Comparison of the use of a child and an adult dentifrice by a sample of preschool children

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Abstract

The purpose of this study was to compare the use of a child dentifrice (CD) and an adult dentifrice (AD) by a convenience sample of preschool-aged children. Fifty participants, ages 31 to 60 months, were recruited from a dental school clinic and an area day care center. All were healthy, free of developmental delays, and capable of applying dentifrice to a toothbrush. The study employed a crossover design in which the children each brushed their teeth twice, once with each type of dentifrice. The order of dentifrice use was assigned randomly, and the two brushings were separated by at least 1 week. The following were recorded: 1) the amount of dentifrice applied, 2) the time spent brushing, and 3) whether the child expectorated and/or rinsed after brushing. The mean weight of CD the children used (0.689 g, 0.43 SD) was significantly greater than that of AD (0.509 g, 0.41 SD, P = 0.02, Wilcoxon's signed rank test). The mean time spent brushing with CD (83.56 sec, 85.4 SD) was significantly greater than that for AD (57.48 sec, 39.0 SD, P = 0.01). A "risk factor" (dentifrice weight x usage time) was derived to estimate the relative fluoride exposure of each child. The mean risk factor for CD (58.54, 64.8 SD) was significantly greater than that for AD (27.43, 25.0 SD, P < 0.001). Most children did not expectorate or rinse after brushing. Most parents selected drawings on a questionnaire that indicated that their child routinely used 0.25–0.5 g of dentifrice per brushing, which underestimated the amount they used in the study. The results of this study indicated that young children may be exposed to more fluoride for a longer period of time with CD. (Pediatr Dent 19:99–103, 1997)

Undoubtedly, the increased use of topical and systemic fluoride applications has been an important factor in the decline of dental caries among U.S. children. Along with the benefits derived from optimal amounts of fluoride comes the risk of dental fluorosis due to greater-than-optimal ingestion of fluoride. In the 1980s, researchers noted that the prevalence of dental fluorosis had increased in both fluoridated and nonfluoridated communities.[1] The prevalence is higher than would be predicted by the epidemiologic studies of Dean[2,3] in the 1930 and 40s, and is indicative of excessive fluoride ingestion during tooth maturation.[4]

Fluoride dentifrices, unavailable in Dean's day, are a major source of fluoride for children residing in both optimally fluoridated and fluoride-deficient communities. Many children use more dentifrice than necessary when brushing their teeth. Barnhart et al.[5] reported that 2- to 4-year-old children used an average of 0.86 g of dentifrice per brushing. Bruun and Thylstrup[6] reported a mean use of 1.1 g per day by 3-year-olds. Naccache et al.[7] found a range of 0.46–0.57 g per brushing by 3-year-olds, and 0.36–0.54 g by 5-year-olds. In a later study, Naccache et al.[8] reported mean dentifrice use of 0.446–0.618 g per brushing by children ages 2–5 years. Young children, who have incomplete mastery of their swallowing reflex, may ingest 25–65% of the dentifrice placed on the toothbrush.[5,8–10]

Post-brushing activity (i.e., expectorating and rinsing with water after brushing) is another factor that can affect fluoride ingestion after toothbrushing. Sjögren and Birkhed[11] and Sjögren et al.[12] determined that the degree of fluoride systemic absorption after toothbrushing with a fluoridated dentifrice was strongly related to the mode of water rinsing. Therefore, the amount of fluoride ingested by an individual during and after toothbrushing was influenced by whether the subject did not rinse or rinsed from one to three times.[12]

Within the past 10 years, several dentifrice companies have begun marketing dentifrices with special colors and flavors that appeal to children. At least one study reported that children did prefer dentifrices designed specifically for them.[13] There is some concern that this packaging may encourage young children to use more dentifrice and potentially ingest significant amounts of fluoride during toothbrushing, thereby further contributing to the prevalence of dental fluorosis.[14,15] These child dentifrices contain fluoride in a concentration of 1000 parts per million (ppm).

The purpose of this study was to compare the use of a child and an adult dentifrice by a sample of preschool children (ages 2–5 years), including the amount of dentifrice used, the time spent brushing, and the occurrence of post-brushing expectoration and rinsing.

Materials and methods

The study comprised 50 preschool children from 31–60 months old. The children were recruited with informed parental consent from the patient pool in the department of pediatric dentistry at the Medical College of Georgia (MCG) School of Dentistry and from two local day care centers. The study was approved by the Medical College of Georgia Human Assurances Committee. For inclusion in the study, the subjects had to:

1. Be free of developmental delays
2. Have a noncontributory medical history and not be at risk for infective endocarditis
3. Be 24–60 months of age
4. Be capable of applying dentifrice to a toothbrush without adult assistance.

The nonrandom convenience sample was obtained by asking parents to participate. The sample size of 50 was determined *a priori* by a power analysis.

Parents also were required to complete a brief questionnaire concerning their perceptions of their children's toothbrushing habits. In addition to demographic information, the questionnaire asked for the following: 1) the number of times that the child brushed the previous day, 2) the degree of parental involvement in toothbrushing, and 3) a visual estimate of the amount of dentifrice that the child typically used at each toothbrushing. For the first question, we asked about a specific day that the parent and child were likely to remember, rather than asking about an "average" or "typical" day. For the third question, life-size drawings were provided that depicted different amounts of dentifrice on the toothbrush (0.25 g, 0.50 g, 1.00 g, and 1.50 g). Parents were asked to circle the drawing that represented the amount of dentifrice that their child typically used at each toothbrushing.

Two separate brushings (at least 1 week apart) were required for all children. Children recruited from MCG were accompanied to a dental operatory sink by an investigator (WPP) after procuring informed parental consent and the questionnaire data. A cup of water was provided. Oral-B 20® toothbrushes were used at all sessions. Each toothbrush had been weighed to the nearest 0.01 g on a Fisher/Ainsworth™ balance before any dentifrice was applied. A coin flip was used to determine which dentifrice would be used at the first session. Crest Regular® flavor and Crest Sparkle® were chosen for the study because of their similar shape, size, and method of dispensing. The only difference between these two brands was the colorful packaging and bubble gum flavor of the Crest Sparkle® compared with the mint-flavored Crest Regular®. Children were asked to dispense the amount of toothpaste that they normally used onto the toothbrush. After the dentifrice was dispensed, the brush was reweighed. The difference between the two weights was recorded as the weight of dentifrice dispensed. The toothbrush was returned to the child, who was then asked to begin brushing the teeth as would normally be done at home for the normal length of time. Toothbrushing was timed in seconds with the beginning and the end determined by the child saying "I'm starting" and "I'm finished". Expectoration and rinsing with water were recorded separately as present or absent. The same procedure was repeated at the next visit for the untested brand of dentifrice. The same protocol was followed at the day care centers. All data were collected by one investigator. The results are expressed as mean and standard deviation.

Because the data were not normally distributed, Wilcoxon's signed rank test was employed for repeated measures comparison. Pearson product-moment correlation and Fisher's exact test also were used. An *a priori* alpha value of 0.05 was selected as the level of statistical significance.

Results

Fifty subjects (31 males and 19 females) participated in the study. They ranged in age from 31–60 months with a mean age of 47.6 (7.2 SD) months. There were no significant differences by sex or location of study for any of the variables tested. There was, however, a weak but significant negative correlation between age and the amount of adult dentifrice used ($r = -0.38$, $P = 0.006$), with older children using significantly less adult dentifrice. There was no significant correlation between the child's age and the amount of child dentifrice used, nor between age and time spent brushing with either dentifrice.

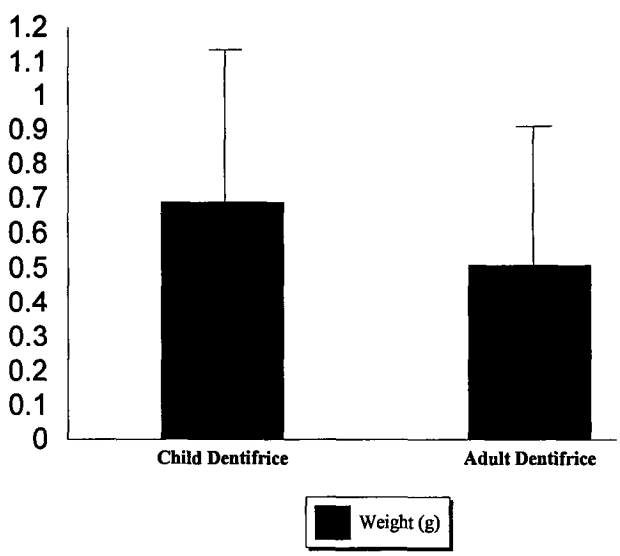

Fig 1. Comparison of weights used (mean, SD).

The amounts of toothpaste used ranged from 0.01 to 1.85 g for adult dentifrice, and 0.08 to 2.09 g for child dentifrice. The mean amounts of adult (0.509 g, 0.410 SD) and child (0.689 g, 0.428 SD) dentifrice are compared in Fig 1. This difference was statistically significant ($P = 0.02$). The mean toothbrushing times ranged from 19 to 175 sec for adult dentifrice, and 11 to 530 sec

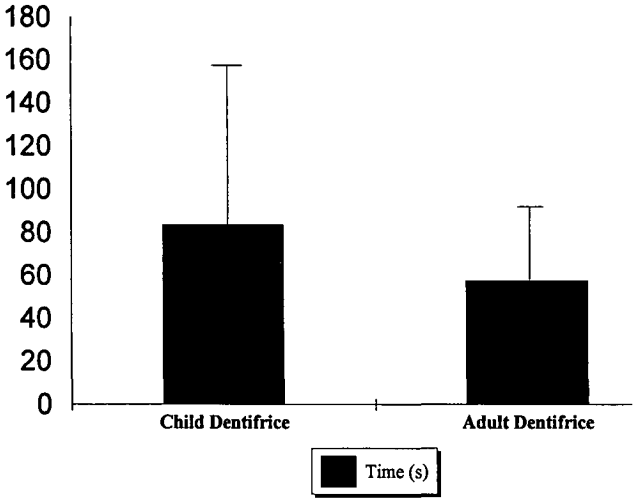

Fig 2. Comparison of brushing times (mean, SD).

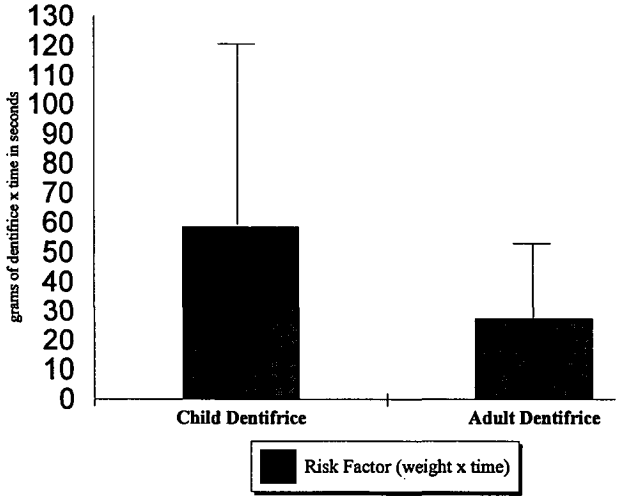

Fig 3. Comparison of risk factors (mean, SD).

for child dentifrice. The mean brushing times for adult (57.48 sec, 39.01 SD) and child (83.56 sec, 85.43 SD) dentifrice are compared in Fig 2. This difference also was statistically significant ($P = 0.01$).

As shown in Table 1, the frequency of expectoration after brushing with the adult dentifrice (56%) was slightly higher than with the child dentifrice (50%). The same finding was true for rinsing, but the children rinsed almost half as often as they expectorated. Fisher's exact tests for the 2x2 distributions of expectoration and rinsing showed statistically significant differences in the distributions between the child and adult dentifrices. The number of children who both rinsed and expectorated after brushing with the child's dentifrice (7) was almost half the number who did so after using the adult dentifrice (13).

A risk factor (dentifrice weight in grams x toothbrushing time in seconds) was derived to estimate the relative exposure to fluoride with each dentifrice for each child. The mean risk factor for the child dentifrice was 58.54 (64.8 SD), which was significantly greater than that for the adult dentifrice, 27.43 (25.0 SD, $P < 0.001$, Fig 3).

The questionnaire data are summarized in Tables 2, 3, and 4. Ninety-eight percent of the respondents indicated that their children brushed their teeth either once or twice the previous day. Most parents indicated that they helped their child brush, while the majority of the remaining parents either watched the child brush, or brushed the child's teeth themselves. When asked how much dentifrice their child typically uses at each brushing, 74% of the parents circled drawings depicting 0.25 or 0.50 g.

Discussion

The mean amounts of dentifrice used per brushing by children in this study are very similar to data for preschool children reported by Naccache et al.[7,8] For children in our study who would have brushed twice daily with 0.5–0.7 g of dentifrice, our data are consonant with those of Bruun and Thylstrup[6], who reported use of 1.1 g/day for 3-year-olds. Our usage data are lower than those reported by Barnhart et al.[6]

The results of this study support the data of Levy et al.[15], which indicated that their subjects used a mean of 0.81 g of child dentifrice and 0.66 g of adult dentifrice. These weights were a little higher than, but similar to, the results of our study. The Levy et al. study may have overestimated the amounts of dentifrice used. In that study, children were asked to use a preweighed tube of dentifrice at home for a week. It is possible that other children used some of the dentifrice even though parents were given instructions to allow only the study subjects to use the dentifrice. In our study, one investigator weighed the dentifrice on the toothbrush immediately after the child dispensed it.

In view of Sjögren's research on the effect of expectoration and rinsing on fluoride ingestion and absorption,[11,12] the number of children in our study who did not expectorate is noteworthy. Those children had a potential for greater fluoride ingestion and absorption than the children who expectorated with or without rinsing, regardless of which dentifrice was used.

The results of this study confirmed the notion that children tend to use larger amounts of dentifrice, brush for a longer period of time, and rinse and expectorate less when using a child dentifrice than when using an adult

TABLE 1. FREQUENCY OF EXPECTORATION AND RINSING AFTER BRUSHING, *N* (%)

	Expectorated	*Rinsed*	*Rinsed and Expectorated*
Child dentifrice	25 (50%)*	11 (22%)†	7 (14%)
Adult dentifrice	28 (56%)*	15 (30%)†	13 (26%)

* $P = 0.001$ for two-tailed Fisher's exact test of 2x2 distribution.
† $P = 0.01$ for two-tailed Fisher's exact test of 2x2 distribution.

TABLE 2. PARENTAL RESPONSES REGARDING THE NUMBER OF TIMES CHILD BRUSHED TEETH "YESTERDAY"

Number of Toothbrushings	*Responses, N (%)*
None	0 (0%)
Once	24 (48%)
Twice	25 (50%)
Three times	0 (0%)
More than three times	0 (0%)
"I'm not sure"	1 (2%)

TABLE 3. PARENTAL RESPONSES REGARDING INVOLVEMENT IN THEIR CHILD'S TOOTHBRUSHING

Parental Involvement	*Responses, N (%)*
No parental supervision	1 (2%)
Parent checks after child brushes	3 (6%)
Parent watches while child brushes	8 (16%)
Parent shares brushing with child	29 (58%)
Parent brushes child's teeth	9 (18%)

TABLE 4. PARENTAL RESPONSES DESCRIBING AMOUNT OF TOOTHPASTE CHILD TYPICALLY USES AT EACH BRUSHING

*Amount of Dentifrice**	*Responses, N (%)*
0.25 g	17 (34%)
0.50 g	20 (40%)
1.00 g	9 (18%)
1.50 g	1 (2%)
"Don't know"	3 (6%)

* Dentifrice amount was estimated from a series of life-size drawings depicting 0.25–1.5 g of toothpaste on a child-size toothbrush.

dentifrice. The child dentifrice used in this study is marketed to appeal to children, with a somewhat milder taste, a bubblegum flavor, and a greater visual appeal (blue "sparkles" versus light green paste) to the child than the adult dentifrice. These characteristics, along with the outer packaging designed to attract children, may explain the results of this and other studies.

The questionnaire data concerning the parental perception of the amount of dentifrice used by their children was of interest. Seventy-four percent of the parents circled drawings depicting 0.25 g or 0.50 g of dentifrice, yet the mean amounts of dentifrice used in this study were somewhat higher. Several possibilities may account for this difference. The children may have dispensed more dentifrice onto the toothbrush in the study because they were in an artificial environment. The parent may normally dispense the dentifrice at home, whereas the child dispensed the dentifrice in the study. Also, the parents may have allowed the child to dispense the dentifrice without supervision, so the parents would not have known how much dentifrice the child used. The methodology of this study did not allow us to determine which explanation may be correct.

While this is one of only a few studies examining the effect of dentifrice flavoring on children's use of dentifrice, it does not address fluoride ingestion. Estimates and inferences must be made concerning ingestion. For instance, one 4-year-old child dispensed 0.7 g of child dentifrice onto the toothbrush in the present study. Simard et al.[16] found that 4-year-olds ingested 50% of the dentifrice on the toothbrush. Since the dentifrice formulations on the market contain approximately 1000 ppm fluoride, 0.7 g of dentifrice delivers 0.7 mg of fluoride. If this child brushed twice daily, and swallowed half of the dentifrice each time, then he or she potentially ingested 0.7 mg of fluoride per day from toothbrushing alone. This amount represents 140% of the optimal supplementation dosage (0.5 mg) of fluoride for a 4-year-old child in a fluoride-deficient area. This emphasizes the recommendation that a small quantity of fluoride dentifrice should be placed on the toothbrush.

The calculated risk factors, which represent estimates of the exposure to fluoride for each child, strongly suggest that the relative exposure to fluoride would be greater with the child dentifrice than with the adult dentifrice. The risk factor, however, was empirically derived. It assumes a linear relationship between amount of dentifrice, time in the mouth, and ingestion, and it does not take into account the mitigating effects of expectoration and rinsing.

The findings of this study should be interpreted with some care. The sample studied was not drawn randomly from a large population. The participants were asked to brush their teeth in an artificial environment, and data were collected on single brushings with single brands of a child and an adult dentifrice. The brands tested may have been unfamiliar to a number of the participants and, thus, influenced the amount used. The data are cross-sectional, so no conclusions can be drawn about any participant's dentifrice use habits over time. We did not collect data concerning fluoride ingestion. The risk factor was derived empirically for comparing ingestion potential for the child and adult dentifrices.

Conclusions

The following conclusions were drawn:

1. Children in this study used significantly more child dentifrice than adult dentifrice;
2. Children brushed their teeth for a significantly longer period of time with child dentifrice than with adult dentifrice;
3. Only about half of the participants expectorated and only about a quarter of them rinsed following brushing. The number of children who rinsed and expectorated was even smaller.

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