

Dental Visits and Professional Fluoride Applications for Children 72 to 108 Months Old

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ABSTRACT

Purpose: The purpose of this study was to report patterns of dental visits and fluoride applications longitudinally during ages 7 to 9.

Methods: A cohort recruited at birth was followed in the Iowa Fluoride Study, with pretested questionnaires—sent to participants at 3- to 6-month intervals—concerning children having a dental (or dental hygiene) appointment or a fluoride application during the period.

Results: The percentages with dental visits were stable during these years (92%-93%), however, the percentages reporting fluoride applications increased from 68% (seventh year) to 74% (ninth year). Among children with complete data for 72 to 108 months of age, 99% visited the dentist and 84% received fluoride applications. Dental visits were significantly more frequent with a higher socioeconomic status, and fluoride applications were significantly more frequent in children with primary dentition caries experience.

Conclusions: The prevalence of visits and fluoride applications during these years are stable, with most children having at least 1 visit per year. (J Dent Child 2006;73:20-24)

KEYWORDS: DENTAL, VISITS, FLUORIDE, APPLICATION, CHILDREN

The widespread use of fluoridated water, dentifrice, and other forms of fluoride has resulted in a significant decline in dental caries in children over the past 20 years.^{1,2} The prevalence of dental caries, however, was still quite high among a subset of children.³ Improved understanding of the behavior of this group of children concerning dental visits and fluoride applications could be useful in efforts to improve their oral health.

The American Dental Association⁴ and the American Academy of Pediatric Dentistry⁵ have issued recommendations that children's first dental visits should be by age 1. These recommendations were not followed by 98% of Iowa children in one longitudinal study.⁶ The American Academy of Pediatrics⁷ (AAP) recommended that a child

be seen for an oral health risk assessment by 6 months of age. Patients who have been determined to be at risk of development of dental caries should be directed to establish a dental home 6 months after the first tooth erupts or by 1 year of age. Only 31% of Iowa children had visited the dentist prior to age 3.⁶

Relatively little more is known about the extent to which families comply with any of these dental visit recommendations. Data from the 1999 US National Health Interview Survey indicated that about 40% of children 2 to 4 years old and 79% of children 5 to 17 years old had visited the dentist at least once in the previous year.^{8,9} More visits were reported by Caucasians, those with a higher education, and those who were not poor.^{8,9} In the 1996 Medical Expenditure Panel Survey of the US community-based population, 43% of all children from birth through 18 had at least 1 dental visit in 1996.¹⁰ Approximately 86% of visits were diagnostic, and 77% were preventive in that year.¹¹

Dental visits and professional fluoride applications among children participating in the Iowa Fluoride Study were previously reported cross-sectionally and longitudinally from birth to 36 months⁶ and from 36 months to 72 months of age.¹²

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The purpose of this study was to report on patterns of dental visits and professional fluoride applications from 72 to 108 months of age among this cohort followed from birth.

METHODS

As part of the Iowa Fluoride Study (IFS), a longitudinal study of fluoride intake,^{13,14} dental fluorosis,^{15,16} and dental caries,^{17,18} data were collected concerning newborns recruited from 8 hospitals in eastern Iowa and followed for 9 years. The Institutional Review Board of The University of Iowa, Iowa City, Iowa, had approved this study, and parents were asked to provide informed consent. At baseline (1992-95), parents were interviewed and asked to complete questionnaires regarding their ages, education, income, and other family demographics, as well as water sources.^{15,18,19}

Participants then were sent pretested questionnaires by mail at 3- to 6-month intervals when their children were 6 weeks to 108 months of age. The nonrespondents were sent additional mailings after 3 and 6 weeks, if necessary. Each questionnaire included the following questions:

1. "Did your child have a dental (or dental hygiene) appointment during the last 3, 4, or 6 months?" and
2. "Did your child receive a professional (office) fluoride treatment during the last 3, 4, or 6 months?"

The interval for each time period was 3, 4, or 6 months, depending on the age of the child.^{6,12} Mailings were sent to participants:

1. 5 times during the first year of their child's life;
2. every 4 months through 3 years of age; and
3. every 6 months thereafter.

Questionnaires also included questions concerning: (1) fluoride exposures; (2) fluoride intake; and (3) other related factors.^{13,14,19}

Collected data were entered, verified, and analyzed using the statistical programs SAS System for Windows 9.0 (SAS Institute Inc, Cary, NC)²⁰ and SPSS for Windows 9.0 (SPSS Inc, Chicago, Ill).²¹ Data were analyzed separately for each specific time period (72-78, 78-84, 84-90, 90-96, 96-102, and 102-108 months), cumulatively for a year at a time (ages 7 to 9) and cumulatively for longer periods (ages 6 to 8, 7 to 9, 6 to 9, 3 to 9, and 5 to 9). In the cumulative analyses of dental visits and fluoride applications, only those with complete data were included (respondents who completed all questionnaires during that year or for the multiple years until the specific age).

Three levels of socioeconomic status (SES) of the subjects were defined as:

1. low—families with less than \$30,000 income per year and in which mothers did not have a 4-year college degree;

Table 1. Percentages of Children With Dental Visits and Fluoride Applications and Percentages of Periods With Visits Having Reported Fluoride Applications

Time period (mos)	Dental visit		Fluoride application		% of dental visits with fluoride application*	
	n†	% with visit	n†	% with fluoride application	n†	% of visits with fluoride application
72-78	583	76	604	53	583	71
78-84	558	79	566	57	555	73
84-90	549	81	556	61	549	76
90-96	541	81	548	58	540	73
96-102	528	82	529	62	527	76
102-108	537	83	539	62	537	74

*Reported a fluoride application as a percentage of all intervals with visits during the period.

†No. of respondents with valid data during the time period.

2. middle—families with \$30,000 to \$49,999 annual income, but excluding those with mothers having graduate or professional degrees, or less than \$30,000 income but having mothers with a 4-year college or graduate/professional degree; and
3. high—mothers with a graduate/professional degree and \$30,000 or more annual family income or \$50,000 or more in income regardless of mother's educational level.

Dental caries status was determined by means of visual/tactile examinations of primary and permanent teeth by 1 of 2 trained and calibrated examiners. The primary teeth lesions were categorized as either: (1) noncavitated (d1); or (2) cavitated (d2-3).¹⁷ The permanent molar caries examinations used criteria adapted from those used for the primary dentition, which were based on criteria first proposed by the World Health Organization^{22,23} (WHO) and modified by Pitts et al^{24,25} and others.²⁶ These examinations were conducted using a portable chair, exam light, and lighted dental mirror. Compressed air was used to dry the teeth, as the examinations were primarily visual, with dental explorers used only to confirm cavitated lesions. The children with primary caries and with permanent tooth caries examinations were 3 to 7 years old and 7 to 11 years old, respectively.

The statistical analyses used in this study were:

1. descriptive summary statistics (percentages, means, and standard deviations);
2. bivariate analyses using t tests and 1-way analysis of variance to assess relationships with dental visits and fluoride applications; and
3. general linear modeling (GLM) to separately assess the relationships between the number of periods with dental visits and fluoride applications cumulatively, during ages 7 to 9, with several other covariates, including SES, caries status, and family demographics. A P value of <.05 was considered statistically significant.

RESULTS

The number of responses concerning children's dental visits and fluoride applications varied from 528 to 604 for the different individual time periods (Table 1). The percentage of children with reported dental visits during the 72- to 78-month to 102- to 108-month time periods increased slightly, from 76% to 83%. Similarly, the percentage of children with a professional fluoride application increased slightly from 53% for 72 to 78 months to 62% at age 102 to 108 months. The percentage of children's dental visits involving professional fluoride application increased slightly from 71% for 72 to 78 months to 76% for 96 to 102 months, and then declined slightly to age 108 months (74%).

Detailed summaries of the patterns of dental visits and professional fluoride applications for all subjects, with complete data for specific year(s), are presented in Table 2. The Table also presents the mean numbers of time periods with dental visits or fluoride applications for each year or other time interval in the children's life. The percentage of subjects with dental visits is stable during ages 7 to 9 (92%-93%). The percentages reporting professional fluoride applications increased slightly, from 68% during age 7 to 74% during age 9.

Reported fluoride applications as a percentage of all intervals with dental visits increased slightly, from 75% during the seventh year to 80% during the ninth year. The percentages with dental visits and professional fluoride applications during the 2-year periods of the seventh to eighth years and eighth to ninth years were also consistent. The percentages with dental visits and fluoride applications among all respondents who completed all 6 questionnaires (complete data) during the 3-year interval (ages 7 to 9) were 99% and 84%, with means of 5.1 and 3.7 time periods during the interval, respectively.

Table 2 also presents data concerning the percentages with dental visits and fluoride applications during the longer

periods of 4 to 9, 6 to 9, and 1 to 9 years of age, among those with complete data for those periods. These cumulative percentages are very similar to those for ages 7 to 9, showing that very few children had a dental visit or fluoride treatment from ages 5 to 6 or 3 to 6 without having them also during the later years.

Bivariate analyses (comparing the mean numbers of periods) were conducted separately, relating dental visits and fluoride applications cumulatively from 72 to 108 months by categories of:

1. gender;
2. whether the child was the first in the family;
3. whether the child visited the dentist before age 3;
4. presence of primary tooth caries at 3 to 7 years old;
5. presence of caries in the permanent molars at 7 to 11 years old;
6. SES;
7. mother's education; and
8. family income.

Dental visits were not significantly associated with: (1) gender ($P=.25$); (2) early visits before age 3 ($P=.17$); (3) caries in primary teeth ($P=.59$); (4) caries in permanent molars ($P=.49$); or (5) mothers' education ($P=.07$).

Dental visits were significantly higher in children with: (1) higher SES ($P=.01$); and (2) higher family income ($P=.01$). Professional fluoride applications were not significantly associated with: (1) gender ($P=.13$); (2) early visits before age 3 ($P=.12$); (3) caries in permanent molars ($P=.08$); (4) mothers' education ($P=.17$); (5) family income ($P=.34$); or (6) SES ($P=.90$). Fluoride applications were significantly higher for children who had primary tooth caries ($P=.003$).

In general linear model analyses, simultaneously considering all these potential covariates, the only one significantly associated with dental visits from 72 to 108 months was SES. Furthermore, only the presence of caries in the primary

Table 2. Patterns of Dental Visits and Fluoride Applications by Age

Age (ys)	No. of surveys	Dental visit		Fluoride application		% of dental visits with fluoride application*		Periods with dental visits‡	Periods with fluoride applications‡
		n†	% with visit	n†	% with fluoride application	n†	% of visits with fluoride application		
7	2	483	92	501	68	481	75	1.58±0.64	1.09±0.86
8	2	442	93	450	73	441	79	1.66±0.61	1.21±0.85
9	2	434	93	437	74	433	80	1.68±0.60	1.26±0.85
7-8	4	376	97	390	80	374	82	3.29±1.02	2.35±1.54
8-9	4	350	98	357	80	348	82	3.40±0.97	2.50±1.54
7-9	6	318	99	328	84	315	84	5.07±1.33	3.67±2.21
6-9	8	284	99	303	85	279	85	6.59±1.78	4.57±2.86
4-9	12	210	100	228	86	205	85	8.78±2.65	5.50±3.66
1-9	23	150	99	150	84	150	85	9.82±3.08	5.49±3.95

*Reported a fluoride application as a percentage of all intervals with visits during the period.

†No. of respondents who returned all surveys during time period.

‡(Mean±SD) Mean number of periods, not actual units.

teeth was significantly related to reporting fluoride applications during this interval.

DISCUSSION

The present study provides additional longitudinal data on children's dental visits and professional (office) fluoride applications from ages 6 to 9. It is an extension of previously published reports from birth to age 36 and from ages 3 to 6.¹² There are no other previously published studies of longitudinal patterns of dental visits and professional fluoride applications in childhood.

Data from the 2 previous reports indicated that the annual percentage with dental visits increased sharply, from 2% during age 1 to 11% at age 2, 26% at age 3, 65% at age 4, and 81% at age 5. The percentages with dental visits then continued to increase more slowly, from 87% at age 6 to 92% at age 7 and 93% during ages 8 and 9. Similarly, the annual percentage with fluoride applications increased sharply, from 6% at age 3 to 28% (age 4), 46% (age 5), and 58% (age 6). The percentages with fluoride applications were 68% at age 7 and then leveled off at ages 8 and 9 (73%-74%).

The percentages of children 5 to 8 years old with dental visits annually (81%-93%) in this study were comparable to those of the 1999 US National Health Interview Survey of ages 5 to 17 years (79%),⁸ but lower than that of Swedish children 3 and 5 years old in 1995.²⁷ There were no other published data available concerning the percentages with professional fluoride applications with which to compare this study's results.

While these results provide important information on the patterns of dental visits and professional fluoride applications over an extended time period (9 years), the study has limitations. The data were self-reported and, therefore, no direct validation was done. It was not practical to contact dentists and confirm visit dates and fluoride treatments. The sample used in the study (IFS) was primarily Caucasian and included parents with relatively high education. Utilization of health care services is expected to be higher than among the general population. Therefore, generalizing this study's results to the general population should be done with caution. As with other longitudinal studies, the number of respondents decreased over time. This unavoidable attrition was addressed by conducting 2 separate analyses:

1. for subjects with complete data for 3-year time periods (ages 1-3, 4-6, and 7-9); and
2. for those who answered all surveys during individual 1-year time periods.

The number of subjects with complete data for the 9-year time period (birth-9 years old) with dental visits and fluoride applications was 150 subjects, which could limit statistical power. In this study, the actual number of visits or fluoride applications during the previous time period cannot be directly estimated. This is because parents were asked to report whether their children had a dental visit or fluoride treatment in the previous study period or not. They were not asked the actual numbers of visits or fluoride treat-

ments. Therefore, children with 2 or more visits (or fluoride treatments) in a given time period would be recorded only as having at least one.

In this report, income and educational level were combined to obtain a composite SES variable. This was done because of the study's central base in Iowa City, a university town with many student families who could temporarily have low income, but should not be considered as having low SES.

Associations were examined between the number of time periods with dental visits and fluoride applications during ages 7 to 9 and with different independent covariates. Higher dental visit rates were significantly associated with higher SES, while professional fluoride applications were significantly higher in children with previous primary tooth caries. No significant associations were found between the rate of dental visits during ages 7 to 9 and: (1) family income; (2) mother's education; (3) early dental visits; and (4) first child status. The association of dental visits with socioeconomic status in this study is consistent with those of previous studies reporting that children from higher SES families have higher dental utilization of dental services than children from lower SES families.^{28,29}

Having early dental visits by age 3, as recommended by the AAP's guidelines, was tested as a predictor of more dental visits at ages 7 to 9. There was no significant difference, however, between those who had visited the dentist before age 3 and those who first visited after age 3.

The number of periods with dental visits during ages 7 to 9 was not significantly associated with the presence of primary tooth caries at ages 3 to 7 or first molar tooth caries at ages 7 to 11. This suggests that most dental visits are not for caries treatment, but for dental checkups or preventive services. The present results indicated that children who had a primary tooth caries experience at age 5 had more professional fluoride applications in their dental visits during later ages than did children without caries. This suggests that the dentists were providing appropriate prevention by targeting fluoride applications for those with dental caries rather than those who are caries free.

CONCLUSIONS

Based on this study's results, the following conclusions can be made:

1. The percentages of children with dental visits and professional fluoride applications during ages 7 to 9 were fairly consistent at 92% to 93% and 68% to 74%, respectively.
2. Higher socioeconomic status and presence of primary tooth caries were associated with a higher prevalence of dental visits and fluoride applications, respectively.
3. The percentages of children with dental visits and fluoride applications annually were more consistent after age 6.

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