Water Consumption and Nursing Characteristics of Infants by Race and Ethnicity

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Abstract

Objectives: *The purpose of this project was to determine racial/ethnic differences in water consumption levels and nursing habits of children younger than 2 years old.* ***Methods:*** *Data from the 1994–96 Continuing Survey of Food Intakes by Individuals (CSFII) were used for these analyses. Water consumption and breast-feeding data on 946 children younger than 2 years old were used.* ***Results:*** *For black non-Hispanic children younger than 2 years old (n=121), 5.3 percent of the children were currently being breast fed. This percentage was less than that seen in other racial/ethnic groups. For white non-Hispanic children (n=620), this percentage was 10.8 percent; for Hispanic children (n=146), 12.2 percent; for "other" children, 18.5 percent (n=59). Black non-Hispanic children had the highest total water consumption (128.6 ml/kg/day) among all groups, white non-Hispanic had the lowest (113.2 ml/kg/day). These differences were not statistically significant in multivariate regression modeling. Black non-Hispanic children also drank more tap water (21.3 ml/kg/day) than white non-Hispanic children (12.7 ml/kg/day) and Hispanic children (14.9 ml/kg/day). The difference was statistically significant in multivariate regression modeling.* ***Conclusions:*** *The differences in breast feeding and water consumption observed among black children younger than 2 years of age could be a factor in the observed higher levels of fluorosis in black children compared to other children. [J Public Health Dent 2000;60(3):140-6]*

Key Words: infant, breast feeding, water consumption, water fluoridation, fluoride, dental fluorosis, race, ethnicity.

Fluoride exposure in the first years of life comes from (1) fluoridated tap water consumed on its own or mixed with infant formula concentrates, dry cereals, or other reconstituted beverages; (2) fluoridated water used in the processing of infant formula and other food and beverages; and (3) fluoride toothpastes and supplements. It is well established that this fluoride exposure during periods of enamel formation can lead to dental fluorosis. Histologic studies have identified the early maturation phase of enamel development to be the most critical time for fluorosis development (1,2). Several epidemiologic studies have confirmed this chronology and have shown that excessive fluoride intake during the first few years of life is a significant risk factor for dental fluorosis in the permanent incisors and first molars (3-8). Recent reports have focused on fluorosis of the primary teeth (9), which also are affected by fluoride exposure in the first years of life.

In a previous paper (10), we estimated that a typical infant up to age 1 year who drinks fluoridated water containing 1.0 ppm fluoride (F) would consume approximately 0.08 mg F/kg/day from water alone. Others also have identified similar levels of fluoride intake in infants from water intake (11,12). The so-called "optimal" range of fluoride intake, where minimal fluorosis is expected to occur, is considered to be 0.05–0.07 mg F/kg/day (13-15), but there is no firm scientific basis for this estimated range (16). For infants consuming fluoridated water as part of a normal diet outside of breast feeding, their fluoride consumption levels may be sufficient to cause dental fluorosis in their permanent dentition (17,18). For this reason, levels of water consumption during infancy are of interest in understanding fluorosis development.

Several studies have investigated fluorosis levels in different racial/ethnic groups. Generally, these studies have found blacks to have higher fluorosis levels than whites and other racial/ethnic groups. Russell found 40.2 percent of continuously resident blacks to have fluorosis, compared to 19.3 percent of continuously resident whites in the Grand Rapids fluoridation trials (19). Butler et al. found blacks to have an odds ratio of 2.32 (95% CI=1.44,3.71) for fluorosis compared to whites and Hispanics (20). Williams and Zwemer (21) also found fluorosis to be higher in blacks than whites in Augusta, GA, but not significantly so. Heller (22), using data from the 1986–87 NIDR Children's Survey, found non-Hispanic blacks to have higher levels of very mild or greater fluorosis than black-Hispanics, white non-Hispanics, white-Hispanics, and Asian/Pacific Islanders (27.9%, 23.3%, 22.6%, 19.8%, 15.2%, respectively); however, these differences were not significant. In a recent study, Kumar and Swango (23) found an odds ratio of fluorosis for blacks to be 2.3 (95%

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CI=1.8, 3.0), compared to whites for very mild to severe fluorosis.

Few theories have been proposed to explain these differences. One plausible reason is that there are differences in the feeding characteristics of the infants. The purpose of this study was to assess and compare the breast-feeding and water consumption characteristics of infants younger than 2 years of age from different racial and ethnic groups. We hypothesize that differences in water consumption may help to explain the observed higher levels of fluorosis generally seen in black children.

Methods

This study is an analysis of data from the 1994–96 Continuing Survey of Food Intake by Individuals (CSFII), conducted by the US Department of Agriculture (USDA) (24). The conduct of this study has been discussed previously (10). In summary, the study was a stratified, multistage probability sample of individuals in US households. Two separate 24-hour dietary surveys were obtained describing all food and drink consumed the previous day between midnight and midnight. For children, this information came from a parent or caregiver. A computer-assisted food coding and data management system (Survey Net) was used by the USDA to calculate the nutritional composition of the food and drink consumed. Extensive quality control procedures were used in this study, including regular monitoring and validation and reliability testing of study personnel.

Of the total 15,303 persons with both 24-hour dietary surveys, 14,640 persons had complete water, food, demographic, and body weight data. Twenty-one persons with a total water intake relative to body weight over 6 standard deviations from the mean (greater than 249 g water/kg/day) were eliminated as outliers, leaving 14,619 participants. Of these persons, there were 946 children younger than age 2 years. This sample of 946 persons represents a US population of 7,163,440 persons younger than 2 years of age.

In the CSFII, parents or caregivers were asked whether the child was currently breast feeding. No further information was obtained concerning breast feeding frequency or duration. The USDA used a computer-assisted food coding system to tabulate the amounts of water consumed from the 24-hour dietary surveys. For water consumption determination in this study, eight general sources of water consumption were analyzed: (1) plain tap water, (2) reconstituted powdered or liquid infant formula made from drinking water, (3) ready-to-feed and other infant formula, (4) milk and milk drinks, (5) baby food, (6) fruit and vegetable juices and other noncarbonated drinks, (7) carbonated beverages, and (8) other foods and beverages.

The analyses consisted of descriptive statistics of the breast-feeding and water intake of the infants by racial/ethnic groups, including black non-Hispanic, white non-Hispanic, Hispanic and "other" (Asian, Pacific Islander, American Indian, Alaskan Native, and other nonspecified racial/ethnic groups). The variables of age, sex, region, and urbanicity were investigated for inclusion as covariates in multivariable regression modeling. Region was categorized as Northeast, Midwest, South, and West. Urbanicity of the residence was categorized as being in a Metropolitan Statistical Area (MSA), outside of an MSA, or being in a non-MSA. This corresponds to urban, suburban, or rural areas. Poverty level was investigated both as a continuous and as a categorical variable. The continuous variable "poverty income ratio" was calculated by dividing the family's annual income by the federal poverty threshold for that size household. A three-level categorical variable, "poverty category," was derived from the poverty income ratio, representing family's annual incomes of 0–1.30, 1.31–3.50, and greater than 3.50 times the federal poverty level.

Bivariate logistic regression (one outcome variable and one predictor variable) was used to determine the bivariate associations with whether or not the child was currently breast feeding as the dichotomous measure outcome and the racial/ethnic groups and other covariates as predictor variables. Bivariate linear regression was used to determine the bivariate associations with total water intake and tap water intake as the continuous measure outcomes and the racial/ethnic groups and other covariates as predictor variables. Covariates with P-values of less than .25 in the bivariate analyses were further considered for inclusion in the multivariate models. Manual backwards stepwise elimination procedures were used for the multivariate modeling (25,26). First, all covariates meeting the $P<.25$ criterion were included in a multivariate regression model. Second, variables demonstrating clear lack of contribution to the model (determined by examining the −2 log likelihood values and P-values of the regression coefficients in the logistic regression models, or by examining the P-values of the regression coefficient in the linear regression models) were eliminated from the model. Variables that had been removed previously were reconsidered in the reduced models. This process was repeated until an efficient and parsimonious model was produced. In the third step, plausible interaction terms were tried in the main effects model and were retained if they contributed significantly and substantially.

Data management was carried out using Statistical Analysis System (SAS®) software for personal computers (27). Survey Data Analysis (SUDAAN®) software for personal computers was used for all analyses to adjust standard errors for the complex sampling design (28). The "With Replacement" sampling design was used.

Results

Breast Feeding. Table 1 shows the percentage of children under 2 years of age who were reported to be currently breast fed for the different racial/ethnic groups as well as by the covariate groups. Overall, 10.8 percent of all infants were currently being breast fed. Bivariate analyses for breast feeding and racial/ethnic group had an overall Wald chi-square value of 4.10 (P=.250, df=3). Because of our particular interest in this association, individual 2x2 chi-square tests were performed and odds ratios calculated for specific racial/ethnic group combinations. The association between breast feeding in white non-Hispanic and black non-Hispanic children had a significant chi-square P-value of .047, but a nonsignificant odds ratio of 2.17 (95% CI=0.85, 5.54). No other significant differences existed for breast-feeding prevalence between the five other racial/ethnic group combinations.

From the bivariate analyses of the

TABLE 1
Breast Feeding by Race/Ethnicity and Covariates

Variable	*n*	% Breast Feeding	SE	Wald Chi-square	*P*-value
Race/ethnicity				4.10	.250
Black non-Hispanic	121	5.31	2.35		
White non-Hispanic	620	10.84	1.67		
Hispanic	146	12.17	3.99		
Other	59	18.45	7.15		
Age				11.09	<.001
<12 months	296	16.42	2.69		
12–24 months	650	6.39	1.28		
Sex				2.57	.109
Male	475	13.21	1.97		
Female	471	8.33	1.84		
Urbanicity				4.75	.093
Urban	305	7.84	1.88		
Suburban	446	11.18	1.93		
Rural	195	15.01	2.73		
Region				4.23	.238
Northeast	175	11.36	3.48		
Midwest	197	8.25	2.23		
South	352	9.32	1.85		
West	222	14.78	2.76		
Poverty income ratio*	946			0.95	.330
Poverty category†				0.90	.638
0–1.30	289	9.21	1.79		
1.31–3.50	424	10.79	2.02		
>3.50	233	12.29	2.90		
Total	946	10.80	1.22		

*Total family income/federal poverty level income for that size of family, a continuous variable.
†Categories derived from poverty income ratio.

TABLE 2
Multiple Logistic Regression Model of Breast Feeding

Variable	Beta Coefficient	SE Beta	*T*-test B=0	*P*-value *T*-test	OR (95% CI)
Intercept	−3.96	0.61	—	—	—
Race/ethnicity					
Black non-Hispanic (ref)	—	—	—	—	1
White non-Hispanic	0.62	0.48	1.28	.207	1.85 (0.70, 4.89)
Hispanic	0.73	0.62	1.17	.248	2.07 (0.59, 7.27)
Other	1.34	0.76	1.75	.087	3.80 (0.81, 17.8)
Age (<12 months)	1.07	0.30	3.51	.001	2.90 (1.57, 5.35)
Sex (male)	0.58	0.34	1.70	.095	1.79 (0.90, 3.57)
Urbanicity					
Urban (reference)	—	—	—	—	1
Suburban	0.33	0.34	0.95	.346	1.39 (0.69, 2.77)
Rural	0.69	0.35	1.95	.057	1.99 (0.98, 4.04)

−2 Log-likelihood with betas=0: 1,311.43. −2 Log-likelihood full model: 603.89. Approximate chi-square: 707.54. Degrees of freedom: 7. Approximate *P*-value: <.01.

covariates, the continuous poverty income ratio variable and the categorical poverty variables were eliminated because of their high Wald chi-square *P*-values. Interestingly, however, breast-feeding levels increased with increasing wealth, suggesting a linear relationship. The continuous-measure variable appeared to have a somewhat stronger association with breast feeding than the categorical variable. All other variables (race, age, sex, urbanicity, and region) were considered for inclusion in the multivariate models.

In building the multivariate logistic regression model, the region variable (represented by 3 indicator variables) was eliminated because it was nonsignificant and contributed little to the model. All the other variables were left in the model. No interaction variables contributed significantly, so they were not included in the final logistic model, which is shown in Table 2.

Table 2 shows that the odds ratios (OR) of breast feeding of white non-Hispanic, Hispanic, and other racial/ethnic groups compared to black non-Hispanics were 1.85 (95% CI=0.70, 4.89), 2.07 (95% CI=0.59, 7.27), and 3.80 (95% CI=0.81, 17.8), respectively. While the differences among the groups were not statistically significant, they imply that black non-Hispanic infants had lower levels of breast feeding than the other racial/ethnic groups. Age was strongly associated with breast feeding, with children under age 12 months having an OR of 2.90 (95% CI = 1.57, 5.35) of currently being breast fed compared to children aged 12–24 months. As in the bivariate analyses, males had a higher prevalence of breast feeding, and children in urban areas were the least likely to be breast fed; however, these associations did not reach $P<.05$ levels of significance.

Water Intake. Water intake from plain tap water, milk, reconstituted formula, ready-to-feed formula, baby food, carbonated drinks, noncarbonated drinks, and other sources by racial/ethnic groups is shown in Table 3. Overall, black non-Hispanic children had the greatest total water ingestion (128.6 ml/kg/day) and white non-Hispanic children had the least (113.2 ml/kg/day). Because preliminary analyses found that the only statistically significant differences between the racial/ethnic groups were in plain tap water consumption and

TABLE 3
Water Consumption (ml/kg/day) by Race/Ethnicity (SE shown in parentheses)

Race/Ethnic Group	n	Tap Water	Milk	Reconst. Formula	RTF Formula	Baby Food	Carbon. Drinks	Noncarb. Drinks	Other	Total
Black non-Hispanic	121	21.3	24.0	35.3	3.9	7.5	2.2	13.7	20.9	128.6
		(1.71)	(4.61)	(5.95)	(1.95)	(1.64)	(0.68)	(1.33)	(1.71)	(5.67)
White non-Hispan.	620	12.7	23.2	28.8	7.9	10.4	1.1	11.3	17.9	113.2
		(0.77)	(1.16)	(2.67)	(1.46)	(1.18)	(0.17)	(0.73)	(0.76)	(2.61)
Hispanic	146	14.9	22.9	37.9	11.5	9.5	1.1	9.6	16.0	123.2
		(1.23)	(2.35)	(7.30)	(4.04)	(1.37)	(0.34)	(1.57)	(1.37)	(5.18)
Other	59	20.5	18.6	30.5	18.8	7.3	1.3	8.4	18.7	123.9
		(2.41)	(3.67)	(9.12)	(11.23)	(4.0)	(0.47)	(1.98)	(3.23)	(10.57)

TABLE 4
Plain Tap Water Consumption by Race/Ethnicity and Covariates

Variable	N	Tap Water (ml/kg/day)	SE	Wald Chi-square	P-value
Race/ethnicity				26.4	<.001
Black non-Hispanic	121	21.3	1.71		
White non-Hispanic	620	12.7	0.77		
Hispanic	146	14.9	1.23		
Other	59	20.5	2.41		
Age				30.0	<.001
<12 months	296	11.0	1.03		
12–24 months	650	17.7	0.78		
Sex				0.0	.907
Male	475	14.7	1.00		
Female	471	14.8	0.78		
Urbanicity				3.7	.155
Urban	305	16.4	1.46		
Suburban	446	13.3	0.92		
Rural	195	15.2	1.24		
Region				3.7	.295
Northeast	175	13.4	1.40		
Midwest	197	14.2	1.02		
South	352	14.6	1.30		
West	222	16.5	1.14		
Poverty income ratio*	946			12.6	<.001
Poverty category†				12.7	.000
0–1.30	289	19.2	1.52		
1.31–3.50	424	13.9	0.96		
>3.50	233	11.7	1.32		
Total	946	14.8	0.63		

*Total family income/federal poverty level income for that size of family, a continuous variable.
†Cateorized poverty income ratio.

total water consumption, we concentrated on investigating the role of race/ethnicity for these two categories.

Plain Tap Water Intake. Table 4 shows the bivariate linear regression analyses of tap water intake per kg body weight per day by race/ethnicity, age, sex, urbanicity, region, poverty income ratio, and poverty category. Significant differences were found in water consumption by race/ethnic group ($P<.001$). Specific comparisons using ANOVA showed significant differences between white non-Hispanic and black non-Hispanic groups ($P<.001$), white non-Hispanic and other groups ($P=.004$), and black non-Hispanic and Hispanic groups ($P=.004$).

Children younger than 12 months of age consumed less plain tap water (11.0 ml/kg/day) than children aged 12–24 months (17.7 ml/kg/day) ($P<.001$). No significant differences were found in plain tap water consumption by sex, urbanicity, or by region. Higher poverty level (i.e., higher wealth) was significantly associated with lower water consumption when analyzed both as a continuous variable ($P<.001$) or as a three-level categorical variable ($P=.001$). Plain tap water consumption decreased with each increase in categorical poverty level, suggesting a linear relationship.

From the above analyses, the race/ethnicity main variable of interest, as well as the covariates of age, urbanicity, and poverty income ratio were included in the multivariate linear regression analysis of plain tap water consumption. Urbanicity was tried in the model because its bivariate association, while not significant, had a P-value less than .25. Urbanicity was removed from the regression model because of lack of significance, and no interaction terms contributed significantly or substantially to the model.

The final regression model of plain tap water consumption is shown in Table 5. Plain tap water consumption differed significantly by racial/ethnic groups when controlling for the covariates of age and poverty level. For the same age and poverty level, a white non-Hispanic child would consume 5.98 ml/kg/day less plain tap water than a black non-Hispanic child.

TABLE 5
Multiple Linear Regression Model of Plain Tap Water Consumption

Variable	Beta Coefficient	SE Beta	*T*-test B=0	*P*-value *T*-test
Intercept	28.52	2.47	—	—
Race/ethnicity				
Black non-Hispanic	—	—	—	—
White non-Hispanic	–5.98	1.61	–3.70	<.001
Hispanic	–5.44	1.95	–2.78	.008
Other	1.67	3.28	0.51	.613
Age (>12 months)	–6.95	1.26	–5.50	<.001
Poverty income ratio*	–3.10	0.90	–3.46	.001

R^2=0.092.
*Total family income/federal poverty level income for that size of family, a continuous variable.

TABLE 6
Total Water Consumption by Race/Ethnicity and Covariates

Variable	*N*	Tap Water (ml/kg/day)	SE	Wald Chi-square	*P*-value
Race/ethnicity				11.3	.010
Black non-Hispanic	121	128.6	5.67		
White non-Hispanic	620	113.2	2.61		
Hispanic	146	123.2	5.18		
Other	59	123.9	5.67		
Age				19.4	<.001
<12 months	296	129.8	4.55		
12–24 months	650	108.0	1.66		
Sex				0.2	.653
Male	475	116.3	4.05		
Female	471	118.9	3.15		
Urbanicity				6.9	.031
Urban	305	122.9	3.52		
Suburban	446	117.4	3.07		
Rural	195	109.1	3.89		
Region				2.2	.525
Northeast	175	121.3	6.34		
Midwest	197	119.7	3.14		
South	352	113.3	3.68		
West	222	119.0	4.56		
Poverty income ratio*	946			16.1	<.001
Poverty category†				19.4	<.001
0–1.30	289	128.2	2.57		
1.31–3.50	424	116.5	4.21		
>3.50	233	108.9	3.45		
Total	946	117.6	2.28		

*Total family income/federal poverty level income for that size of family, a continuous variable.
†Cateorized poverty income ratio.

Plain tap water consumption decreased by 3.10 ml/kg/day for each increasing unit of poverty income ratio. For example, a child at twice the poverty level (poverty income ratio = 2) would be expected to consume 3.10 ml/kg/day less plain tap water than a child at the poverty level (poverty level =1).

Total Water Intake. Bivariate analyses of total water intake per kg body weight per day for racial/ethnic groups and the covariates are shown in Table 6. As with plain tap water intake, significant associations were seen with race/ethnicity, age, urbanicity, and poverty level. The only specific significant difference between the racial groups for total water consumption was between black non-Hispanics and white non-Hispanics (ANOVA, P=.006). Black non-Hispanics had the highest level of total water consumption at 128.6 ml/kg/day, while white non-Hispanics had the lowest at 113.2 ml/kg/day. Total water intake per kg body weight was less for the 12–24-month-old children than for those younger than 12 months of age. Urban children consumed more water than their suburban and rural counterparts. Total water intake appeared to decrease linearly with poverty level; therefore, the continuous poverty income ratio variable was used in the multiple regression analyses.

Urbanicity was deleted from the total water multivariate regression model because of lack of significance. No interaction terms were included because of lack of contribution. The final model is shown in Table 7. When controlled for age and poverty income ratio, there were no significant differences in total water consumption by racial/ethnic groups. While black non-Hispanic children still showed the highest levels of total water consumption, the differences were not statistically significant. Total water consumption for children younger than 12 months of age was 21.13 ml/kg/day more than that for children aged 12–24 months. While the older children actually consume more water than the younger children, their consumption by body weight is less. As with tap water, total water consumption was strongly associated with the poverty income ratio. For the same racial/ethnic group and same age, a child at twice the poverty income ratio would be expected to consume 6.57 ml/kg/day less water than a child at the poverty level.

Discussion

A major strength of this study was that it examined relatively large numbers of children and used a probability sampling design that allows us to extrapolate these data to the US population. Another strength was the quality

TABLE 7
Multiple Linear Regression Model of Total Water Consumption

Variable	Beta Coefficient	SE Beta	T-test B=0	P-value T-test
Intercept	128.64	6.38	—	—
Race/ethnicity				
Black non-Hispanic (ref)	—	—	—	—
White non-Hispanic	–9.68	5.38	–1.80	.079
Hispanic	–6.39	7.59	–0.84	.404
Other	–1.67	11.58	–0.14	.886
Age (< 12 months)	21.13	5.09	4.15	<.001
Poverty income ratio*	–6.57	2.21	–2.97	.005

R^2=0.085.
*Total family income/federal poverty level income for that size of family, a continuous variable.

of the dietary information—with parents or caregivers completing two 24-hour diet summaries for their infants. Previous studies of fluorosis typically have relied on parental recall of infant feeding that occurred many years previously. The obvious weakness of this study was that, being cross-sectional, we were not able to actually look at the fluorosis levels of the children. Because of this limitation, we cannot make any direct conclusions regarding the associations among race/ethnicity, infant diet, and fluorosis.

Several previous studies have found associations between infant formula use and fluorosis (3,4,6,29,30), while other studies did not detect such associations (31,32). Because of the concern of the possible adverse effects of fluoride in infant formulas, American formula manufacturers all voluntarily began to limit the fluoride content of their products in the early 1980s. All of the referenced studies involved the use of formulas made before this restriction of the formula fluoride content. In a recent study, Kumar and colleagues (33) found breast-fed children to have an unadjusted OR of 1.4 (95% CI=1.00, 1.88) for having fluorosis, compared to those not breast fed; no explanation for this finding was presented. Many researchers, however, have pointed out that fluoridated water intake alone during infancy could be sufficient to cause fluorosis (10-12,17,18).

Because the exact amount of fluoride necessary to cause fluorosis is not known (13-16), it is not possible to determine definitively whether the observed differences in the feeding habits of black non-Hispanic infants would be great enough to cause higher future fluorosis than in other racial/ethnic groups. Black non-Hispanic children consumed significantly more tap water (21.3 ml/kg/day) than white non-Hispanic (12.7 ml/kg/day) and Hispanic (14.9 ml/kg/day) children. Black non-Hispanic children also tended to breast feed less and drink more total water; however, the differences between the racial/ethnic groups were not statistically significant. Other studies have investigated breast-feeding differences in racial/ethnic groups. A study of 696 teenaged mothers found that 15 percent of the African-American, 45 percent of Caucasian, and 55 percent of Mexican-Americans chose to breast feed their children (34). It is important to recall that the CSFII asked only if the children were currently being breast fed, not if they had ever been breast fed. Because of the way in which this information was obtained, breast-feeding prevalence in this survey may not be directly comparable to results from surveys where information was obtained differently.

Because of the amount of fluoride consumed in the diet and the timing of this consumption by infants, it is plausible that dietary differences could play a role in the previously observed higher levels of fluorosis seen in black children. It is important, however, to acknowledge that water and dietary fluoride consumption is but one source of fluoride exposure contributing to fluorosis etiology, and that other sources of fluoride—such as dentifrice and supplements—are also important. Kumar and colleagues (33) found higher fluorosis in blacks even when controlling for possible confounders including breast feeding, and they concluded that more research is necessary to determine whether fluorosis is more apparent among African-Americans or whether the differences in fluorosis may be due to differences in fluoride exposure or fluoride metabolism. An interesting anecdotal observation is that African-American children have been found to have higher rates of lactose intolerance and may drink less milk than whites (35); this difference was not seen in our study. If milk consumption is involved in the binding and excretion of fluoride, lactose intolerance could be a factor in fluorosis. Obviously, more research is needed to pursue these ideas. Ideally, a longitudinal study is needed where comprehensive dietary intake and fluoride history is obtained for the first several years of life, and then the children are examined when they are older for dental fluorosis in the primary and permanent dentitions.

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