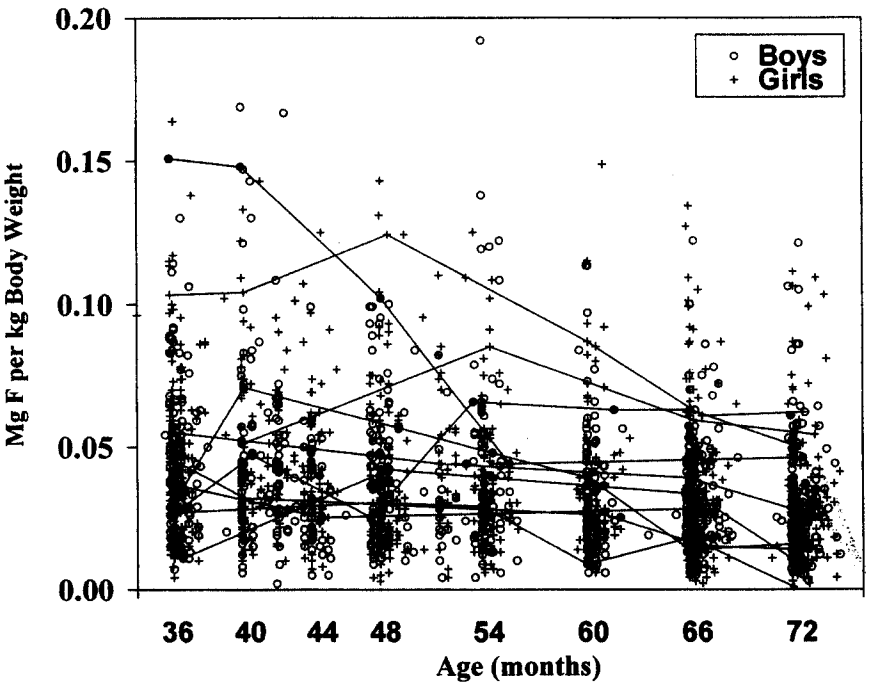


FIGURE 11
Fluoride Intake per Unit Body Weight

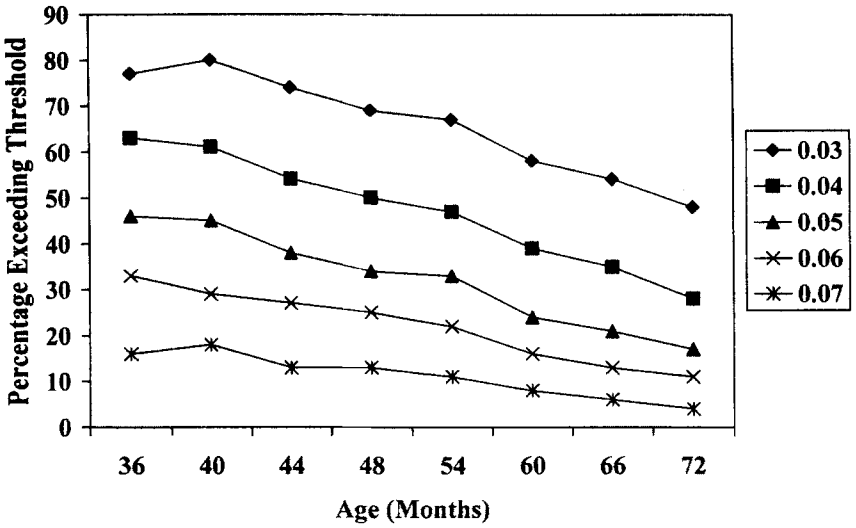


believed associated with fluorosis. The 90th percentiles from 36 to 54 months exceed the level of 0.07 mg F/kg bw, believed to be the upper bound of the so-called "optimal" range (5,6) for fluoride intake, with the level declining to 0.07 at 60 months (Appendix 2 and Figure 9). The 75th percentiles to 60 months were in the "optimal" range of 0.05–0.07, while the means and medians were generally lower at all ages (0.029–0.054 for 36–72 months). However, even these levels may be sufficient to cause dental fluorosis, since levels as low as 0.03 mg F/kg bw have been implicated (25,26). Thus, depending on the threshold chosen, varying percentages reach the threshold. These percentages reaching various thresholds are generally about equal from ages 20 to 40 months, with a gradual decline thereafter.

In terms of the relative importance of the mean fluoride intakes from different sources for the cohort as a whole (Figure 10), dietary fluoride supplements were not very important and selected foods made with water were consistently less than 15 percent of combined intake. Estimated dentifrice ingestion was about 30 percent of combined intake from 36–54 months and declined slightly thereafter. Fluoride from water by itself was about 20 percent of intake for 36–48 months and increased to about 30 percent at 72 months, while the percentage of fluoride from other beverages was steady at about 35 percent throughout this period. Thus, any efforts to reduce excessive fluoride intake during these ages of importance to the later-erupting permanent teeth may be best targeted toward those inappropriately ingesting substantial quantities of fluoride dentifrice and/or large quantities of soft drinks and juices. This would be consistent with ongoing efforts to encourage use of small, pea-sized amounts of F dentifrice and adoption of a lower concentration fluoride dentifrice for young children (27-29).

Generalized linear models were used to develop a model of factors related to fluoride intake, with lower socioeconomic status, as measured by lower family income and mothers' not having a high school education, being predictive of higher fluoride intake per kilogram body weight. This finding was surprising, as at least one previous study (30) demonstrated a relationship between higher SES and fluorosis, indicative of higher fluoride intake during early childhood among higher SES children. The authors speculated that higher SES children were more likely to comply with fluoride supplementation, and were more likely to use fluoride dentifrice. In the present study, however, there were few meaningful differences in dentifrice or supplement use between high and low SES children. Rather, fluoride from water, particularly water added to beverages (such as beverage concentrates), was significantly higher in lower SES children. This finding may be due to greater use of low-fluoride bottled water among higher SES families, higher intakes of beverages made with water (e.g., powdered soft drinks), or higher intakes of water by itself. Perhaps lower SES children were less likely to consume ready-made products such as regular soft drinks or juice drinks because they are more costly than water or beverages

FIGURE 12
Percentages of Subjects with Estimated Combined Fluoride Intake Exceeding Designated Intake Levels (mg F/kg bw)



made at home with water.

These findings should be interpreted in the context of study limitations. The initial study sample, although recruited from eight different hospitals, was not representative of a defined population. The initial sample was generally of high SES and the long-term participants were of even higher SES. The sample sizes varied due to overall attrition and nonresponse at individual time points. Although individual assay results and water system assays were used to calculate estimated water fluoride intake from well, filtered, and bottled water sources and nonfiltered public water supplies, fluoride levels of soft drinks and juices were assigned average fluoride values from our assay of hundreds of different products (22,23). In addition, it was not feasible to directly validate results, although we do not have evidence that parent reports were systematically biased in any way.

In summary, there was substantial individual variation in fluoride intake from single sources and combined. However, at the group level, combined fluoride intake in mg was quite consistent with increasing age from 36–72 months. Dentifrice, water, and other beverages were the largest contributors to combined fluoride intake. Combined intake per unit body weight declined with age. Substantial percentages exceeded different thresholds (i.e., 0.05–0.07 mg F/kg bw) related to fluorosis etiology, and these percentages declined with age. Although levels at these ages are not of substantial concern for incisor fluorosis, they could be important in fluorosis of the later erupting canines and premolars which also have esthetic importance. Thus, additional study is warranted.

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APPENDIX 1

Daily Combined Fluoride (mg F) from Water, Other Beverages, Selected Foods*, Dentifrice, and Supplements (*N*=785)

Adjusted Month	*N*	Min.	10th %ile	25th %ile	Median	Mean (SD)	75th %ile	90th %ile	95th %ile	Max.
1.5	654	0.000	0.000	0.008	0.125	0.269 (0.326)	0.461	0.772	0.911	1.748
3	714	0.000	0.000	0.046	0.230	0.359 (0.363)	0.608	0.906	1.049	1.963
6	673	0.000	0.054	0.145	0.358	0.471 (0.385)	0.764	1.011	1.162	2.202
9	668	0.004	0.103	0.196	0.430	0.514 (0.368)	0.766	1.024	1.193	1.915
12	618	0.022	0.104	0.189	0.330	0.415 (0.325)	0.547	0.840	0.994	2.135
16	588	0.017	0.145	0.250	0.409	0.478 (0.324)	0.634	0.877	1.078	1.948
20	549	0.028	0.253	0.356	0.539	0.617 (0.359)	0.812	1.051	1.202	2.730
24	574	0.044	0.275	0.402	0.600	0.696 (0.426)	0.875	1.234	1.512	3.247
28	540	0.023	0.300	0.433	0.661	0.728 (0.411)	0.927	1.243	1.485	3.770
32	536	0.023	0.307	0.467	0.685	0.781 (0.442)	1.012	1.348	1.560	3.242
36	538	0.118	0.323	0.474	0.726	0.794 (0.448)	1.003	1.327	1.669	3.321
40	411	0.057	0.352	0.503	0.708	0.827 (0.495)	0.993	1.479	1.890	3.381
44	430	0.112	0.324	0.470	0.670	0.785 (0.463)	1.007	1.381	1.646	3.300
48	529	0.065	0.307	0.462	0.696	0.795 (0.491)	1.012	1.356	1.736	4.394
54	558	0.099	0.311	0.468	0.700	0.805 (0.479)	1.064	1.426	1.765	3.540
60	542	0.027	0.279	0.435	0.671	0.759 (0.457))	0.941	1.339	1.628	2.753
66	533	0.080	0.281	0.436	0.675	0.754 (0.438)	0.990	1.349	1.594	2.629
72	501	0.058	0.277	0.420	0.628	0.739 (0.465)	0.950	1.342	1.607	2.957

*Foods are those with substantial water added by the subjects/families, including powdered infant cereals, oatmeal, rice, pasta, canned soups, and gelatin.

APPENDIX 2
Daily Combined Fluoride (mg F per kg bw) from Water, Other Beverages, Selected Foods*, Dentifrice, and Supplements (*N*=785)

Adjusted Month	*N*	Min.	10th %ile	25th %ile	Median	Mean (SD)	75th %ile	90th %ile	95th %ile	Max.
1.5	647	0.000	0.000	0.002	0.026	0.055 (0.066)	0.095	0.159	1.88	0.401
3	701	0.000	0.000	0.007	0.036	0.057 (0.058)	0.099	0.142	0.166	0.346
6	665	0.000	0.007	0.018	0.047	0.060 (0.050)	0.093	0.127	0.147	0.343
9	655	0.000	0.011	0.022	0.048	0.057 (0.042)	0.085	0.114	0.133	0.240
12	614	0.002	0.011	0.019	0.033	0.042 (0.034)	0.054	0.086	0.103	0.272
16	572	0.002	0.013	0.022	0.037	0.043 (0.029)	0.057	0.081	0.099	0.186
20	531	0.002	0.021	0.030	0.046	0.052 (0.031)	0.067	0.088	0.102	0.240
24	563	0.004	0.022	0.032	0.048	0.055 (0.035)	0.068	0.098	0.128	0.298
28	531	0.002	0.023	0.032	0.050	0.054 (0.031)	0.068	0.095	0.116	0.307
32	530	0.002	0.022	0.032	0.049	0.056 (0.032)	0.070	0.098	0.115	0.223
36	534	0.007	0.022	0.032	0.048	0.054 (0.032)	0.068	0.090	0.112	0.246
40	402	0.003	0.024	0.032	0.047	0.054 (0.034)	0.064	0.094	0.122	0.283
44	426	0.006	0.020	0.029	0.042	0.049 0.029)	0.061	0.083	0.103	0.202
48	524	0.003	0.018	0.028	0.040	0.047 (0.030)	0.060	0.080	0.104	0.254
54	552	0.006	0.017	0.026	0.039	0.045 (0.027)	0.057	0.079	0.100	0.223
60	535	0.002	0.015	0.023	0.035	0.040 (0.025)	0.050	0.070	0.089	0.153
66	526	0.004	0.014	0.021	0.032	0.037 (0.023)	0.048	0.066	0.078	0.152
72	498	0.003	0.012	0.019	0.029	0.034 (0.021)	0.042	0.060	0.074	0.136

*Foods are those with substantial water added by the subjects/families, including powdered infant cereals, oatmeal, rice, pasta, canned soups, and gelatin.