



Tooth-brushing and Dentifrice Use Among Children Ages 6 to 60 Months

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Abstract

Purpose: Tooth-brushing and fluoride dentifrice use are the primary oral health activities for young children. Fluoridated dentifrice has had an important impact on the reduction in children's caries lesion rates, but no studies have focused on patterns of use at multiple time points early in life. The purpose of this paper is to describe tooth-brushing and fluoride dentifrice use in a cohort of children from ages 6 to 60 months.

Methods: The data are from the Iowa Fluoride Study, a longitudinal investigation of fluoride intake from birth. Questionnaires assessed tooth-brushing patterns and fluoride dentifrice use at age 6 months, and at 3-, 4-, or 6-month intervals thereafter.

Results: At 6 months of age, 28% of the children's teeth were brushed or cleaned, and 3% of these used fluoridated dentifrice, increasing to 95% at 20 months (83% of them with fluoridated dentifrice). Use of dentifrice flavored for children increased from 40% of those brushing at 9 months to 71% at 60 months. From 9 to 32 months, about 55% of the children were using approximately the recommended amount of dentifrice. However, the percentage using more than recommended increased from 12% at 9 months to 64% at 60 months. Mothers placed the dentifrice on the toothbrush 85% of the time at 9 months, 81% at 20 months, 49% at 36 months, and 31% at 60 months.

Conclusions: By age 2, almost all children were brushing with fluoridated dentifrice, but less than half brushed twice a day, even at age 5. Mothers played the most important role in the children's home care habits. (*Pediatr Dent.* 2004;26:87-92)

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Dental caries is a multi-factorial disease, resulting from a variety of etiological factors such as dental plaque retention due to poor oral hygiene, cariogenic bacterial colonization, and ingestion of cariogenic substrate.¹⁻² Fluoride's effects on caries prevention have been well documented, as has its role in dental fluorosis.^{3,4} The most common source of topical fluoride for children is dentifrice. Other important sources of fluoride for young children include water, formula, and other infant foods, juices, and office topical fluoride applications.³ Approximately 98% of all dentifrice sold in the United States contains fluoride, and it is very widely used among all age groups.⁵ In a review by Burt, it was noted that the suggested upper limit of fluoride intake is being reached in many children by ingestion of fluoride from food and drink and from fluoride dentifrice.⁶

Several studies have assessed different aspects of fluoride dentifrice use.^{4,7-12} A study of infants up to age 12 months⁷

found that mothers did a majority of the brushing for children who were brushing their teeth, while Mattila et al found that 62% of 5-year-olds who were brushing were assisted by their mother and/or father.¹¹ A cross-sectional study by Adair et al,¹² among children ages 31 to 60 months found that the children in the cohort used more dentifrice and brushed longer with dentifrice flavored for children than with regular flavor. Another study done by Naccache et al¹³ found that among children ages 2 to 7 who used adult-flavored gel dentifrice, 77% placed the dentifrice on the toothbrush by themselves and the mean amount of dentifrice used per brushing was about 0.5 g. Although a few of these studies have focused in detail on patterns of fluoride dentifrice use at specific ages, none have looked at multiple time points per year early in life. It is important to better understand patterns of fluoride dentifrice use to make recommendations to enhance caries prevention and reduce fluorosis risk.

Table 1. Demographic Characteristics of Subjects and Their Families at Enrollment (%) (N=697 subjects)

Male	49	
Female	51	
Birth order		
First child	44	
Other	57	
Household income		
<\$19,999	13	
\$20,000-\$39,999	36	
\$40,000-\$59,999	29	
≥\$60,000	18	
Unknown	3	
Age	Mother	Father
16-24	18	7
25-29	33	27
30-34	31	33
35+	19	28
Unknown	0	5
Education	Mother	Father
High school/GED or less	20	27
Some college	35	27
4 yr. college or more	45	41
Unknown	0	5

Table 2. Numbers of Responses to Questionnaires at Different Ages

Age	Number of responses
6 months	638
9 months	633
12 months	587
16 months	585
20 months	551
24 months	541
28 months	533
32 months	532
36 months	535
40 months	434
44 months	406
48 months	539
54 months	567
60 months	569

obtained prior to the investigation. This study has collected large amounts of data over the past 10 years with the aim of relating estimated total fluoride intake and exposures to den-

The purpose of this paper is to describe tooth-brushing and fluoride dentifrice use in a cohort of children from ages 6 to 60 months.

Methods

The data for this study come from the Iowa Fluoride Study,^{4,7,14-16} a longitudinal investigation of fluoride intake among a cohort recruited at birth from 8 Iowa hospitals from March 1992 through February 1995. The project was approved by The University of Iowa Institutional Review Board, and parents' informed consent was

tal fluorosis and dental caries lesions. While the mothers and newborns were in the hospital postpartum and after informed consent was obtained, mothers provided information about their age, education, family income, and number of children in the household, and were informed about the protocol to be followed thereafter.⁷

Questionnaires were sent to the mothers when the children were 6 weeks and 3 months, and at 3-, 4-, or 6-month intervals thereafter. Shorter intervals were used with the youngest children whose feeding and tooth-brushing habits were less stable. This report concerns data up to and including the 60-month questionnaire. Questionnaires included detailed questions concerning the previous time period assessing water sources, ingestion of water by itself, water mixed with other beverages and foods, patterns of use of dietary fluoride supplements, tooth-brushing patterns, and type of dentifrice.

For this paper, the data concerning whether the children's teeth were cleaned/brushed were derived from a question on each questionnaire from 6 to 20 months of age asking if the child's teeth were cleaned or not.⁴ If the child's teeth had been cleaned, mothers were asked whether a cloth or toothbrush were used for the cleaning, but at 24 months of age, it was assumed that all children were using a toothbrush.

In each questionnaire, parents were asked to list the full name of the dentifrice the child most often used. This was then coded and linked to the study's database containing information about fluoridated vs nonfluoridated status and flavor of each dentifrice. Data concerning the frequency of brushing, who placed the dentifrice, and who brushed the teeth were derived from specific questions that addressed these issues on each questionnaire.^{4,7}

The data concerning amount of dentifrice used were obtained from each questionnaire using a series of diagrams of toothbrushes with varying amounts of dentifrice, with the parent selecting the picture that best depicted the amount that was most often used to clean the child's teeth.^{4,7} The 7 quantities, with estimated mg of fluoride in parentheses, were:

1. thick, full strip covering toothbrush head (1 mg);
2. thin, full strip (0.875 mg);
3. three quarters covered (0.75 mg);
4. half covered (0.5 mg);
5. one quarter covered (0.25 mg);
6. one eighth covered (0.125 mg);
7. one sixteenth covered (0.063 mg).

These quantities were then grouped further into 4 categories:

1. very small amount (0.063);
2. recommended amount (0.125 mg and 0.25 mg);
3. somewhat more than recommended (0.5 mg and 0.75 mg);
4. substantially more than recommended (0.875 mg and 1 mg).

The data were double entered and converted to SAS version 8.01 for analyses. Reliability of questionnaires was assessed by follow-up phone calls the week after receipt of

Table 3. Percentages of Children With Various Patterns of Tooth Cleaning by Age

Age in months	6	9	12	16	20	24	28	32	36	40	44	48	54	60
Teeth brushed or cleaned	29	53	74	91	97	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cleaning done with:*														
Cloth	85	46	18	3	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toothbrush	10	43	72	92	98	NA	NA	NA	NA	NA	NA	NA	NA	NA
Both	5	11	10	5	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
Use of dentifrice:*														
None	96	81	60	30	15	9	5	5	3	2	1	1	2	1
Fluoridated	3	17	37	67	83	89	94	94	96	98	98	99	98	98
Nonfluoridated	1	3	4	4	2	2	1	1	1	0	0	0	0	1

NA=not asked after 20 months.

*Percentage of those with teeth cleaned.

the completed questionnaire for a sample representing ages 28 to 60 months, using percent agreement and kappa scores. Toothpaste usage patterns over time were estimated using area under the curve (AUC) computed using the trapezoidal rule. The AUC composites represent months of usage for each dentifrice flavor category and separately for fluoridated dentifrice, as well as daily brushing frequency for children from age 12 months through 60 months. Descriptive statistics were generated, and associations between (1) dentifrice flavor (child, adult, none), (2) fluoridated dentifrice use, and (3) frequency of brushing per day were analyzed separately with (a) whether the child was the first in the family, (b) mother's level of education, (c) father's level of education, and (d) family income level. Spearman rank correlations were used to compare the AUC composites by education and income, and Wilcoxon rank sum tests were used for first-child status. Values of $P < .05$ were considered statistically significant.

Data concerning children using fluoridated dentifrice are reported beginning at 9 months due to the fact that there were only 8 children using dentifrice at 6 months of age.

Results

Table 1 summarizes the demographic characteristics of subjects and their families at enrollment. Over 47% of the families had household incomes of \$40,000+ per year, and 97% were Caucasian. Table 2 provides the number of responses received at each age among the total of 697 different families that submitted responses.

Reliability data were available for 2 questions on the questionnaires for ages 28 to 60 months ($N=190$). For brushing frequency, there was 81% agreement, with a simple kappa score of 0.69. For whether toothpaste was used when the children's teeth were brushed, agreement was 97% with a simple kappa of 0.27.

Table 3 shows that the percentage of children whose teeth were brushed or cleaned increased rapidly from 29% at 6 months to 97% at 20 months. Parents of infants often are told to either use a cloth or a toothbrush to clean their children's teeth. Parents distinguished between cloth and toothbrush for children 20 months of age or younger. Among those whose teeth were brushed or cleaned, exclusive cloth use declined from 85% (6 months) to 18% (12 months), exclusive use of a toothbrush increased from 10% at 6 months to 98% at 20 months, and small

percentages used both a toothbrush and cloth.

Table 3 also summarizes findings concerning use of dentifrice (fluoridated, nonfluoridated, both, or no type of dentifrice) among those with teeth brushed or cleaned. At 6 months of age, the large majority were using no dentifrice. Use of dentifrice increased rapidly to 91% of those with teeth cleaned at 24 months. Fluoridated dentifrice use increased dramatically from 3% at 6 months to 94% (28 months and after), while nonfluoridated dentifrice use and use of both were consistently low.

Figure 1 summarizes daily frequency of teeth being cleaned. The percentages brushing less than once a day and once a day increased at almost identical rates until 12 months of age, with once per day becoming more common from 16 months on. At 60 months, only 40% of children were brushing twice or more per day. Among those with their teeth cleaned, the mean daily frequency of cleaning increased from 1.02 to 1.12 (6-16 months) to 1.16 to 1.20 (20-36 months) and 1.28 to 1.41 (40-60 months) (data not shown). There was substantial variation, with standard deviations of 0.59 to 0.77.

Figure 2 summarizes the category of flavor of dentifrice used by those who were having their teeth brushed using dentifrice. The percentage using dentifrice flavored for children increased from 40% at 9 months to 71% at 60 months.

Figure 3 summarizes, among those cohort children whose teeth were brushed with dentifrice, the person(s) placing the dentifrice on the toothbrush. The mother alone most often placed the dentifrice on the toothbrush, but the percentage with mother alone placing the dentifrice declined with age from 81% to 88% (9-20 months) to 49% to 63% (24-36 months) and 31% (60 months). Fathers rarely were the primary responsible party ($\leq 5\%$ throughout), but fathers more frequently shared responsibility with mothers ($\leq 10\%$ to 20 months about 24% from 24-44 months, declining to 14% at 60 months). Parents placing

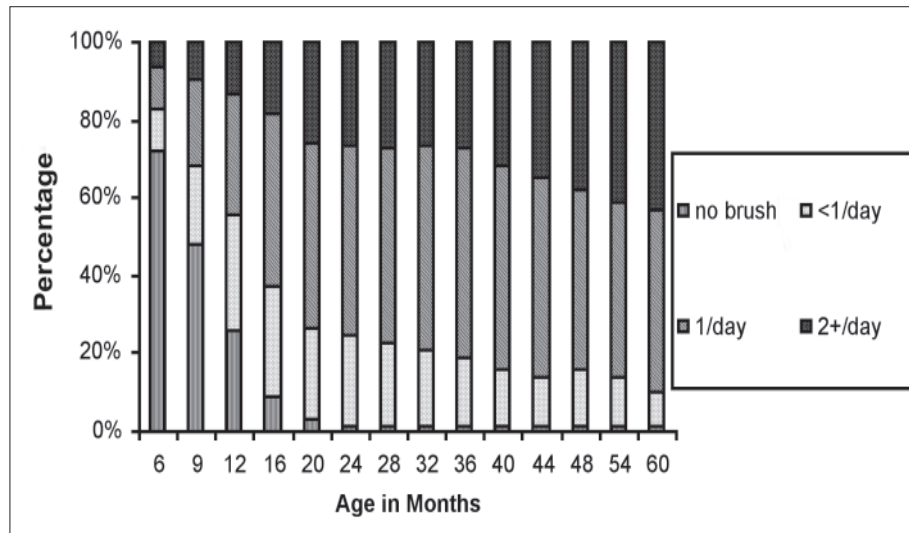


Figure 1. Frequency of cleaning among all cohort children.

the dentifrice along with their children increased from $\leq 1\%$ (9-20 months) to about 30% (48-60 months). Percentages of children placing dentifrice themselves increased from $\leq 1\%$ (9-32 months) to 21% (60 months).

Figure 4 summarizes, for all cohort children whose teeth were brushed, the person(s) brushing the teeth. Mothers alone cleaning the teeth decreased from 86% (6 months) to 5% (60 months). Fathers were infrequently the main one brushing ($\leq 5\%$), and mothers/fathers were also infrequently the main ones together ($\leq 7\%$). However, the percentage of parents and children sharing brushing increased substantially from 9% (12 months) to about 50% (24-60 months). The percentage of children brushing on their own increased substantially from 10% at 12 months to 44% at 60 months.

The percentages of children using different amounts of fluoridated dentifrice were collapsed into the 4 categories shown in Figure 5. From 9 to 32 months, 51% to 58% of the children reportedly were using approximately the recommended amount (0.125-0.25 g), declining to 28% at 60 months. The percentage of children using somewhat more than recommended amounts of dentifrice (0.5-0.75 g) increased from 12% (9 months) to 64% (60 months). The percentage using substantially more than recommended (0.875-1 g) was small, ($< 3\%$ to 28 months, 3%-5% for 32-54 months, and 7% for 60 months).

Spearman rank correlations for family income (7 levels) showed positive association with child-flavored dentifrice use AUC (cumulative number of months using child-flavored dentifrice) ($r=.23$,

$P<.01$), but negative association with adult-flavored dentifrice use AUC ($r=-.18$, $P<.01$) and no dentifrice use AUC ($r=-.10$, $P<.05$). Spearman rank correlations for mother's education (7 levels) with child-flavored dentifrice use AUC also showed positive association ($r=.10$, $P<.05$). A Wilcoxon rank sum test showed that first child status was positively associated with the use of adult-flavored dentifrice AUC ($P<.05$). The median number of months usage of adult-flavored dentifrice for first-born children was 14 months vs 10 months for children with older siblings. Spearman rank correlations showed brushing frequency AUC to be positively associated with both mother's ($r=.14$, $P<.01$) and father's educational level ($r=.14$, $P<.01$). No significant differences were found for fluoridated dentifrice use AUC by family income, parent educational level, or first-child status.

Discussion

In a study by Adair et al,¹² preschool-age children were seen to use larger amounts of dentifrice, brush for longer periods of time, and rinse and expectorate less when using a child-flavored dentifrice than when using an adult-flavored dentifrice. Other studies have also determined that children use more dentifrice when the product is a flavored-for-children dentifrice.⁹ In the present study, it was observed at 24 months that there were approximately the same number of children using regular-flavored dentifrice and dentifrice flavored for children. However, at age 28 months and older, more children were using dentifrice flavored for children.

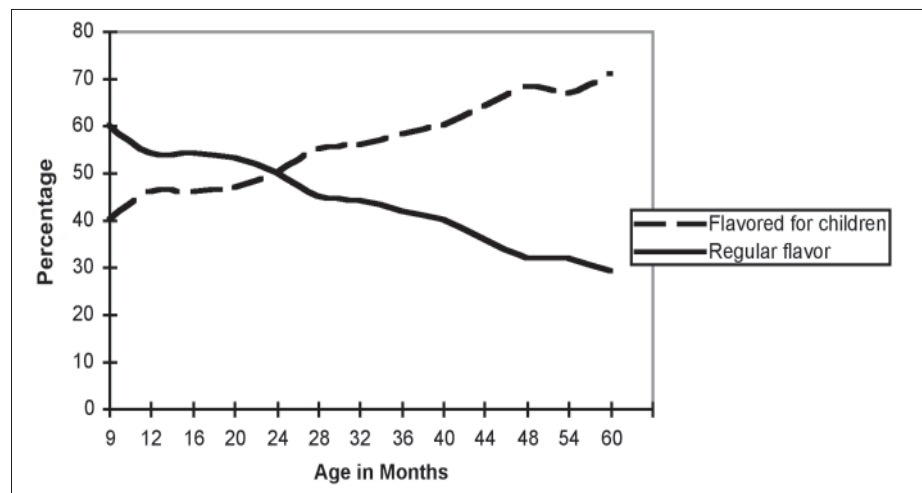


Figure 2. Category of dentifrice among children who used dentifrice.

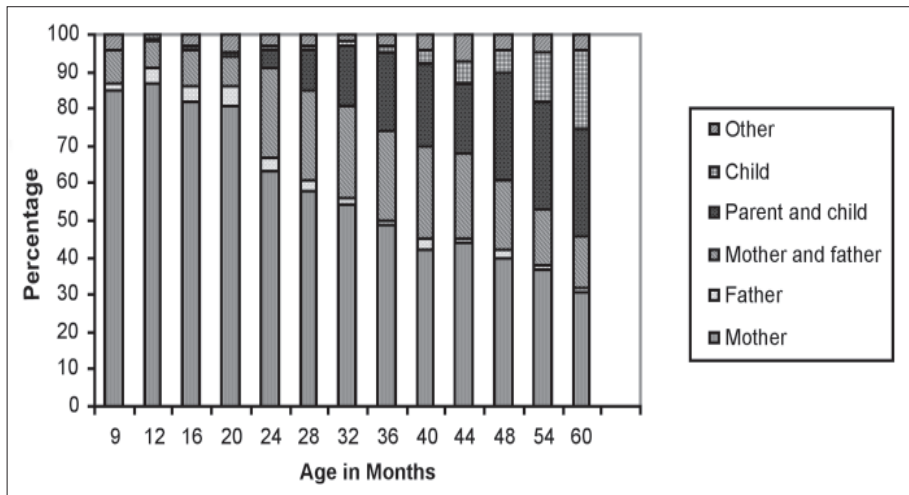


Figure 3. Person placing dentifrice (among those brushing with dentifrice).

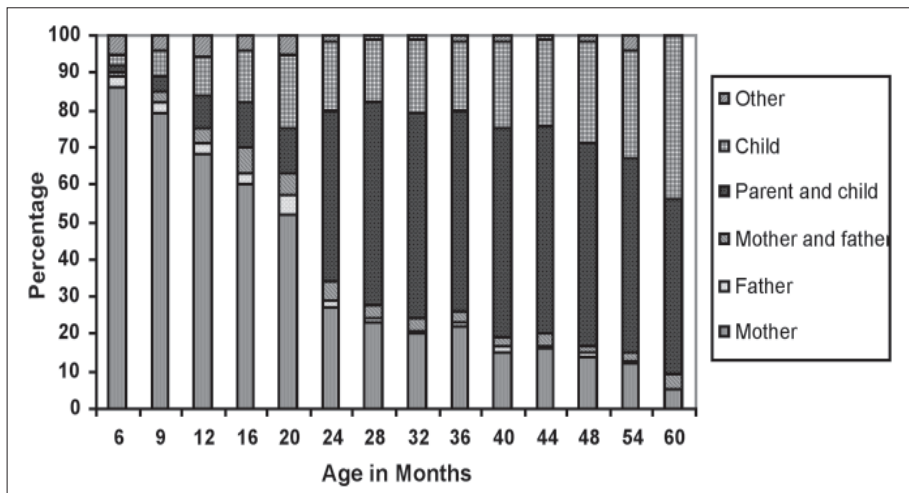


Figure 4. Person brushing teeth (among those brushing).

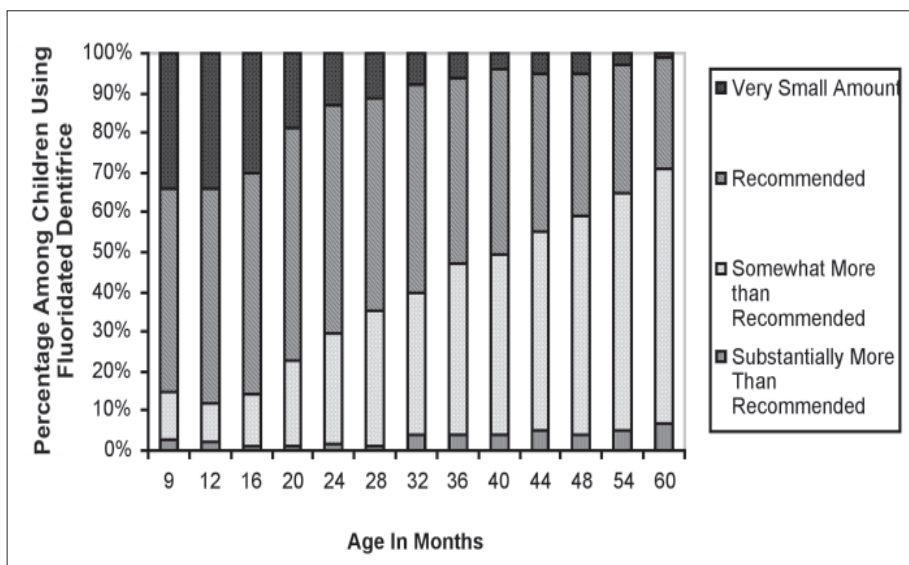


Figure 5. Amount of fluoridated dentifrice used (among those brushing with fluoridated dentifrice).

In a study by Vanobbergen et al,¹⁷ 15% of 7-year-old children brushed their teeth less than once per day, 52% once per day, and 33% more than once per day. Bentley et al¹⁸ found that among children 11 to 54 months of age who had parental help brushing, 6% brushed 3 times per day, 81% brushed 2 times per day, and 13% brushed once per day. Bruun et al¹⁹ found that the average brushing frequency was 2 times per day for 3-year-olds. In the current study, 9% of children at age 60 months were brushing less than once per day, 47% were brushing once per day, and 43% were brushing 2 or more times per day.

Vanobbergen et al¹⁷ observed that 55% of 7-year-old study children had received parental help when brushing until at least age 4. Bruun et al¹⁹ reported that 97% of 3-year-olds had parental assistance placing the dentifrice. On the other hand, Naccache et al¹³ found that 77% of children ages 2 to 7 placed the dentifrice themselves. In this study, even at age 60 months, more than 70% of the children had parental assistance placing the dentifrice and more than 60% had help with brushing.

Fourteen percent of the children in the Vanobbergen study¹⁷ were using a single pea-sized amount of toothpaste per brushing, 53% were using double pea-sized amounts, and 33% were using a full brush of toothpaste. Naccache¹³ found the mean amount was about 0.5 g used per brushing among children aged 2 to 7. In this study, the percentage of children using more than recommended amounts of dentifrice increased steadily from 6 to 60 months, with 71% of children using 0.5 g or more of dentifrice per brushing at 60 months.

The significant relationships in the present study suggest that, if a child is the first child in the family, then they have a higher likelihood of using adult-flavored

dentifrice. This could be due to the fact that parents did not have a good idea of what types of flavored-for-children dentifrice were available, the possibility that they did not deem it necessary for a young child to have a different type of dentifrice, or other possible factors.

Significant relationships also suggest that, for lower-income families, more children used adult-flavored dentifrice. This could possibly be due to a higher cost for dentifrice flavored for children, which, during the early part of data collection, was more limited to brand-name products. It is also possible that lower-income families were not able to afford 2 types of toothpaste, so only adult-flavored products were used in more of the households.

In addition, the mother's and father's educational levels were positively associated with brushing frequency. This suggests that parents with higher educational levels were more likely to brush their children's teeth more often than those with less education.

The Iowa Fluoride Study provides a unique opportunity to study the tooth-brushing behaviors of children for several reasons, including the large number of respondents, its longitudinal design, and the detailed nature of the questionnaires. However, the sample is not representative of any defined population and is comprised of subjects with a generally high socioeconomic status and who are primarily white, which suggests caution in generalizing. A second limitation is that data were reported by parents and not directly validated by investigators. The fact that the parents knew they were participants in a research study could have also influenced the degree to which they cared for their children's oral health (defined as the Hawthorne effect). Finally, there was some missing information due to failure of some parents to return questionnaires.

Conclusions

1. By age 2, almost all children were brushing with a fluoridated dentifrice.
2. Even at age 60 months, only about 40% of children were brushing twice per day, as recommended.
3. Mothers played the most important role in their children's home care habits throughout the first 5 years.
4. First-born children were more likely to use regular-flavored dentifrice than second- and later-born children.

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