

Changing patterns of dental caries in young children presenting at the University of North Carolina School of Dentistry between 1960 and 1984

Carolyn Bentley, BDS Claude W. Drake, DDS, MPH, MS

Abstract

Caries prevalence was studied in children aged 3-6 presenting for treatment at the University of North Carolina at Chapel Hill School of Dentistry in the years 1960, 1965, 1970, 1975, 1980, and 1984. It was found that the mean number of dft in 5- to 6-year-old children had declined over the observation period and this was associated with a concomitant increase in the percentage of children who were caries free. Histograms of the frequency of occurrence of carious lesions showed a clear trend from a predominance of severely affected children in 1960 to a predominance of caries-free and minimally affected children in 1984. These results all were found to be significant statistically at the 5% level. No such changes, however, were observed in the 3-4 year age group. This finding is believed to reflect the greater proportion of high-risk children in the 3-4 year age group. Previous studies have indicated that the generally declining trend in caries prevalence is less favorable for such high-risk children.

Dental caries is declining in the general population. Stamm¹ presents overwhelming evidence that caries has declined in the United States between 1971 and 1980, especially among children, and this view is supported by many others.²⁻⁴ Similar reductions have been documented in most other countries throughout the developed world.⁵⁻⁹

For the dental profession, this reduction comes as the welcome outcome of years of advocating fluoridation and various other caries-preventive measures. For dental educators, however, these developments pose a certain dilemma. Although the total elimination of caries has been and remains our ultimate goal, dental schools must continue to prepare students with sufficient restorative skills to meet the requirements of the affected population as long as a significant incidence of caries persists. This dilemma has been discussed by Bohannon¹⁰ and long-range planning has been proposed.

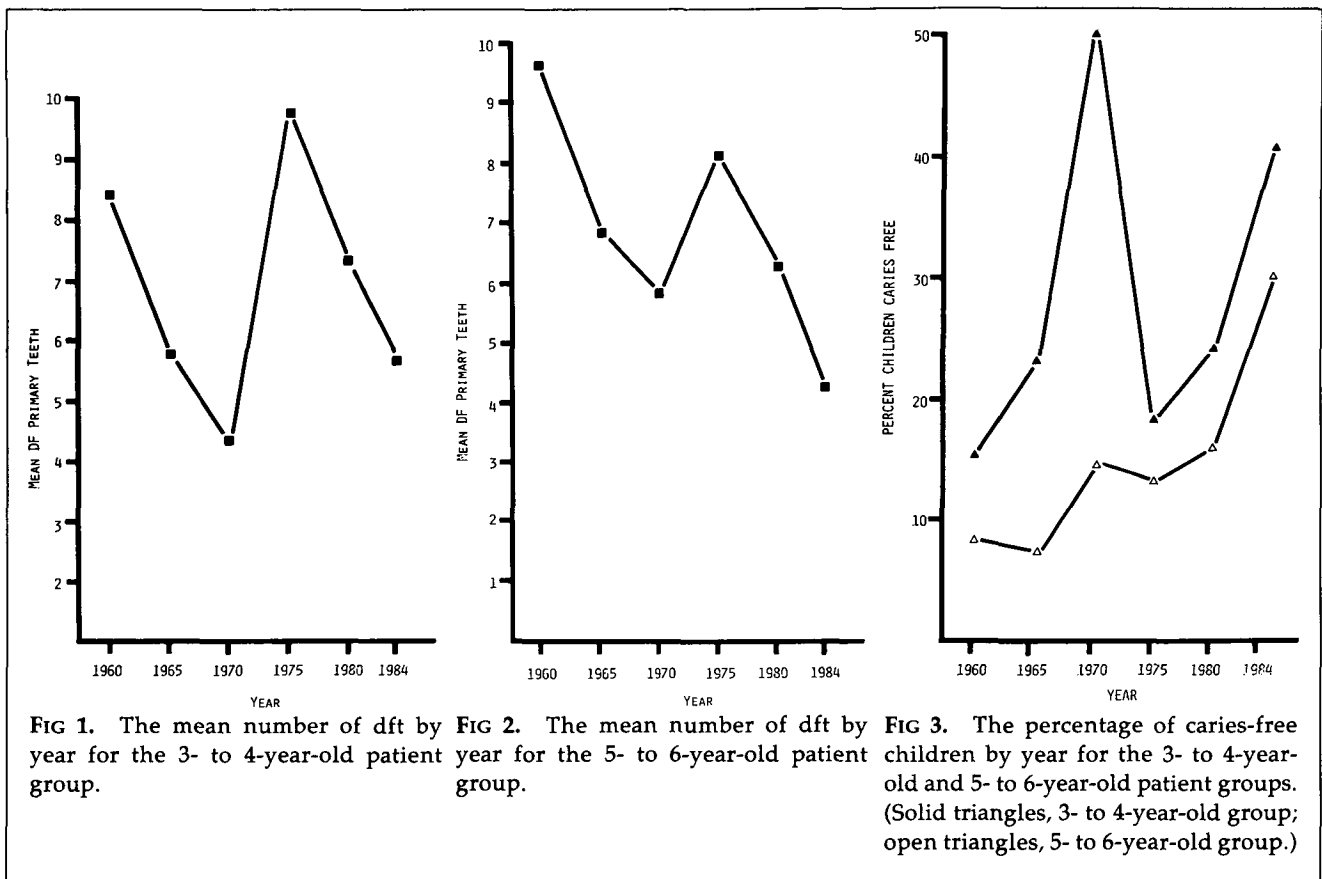
While the decline in caries prevalence is established clearly for the overall population, relatively few publications have addressed changes in the caries rate for those children who seek care in a dental school environment. Moreover, studies of caries prevalence rarely include very young children of preschool age. These children, however, constitute a significant proportion of the pediatric case load of an average dental school. At the University of North Carolina, for example, children in the 3-6 year age group accounted for 19% of pediatric screening visits in 1984. In view of the dramatic and well-documented decline in caries prevalence among school children, it would be expected that the pediatric population presenting for treatment in dental schools would show similar trends, but this is by no means established.

Planning of the pediatric dental curriculum, particularly in the areas of behavior management and sedation training, assumes an adequate supply of young children with dental needs. The present study of caries prevalence in children from 3 to 6 presenting at the University of North Carolina School of Dentistry therefore was undertaken.

Methods and Materials

The charts of all pediatric patients accepted into the undergraduate treatment program at the University of North Carolina School of Dentistry in the years 1960, 1965, 1970, 1975, 1980, and 1984 were reviewed. Data were collected for children 3 to 6 years old at the time of the first clinical appointment (as distinct from the preliminary screening appointment). For each child, routine demographic information was collected and relevant clinical data were tabulated.

The presence of decayed and filled teeth was in-



ferred from chart entries, treatment plans, radiographs, and, in the more recent cases, study models. With the exception of 1980 and 1984, the patients' charts were in archival storage, but it was possible to confirm by the numbering system that all charts for the earlier years had been located. If there was insufficient information for complete assessment of a patient's clinical condition, then that patient was excluded from further evaluation.

The tabulated data were processed and various parameters extracted. The overall caries prevalence was determined by age, sex, and year as the mean dft and, in the 5- and 6-year-old groups, as the mean DFT. Missing primary teeth were not included in the final statistical analyses as it was not possible in the ma-

majority of cases to determine whether teeth had been extracted because of caries or exfoliated. If a tooth was indicated for extraction because of caries it was recorded as decayed. This did not appear to bias the study, as analyses that included missing primary teeth yielded essentially similar conclusions to those currently reported. The severity of dental caries was estimated as the frequency distribution of children with various numbers of dft, by age, sex, and year. The percentage of caries-free children also was determined. In order to assess the pattern of carious lesions within the mouth, the per cent df for each individual primary tooth was analyzed by age, sex, and year.

Statistical analyses of regression and correlation employed a simple linear least squares procedure. Analyses in which distributions were compared employed the chi-square statistic, derived from general contingency tables.¹¹

Results

A total of 553 patient records were included in the study, of which 514 were sufficiently complete for further evaluation. The patient sample is classified by age, sex, and year in Table 1. Preliminary analyses of the data indicated that sex differences with respect to caries prevalence were insignificant in the patients

Table 1. Numbers of Children in the Test Population

Year	Age 3-4		Age 5-6		Total
	Female	Male	Female	Male	
1960	25	34	33	30	122
1965	11	15	14	14	54
1970	13	15	19	30	77
1975	20	13	27	27	87
1980	22	19	17	15	73
1984	18	26	23	34	101
Totals	109	122	133	150	514

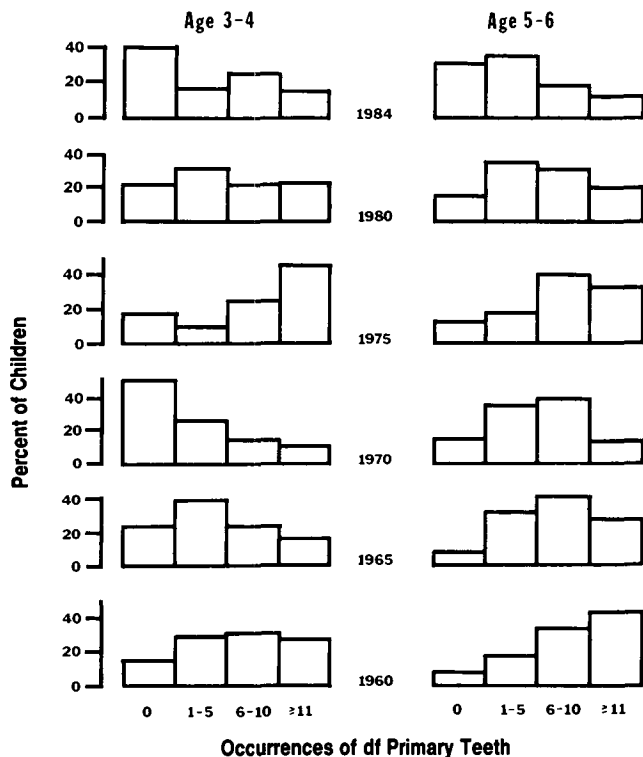


FIG 4. The number of children by dft scores for the 3- to 4-year-old and 5- to 6-year-old patient groups by year.

studied. Therefore the male and female data were pooled. It was demonstrated further that trends in caries prevalence in the sample population as a whole would be studied most appropriately by combining the 3- and 4-year-olds in 1 test group and the 5- and 6-year-olds in another.

A plot of the mean number of decayed and filled primary teeth (dft) per child as a function of time for the 3- to 4-year-old group is shown in Fig 1. The correlation coefficient is -0.07 and this is not significant statistically, indicating that there was no clear declining trend in caries prevalence for the 3- to 4-year-old group during the study period. An equivalent plot for the 5- to 6-year-old group is shown in Fig 2. The correlation coefficient is -0.75 and this value is significant statistically ($P < 0.05$), indicating that there was a significant declining trend in caries prevalence for the 5- to 6-year-old group over the same period. Similar results (not shown) were obtained for the mean number of decayed and filled permanent teeth (DFT) in the 5- to 6-year-old group ($r = -0.73$, $P < 0.05$). A declining caries prevalence is thus demonstrated for the 5- to 6-year-old group but not for the 3- to 4-year-olds.

Plots of the percentage of caries-free children as a function of time for the 3-4 and 5-6 year age groups are illustrated in Fig 3. The correlation coefficient of 0.37 for the 3- to 4-year-old group is insignificant

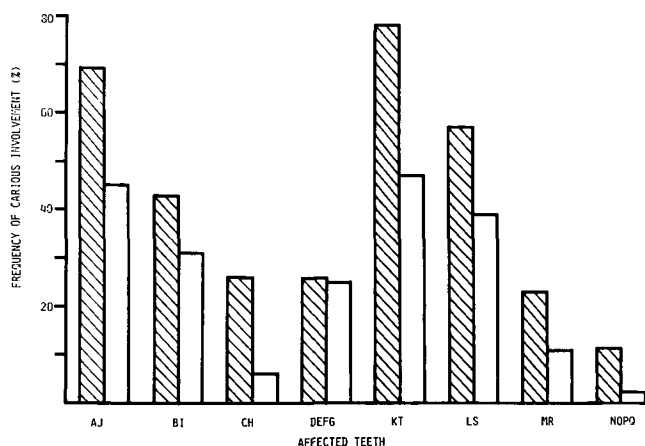


FIG 5. The percent dft for individual primary teeth in the 3-4 year age group for the years 1960 and 1984.

statistically ($P > 0.05$), indicating that there was no significant increase in the percentage of caries-free 3- to 4-year-olds during the study period. There is, however, significant correlation for the 5- to 6-year-old group ($r = 0.86$, $P < 0.05$), indicating that the percentage of caries-free, 5- to 6-year-olds has increased significantly over the same period.

Figure 4 shows frequency distributions for children with varying degrees of carious involvement by year in the 3-4 and 5-6 year age groups. In the 3- to 4-year-old group, there is considerable variation by year, but no clear trend is evident. In the 5- to 6-year-old group, however, there is a well-defined trend from a predominant pattern of extensive carious involvement (>10 dft) in 1960 to a predominance of low prevalence and caries-free cases in 1984. This trend in the 5- to 6-year-old group is highly significant statistically by contingency table analysis (chi-square = 40.14 , $P < 0.001$).

Histograms of per cent df for individual primary teeth in the 3-4 and 5-6 year age groups (data not shown) showed essentially similar distributions. In neither group were variations by year significant by contingency table analysis ($P > 0.05$). To investigate the possibility that major trends might be obscured by year-to-year variations, caries distributions from the 1960 patients were compared to those from the 1984 patients. The data for the 5- to 6-year-old patients showed no significant difference ($P > 0.05$), but the data for the 3- to 4-year-olds showed significant changes in distribution (chi-square = 14.98 , $P < 0.05$), as shown in Fig 5. The per cent dft for upper incisors showed little change from 1960 to 1984 (26% and 25% respectively), while corresponding figures for most other teeth were lower in 1984. These reductions were particularly marked for upper canines and lower incisors.

Discussion

There is a substantial volume of literature documenting a declining caries prevalence throughout the developed countries of the world, involving all sections of the population but it is most marked in children.¹⁻⁹ In most of these studies, however, data were collected from children attending school. In contrast, there are very few published reports of caries prevalence studies that have included children in the 3-4 year age group. This age group was included in 2 recent studies of the prevalence of dental disease in North Carolina,^{12,13} but no separate data analyses were performed. The mean dft scores were higher in the present study than those previously reported,^{12,13} presumably reflecting the fact that the present sample consisted entirely of patients presenting for treatment at a dental school. It is not possible to draw firm general conclusions regarding the prevalence of caries in 3- to 4-year-old patients and the extent to which it may have declined in recent years.

In assessing the significance of the results obtained in the present study, it is important to note that the population was small and represented a highly select group of individuals, namely patients presenting for treatment at a particular university dental school. The observations reported thus may reflect merely local factors. Extensive inquiries were therefore made into the operational policies of the Department of Pediatric Dentistry at the University of North Carolina and the extent to which such policies may have changed over the observation period. Particular emphasis was placed upon policies that might discriminate between 3- to 4-year-olds and 5- to 6-year-olds. Current departmental policy is that all children in these age groups presenting at the screening clinic are accepted into the program. There has been no change in this policy within departmental memory that might account for the present findings, nor are the authors aware of any special projects that might have distorted the patient mix at any point in the study. There is also a possibility that these relatively small groups were not truly representative of their time period. The high prevalence of dental caries in children presenting in 1975 is particularly suspicious in this respect, although no demographic factor could be identified that might have caused it. It was concluded that the observations recorded were a true reflection of trends within the patient population and a variety of explanations were considered.

It is most probable that the observed differences between the 3- to 4-year-olds and the 5- to 6-year-olds reflect social and behavioral factors. In spite of the best efforts of the dental profession, many parents remain unaware of the need to begin regular dental care as early in life as possible. The majority

of children are not, therefore, examined by a dentist until they reach school age, at which time a dental examination is often mandatory. It follows that the population of children presenting before school age is more likely to include a greater proportion of cases in which there is a clearly perceived need for dental treatment beyond routine examination and prophylaxis, i.e., overt pathology. It is thus probable that the 3- to 4-year-old and 5- to 6-year-old populations were fundamentally different and it is not surprising that they were subject to different trends with respect to caries prevalence.

Epidemiological studies would support such an interpretation. It has been shown that caries experience is a major factor determining caries risk.¹⁴ This observation is supported by recent work presented by Graves et al.¹⁵ In studying the progression of cohorts of children with caries of varying severity, the latter group observed major differences between the most severely affected individuals and the other cohorts. These "high-risk" individuals showed more extensive disease and more rapid progression. More importantly, however, the general decline in caries prevalence, although clearly manifest in the low-risk groups, was less obvious in the high-risk group. Presentation for dental treatment at 3-4 would, in itself, be a manifestation of more rapid disease progression than presentation at 5-6. The 3- to 4-year-old group would thus include a greater proportion of high-risk individuals as defined by Graves et al.,¹⁵ a group that does not show the same degree of declining caries prevalence seen in the general population.

A variety of alternative biological interpretations were explored but these did not withstand serious scrutiny. One was the potential impact of local public health measures. In this respect, the 3- to 4-year-olds and 5- to 6-year-olds may be regarded as mutual controls as both groups were derived from the same local population. They would thus be subject to the same general health trends, the only significant difference being that the 5- to 6-year-old group included a major proportion of schoolchildren. The potential relevance of school attendance to differences with respect to caries prevalence could involve such factors as dental health education programs, school meals, etc.

Another possibility is that the 3- to 4-year-old group could have included a significant proportion of children presenting with nursing caries, which might not be subject to the declining prevalence observed for caries in general. The latter interpretation derived partial support from the observed changes in the intraoral distribution of caries in 3- to 4-year-olds between 1960 and 1984, which might suggest a continuing prevalence of nursing caries with a declining prevalence of smooth surface caries in general (Fig

5). No such trends were manifested in the 5- to 6-year-olds. Although this possibility could account in part for the observed differences, it is most unlikely that changes in the relative prevalence of nursing caries could provide a complete explanation.

With regard to the pediatric case load in university dental schools, our data would suggest that preschool children may comprise an increasing proportion of the patient population in future years, as caries prevalence declines. It is probable that this group will include larger numbers of high-risk "problem" patients, referred by outside dentists. This change may not entirely reflect trends within the population as a whole and dental educators should be aware of this possibility. Our findings thus underline the need for improved marketing strategies to increase the utilization of pediatric dental services within the university environment by young children of preschool age.

It is clear that relatively little information is available regarding the prevalence of caries among very young children in the population as a whole. It is not possible to draw general conclusions from small-scale, local studies such as ours and studies employing large-scale epidemiological techniques would therefore be of considerable interest.

Conclusions

The data presented show that the prevalence of caries in 5- to 6-year-old children presenting at the University of North Carolina School of Dentistry has declined considerably between 1960 and 1984. Thus the mean dft and DFT scores show significant downward trends over the observation period, with a significant upward trend in the percentage of caries-free children and a change by distributional analysis from a preponderance of severely affected cases to a preponderance of unaffected and minimally affected cases. These trends are not evident, however, in 3- and 4-year-olds, who appear to have changed very little with respect to dental caries prevalence over the same period.

Dr. Bentley is an assistant professor and Dr. Drake is an associate professor, Department of Oral Diagnosis, University of North Carolina. Reprint requests should be sent to: Dr. Carolyn Bentley, Dept. of Oral Diagnosis, 196 Dental Office Building 209H, University of North Carolina, Chapel Hill, NC 27514.

1. Stamm JW: Is there a need for dental sealants? Epidemiological indications in the 1980s. *J Dent Ed* 48:9-17, 1984.
2. Brunelle JA, Carlos JP: Changes in the prevalence of dental caries in U.S. schoolchildren, 1961-1980. *J Dent Res* 61:1346-51, 1982.
3. Stookey GK, Park KK, Drook CA, Sergeant JW, Jackson RD: Prevalence of dental caries in Indiana schoolchildren: results of 1982 survey. *Pediatr Dent* 7:8-13, 1985.
4. De Paola PF, Soparkar PN, Tavares M, Allukian M Jr, Peterson H: A dental survey of Massachusetts schoolchildren. *J Dent Res* 61:1356-60, 1982.
5. Anderson RJ, Bradnock G, Beal JF, James PMC: The reduction in dental caries prevalence in English schoolchildren. *J Dent Res* 61:1311-16, 1982.
6. Brown RH: Evidence of decrease in the prevalence of dental caries in New Zealand. *J Dent Res* 61:1327-30, 1982.
7. Kalsbeek H: Evidence of decrease in prevalence of dental caries in the Netherlands: an evaluation of epidemiological caries surveys on 4- to 6- and 11- to 15-year-old children performed between 1965 and 1980. *J Dent Res* 61:1321-26, 1982.
8. Koch G: Evidence for declining caries prevalence in Sweden. *J Dent Res* 61:1340-45, 1982.
9. Von der Fehr FR: Evidence of decreasing caries prevalence in Norway. *J Dent Res* 61:1331-35, 1982.
10. Bohannon HM: The impact of decreasing caries prevalence: implications for dental education. *J Dent Res* 61:1369-77, 1982.
11. Armitage P: *Statistical Methods in Medical Research*. Oxford; Blackwell, 1971 p 211.
12. Hughes JT, Rozier RG: The survey of dental health in the North Carolina population: selected findings, in *Planning for Dental Care on a Statewide basis*, Bawden JW, De Friese GH, eds. Chapel Hill; The Dental Foundation of North Carolina, 1981 pp 21-37.
13. Hughes JT, Rozier RG, Ramsey DL: *Natural History of Dental Diseases in North Carolina 1976-1977*. Durham, N.C.: Carolina Academic Press, 1982 p 200.
14. Birkeland JM, Broach L, Jorkjend L: Caries experience as a predictor for caries incidence. *Community Dent Oral Epidemiol* 4:66-69, 1976.
15. Graves RC, Bohannon HM, Abernathy JR, Disney JA, Stamm JW, Greenberg BG: Contrasts in dental caries in U.S. children by risk groups. *IADR Program and Abstracts*, 456, 1985.