Dispelling the Myth that 50 Percent of U.S. Schoolchildren Have Never Had a Cavity

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SYNOPSIS

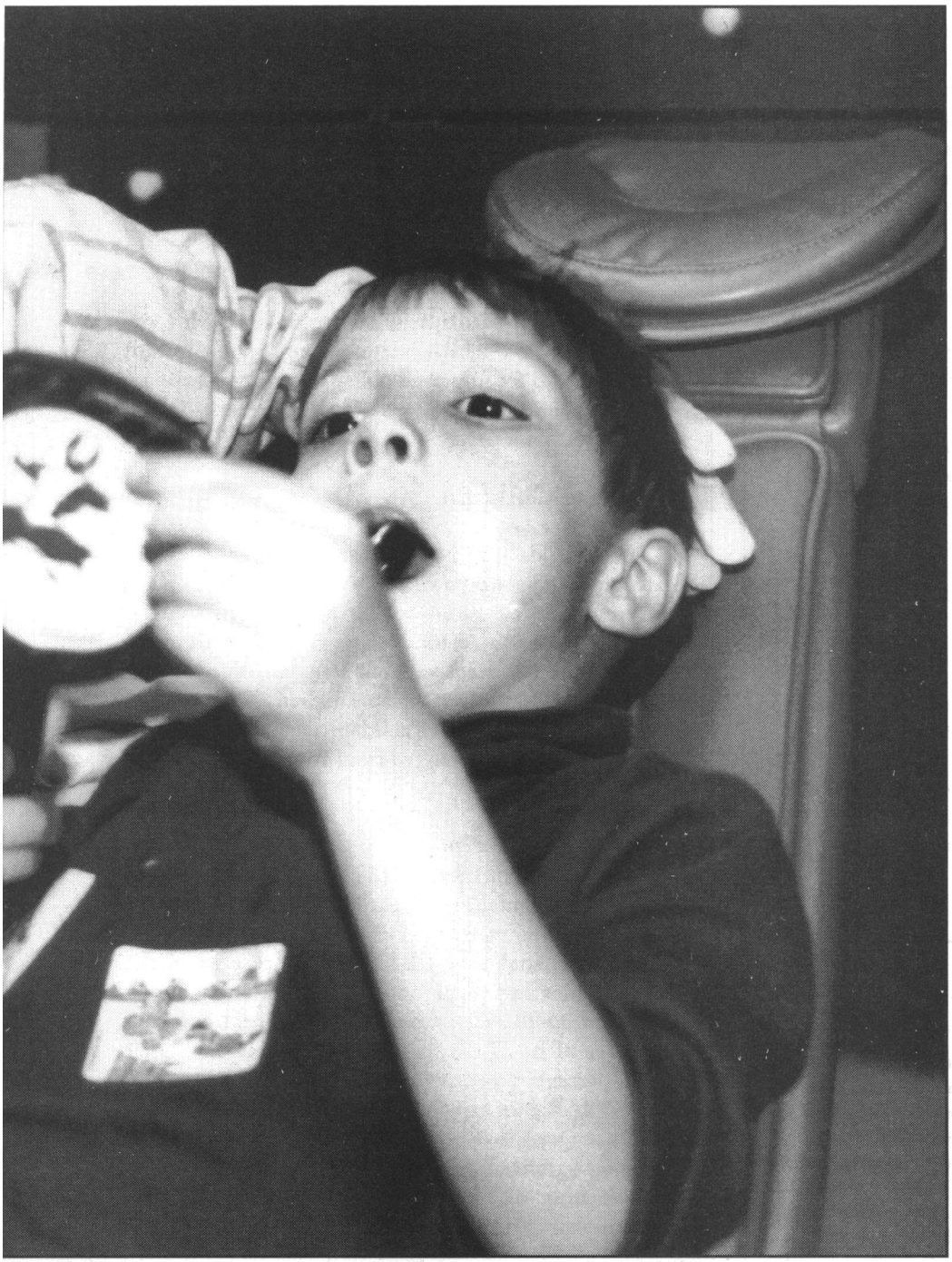
THE ERRONEOUS CLAIM that 50 percent of U.S. schoolchildren have never had a cavity has taken on the virtues of truth through frequent and widespread restatement. The 50-percent caries-free statement is an excessively optimistic misrepresentation by the media of the 1986–87 survey of oral health among schoolchildren by the National Institute of Dental Research because it only tells part of the story—it ignores dental disease in the primary dentition.

This article documents that numerous public policy papers reflect failure to consider primary tooth caries data. Consequently, a significant disease burden has been overlooked. The article reviews the persistent underreporting of children's caries experience in policy documents and the dental literature, and reviews additional epidemiologic studies of caries reported in U.S. dental literature since 1985.

Dental caries remains the single most common disease of childhood that is not self-limiting or amenable to a course of antibiotics. The popular statement that half of U.S. schoolchildren have never experienced tooth decay fails profoundly to reflect the extremity and severity of this still highly prevalent condition of childhood.

At a time of extreme pressure on the Medicaid Early and Periodic Screening, Diagnosis, and Treatment budget this uncritically held belief is leading to inappropriate policy and funding decisions that can put the health of children at risk.

In an October 19, 1994, New York Times article appears the statement, "Half of today's schoolchildren have never had a cavity." Attributed to the American Dental Association, the claim was part of a piece entitled "Endangered Species: Cavities" (*1*). This erroneous claim, first made in 1988 (*2,3*), has taken on the virtues of truth through frequent and widespread restatement. The basis for this myth was an excessively optimistic misinterpretation of the 1986–87 survey of oral health in U.S. schoolchildren by the National Institute of Dental Research (NIDR); an interpretation that did not include findings for decayed primary (baby) teeth.



We find fault not with the quality or scope of the NIDR study but with the popularly and uncritically held misrepresentation of that study. When NIDR's findings for baby teeth cavities are considered, the Federal data actually show that half of U.S. schoolchildren already have cavities by the time they are age 7. In fact, prevalence of tooth decay is high among kindergartners (42 percent) and continues to increase steadily until more than five out of six adolescents are affected by the end of high school.

The New York Times is far from the only publication to cite the 50-percent statistic. A 1989 Congressionally mandated report on oral health activities of the Department of Health and Human Services (*4*), a 1993 Public Health Service review of the oral health status of Americans (*5*), a 1993 review of the "oral health burden in the United States" written for the national health reform debate (*6*), the 1993 lead article for the American Association of Dental Education's "Symposium on Dental Health Care Reform—the Challenge Ahead" (*7*), and even the current American Dental Association's "Key Dental Facts" information book (*8*) use this statistic.

Other documents do include discussions of primary teeth caries but, nonetheless, restate the 50 percent caries-free myth. Examples include a 1990 background paper for the special issue of the Journal of Public Health Dentistry on "Issues in Maternal and Child Oral Health" (*9*), the 1991 American Association of Public Health Dentistry's Symposium on Appropriate Uses of Fluoride in the 1990's paper on topical fluorides (*10*), the 1993 National Center for Education in Maternal and Child Health report entitled "Pediatric Oral Health" that serves as a basis for policy recommendations for the Bright Futures Project (*11*), and the 1995 Institute of Medicine monograph on Dental Education at the Crossroads background paper that reviews historical oral health changes in the United States (*12*).

With Medicaid Early and Periodic Screening, Diagnosis, and Treatment (EPSDT) programs under extreme pressure, this understatement of the oral disease burden borne by American children may have serious negative effects on the

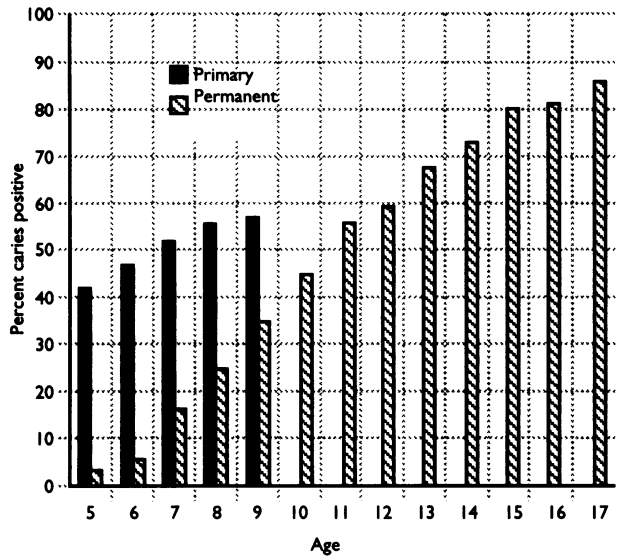
development of public health policy and prevention strategies.

The 50-percent caries-free claim may have been initiated when an NIDR public affairs specialist in announcing the results of the study to the profession through the Journal of the American Dental Association, wrote, "Half of the schoolchildren in the United States have never had a cavity" (*3*). In a separate announcement to the public, the New York Times led its front page feature article by stating, "Half the nation's schoolchildren have no cavities or other tooth decay in a continuation of gains that health officials say could mean the virtual end of dental disease as a major public health problem, a new Federal survey...shows" (*2*).

Careful reading of the entire article reveals that findings are limited to permanent teeth. Subheads, graphics, and text, however, all promote a misinterpretation of the NIDR's complete findings. Statements in the public and professional press fail to consider primary tooth caries data and rely on necessarily conservative methods, such as no radiographs, as representing permanent tooth caries data. Together with the lack of other large scale epidemiologic surveys, this understatement compounds the false impression that childhood dental caries is no longer a significant public health problem.

Without question, caries experience of children relative

Figure 1. Percent of children with caries in primary and permanent teeth (NIDR 1986–87)



This figure shows an alternative presentation of the NIDR 86–87 data by including both primary tooth and permanent tooth caries data for each age cohort. It provides a dramatically different sense of the findings and reveals that caries prevalence already approaches 50% for the very youngest schoolchildren. Although caries progresses steadily throughout childhood, increases in caries prevalence appear to slow or reverse between ages 8 and 12 because decayed primary teeth are shed and many new permanent teeth have not been present long enough to show disease.

Primary Teeth Caries in Subpopulations Since 1985

Despite the 50 percent caries-free myth, there has been considerable research on primary tooth decay, published since the NIDR 1986–87 national study. These studies (see boxes 1 and 2 and figure 3) substantiate the ongoing existence of significant disease.

Yet these studies also mask the seriousness of caries prevalence in some populations. Pediatric dental caries is unevenly distributed, with a small percentage of children demonstrating the majority of carious tooth surfaces. Epidemiologic studies commonly report caries experience for populations as "mean dfs" that unfortunately tends to mask the extent of disease experienced by those affected. This use of the mean—even when age-specific—tends to conceal rather than elucidate dental caries rates and dental care needs.

The findings, particularly among children with low education and low-income status parents, point toward the urgent need for improved policy to target educational and prevention programs to those with greatest disease risk and treatment need.

Preschool Children

Published data on preschool children in the United States are based almost exclusively on Head Start populations, primarily low-income children ages 3 to 5 (box 1). Waldman *(9)* reviews many of these studies for treatment needs, noting that needs vary but are great, especially for minority and Native American children. The reported percentages of Head Start children requiring treatment to repair decayed teeth ranged from 16 to 65 percent.

Toddlers

Baby bottle tooth decay (BBTD) is a particular form of early onset dental caries that first affects the primary maxillary anterior teeth, typically by age 2 years. No population based studies of BBTD prevalence exist in the United States and data on caries experience among infants and toddlers is sparse. Ripa estimates the overall prevalence of BBTD in the United States at "no higher than 5 percent" based on an exhaustive 1988 literature review *(27)*. Recent experience, however, among pediatric dentists suggests that prevalence of early onset decay is increasing significantly in their practices.

Estimating BBTD among low-income preschoolers by extrapolating retrospectively from Head Start exami-

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nations reveals prevalence clustering at 20–25 percent generally and ranging from 17 to 85 percent for Native Americans *(28)*.

Examination of 869 U.S. southwestern white, Hispanic, and Native American Head Start children from rural and urban populations revealed an overall BBTD rate of 36 percent. Higher levels were recorded for Hispanic and Native American rural children than their Caucasian and urban counterparts *(29)*. Studies of small convenience samples in Federal Women's, Infants, and Children (WIC) nutrition programs show high levels of BBTD. A sample of 77 WIC children in the Seattle area revealed a disease rate of 35.1 percent at a mean age of 24.4 months *(30)*. More than half (56.4 percent) of Navajo children demonstrated maxillary anterior pattern caries before age three (*31*).

The occurrence of BBTD in particular, and caries in general, has strong psychosocial, behavioral and dietary components *(32)* and may also be influenced by perception and acceptance of disease. Variation in dental disease seen between sub-populations may well reflect these differences in attitudes and behaviors. As juvenile caries becomes increasingly a problem of disadvantaged minority youth, prevention and treatment programs that are culturally sensitive and truly accessible must be developed. Only through effective interventions, including correction of EPSDT Medicaid shortcomings, can the gains made for affluent children be extended to all of our youth.

Box 1. Studies of Primary Tooth Dental Caries Prevalence Among Headstart Preschoolers (Ages 3–5)

Study and author	*Caries index—Mean dfs*	*Percent caries positive*
Alaska 544 children – Jones et al.,1992 (*46*)	8.73 overall 4.9 at age 3 11 at age 5	80.5 Native Americans 36.8 Non-native Americans
California 488 children – Louie,et al., 1990 (*43*)	7.44 in fluoride deficient area 4.80 in fluoride areas	66 overall 70 fluoride deficient area 64 fluoride areas
Connecticut 276 children – Reisine,et al., 1994 (*32*)	3.6 for children with posterior caries only; 18.9 for children with anterior and posterior caries	60
Mississippi 2,393 children –Trubman,et al., 1989 (*44*)	2.33 at age 3 4.91 at age 4 7.33 at age 5 9.99 at age 6	Not given
Navajo 2,003 children – O'Sullivan, et al.,1994 (*31*)	10.73 at age 3 15.29 at age 4 18.94 at age 5	81.2 at age 3 87.7 at age 4 89.6 at age 5
Ohio 1,310 children – Johnsen, et al., 1986 (*45*)	3.3 in fluoride areas; 4.7 in fluoride deficient areas	57 overall Range: 50 rural fluoridated areas to non-fluoridated 64 urban areas
Oregon 788 children – Phipps and Mason, 1994 (*39*)	5.48 dmfs overall Range: 4.52 for blacks 8.68 for Asians	47
Washington 1,036 children – Phipps, 1995 (*41*)		38.2 overall 11.2 rampant caries

dfs = decayed and filled surfaces of primary teeth

dmfs = decayed, missing or filled primary teeth

Numbers in parentheses are references

For preschool low-income children, ages 3–5, eight studies reveal that (*a*) low-income preschoolers have caries rates comparable to those found by the National Institute of Dental Research for school children of all income levels who are three years older (caries prevalence frequently exceeds 60 percent), (*b*) the extent of low-income children's caries exceeds mean dfs for children of all income levels who are three years older (mean decay extent frequently exceeds 5 tooth surfaces per child), (c) low-income children show a wide range of caries experience related to fluoride exposure and, (*d*) estimates of caries progression from these studies suggest that caries develops at a dramatic pace among low-income children, frequently ranging beyond 2.5 additionally decayed tooth surfaces per year.

to their peers of 10 and 20 years ago has declined dramatically (*13,14*). However, ongoing caries prevalence among U.S. children and adolescents is still very high. Of those children with cavities, most have few lesions while minority, low-income, and underserved groups continue to experience extensive destruction in both primary and permanent teeth. With this segment of the pediatric population growing rapidly and disproportionately (*15,16*) overall population caries rates in primary teeth can be expected to rise, further aggravating this problem.

Reexamining the NIDR Study

The largest, most representative, and most frequently cited source of pediatric caries data in the United States is the 1986–87 NIDR "National Survey of Oral Health in

Box 2. Recent Studies of Primary Tooth Dental Caries Prevalence Among Schoolchildren

Study and author	*Caries index*	*Percent caries-positive*	*Comments*
Georgia, 3,799 children ages 5–17 representing 1,174,118 —Alderman, 1994 (*38*)	Peak: 2.58 for nonwhites at age 5; 1.84 for whites at age 7		Summary statement on pediatric caries disregards primary tooth findings
Michigan, 439 in 1986, 271 in 1993 ages 6–8 —Heller, et al. 1994 (*37*)	Mean: 3.05 in 1986 3.20 in 1993	47.7 in 1986, 50.2 in 1993, primary dentition	No further decline in primary teeth noted over time
New York (Downstate) 713 children ages 7–8, representing 96,300 —Kumar, et al. 1993 (*35*)	Mean: 3.14 for high SES 2.43 for low SES	50.5 primary dentition	Continued decline in dft noted over prior studies
New York (Upstate) 960 children ages 7–8, representing > 95,000 —Kumar, et al. 1991 (*34*)	Mean: 2.38 for high SES 3.26 for low SES		High treatment need in low SES group
North Carolina State 6,054 children ages 5–19 —Stamm, 1990 (*36*)	Peak: 5.3 for males at age 9 4.7 for females at age 8		Low parental education and rural residence relate to higher caries
Oregon State 1,408 children ages 6–8 —Phipps and Mason, 1994 (*39*)	Mean dmfs: 5.68 overall 5.01 for whites to12.61 for Native Americans	55.3 in combined dentitions, 47.9 in primary dentitions	29 percent total in need of treatment; 5 percent in need of urgent treatment. Caries and need relate to race.
Tennessee 2,588 children ages 5–9, representing 927,000 —Gillchrist, et al. 1992 (*33*)	Mean dfs: 5.52 mean dft: 2.23 peak dfs: 7.26 at age 7 peak dft: 2.61 at age 7		Primary dentition caries reductions less than permanent tooth reductions
Washington 4,635 children ages 6–8 —Phipps, 1995 (*41*)		45.8 in combined dentitions 10.9 rampant caries	16.6 percent need treatment; 2.2 percent need urgent treatment. Caries and need relate to race
Portland, ME, and Aiken, SC 1,086 ME, 1,099 SC children ages 6–7 —Margolis, et al. 1994 (*40*)	Mean range: 2.9 for ME whites to 10.2 for Aiken blacks	Range: 37 ME to 73 SC	Combined dentitions increments: grades 1–2: 1.5 s,S grades 2–3: 3.3 s,S grades 3–4: 2.8 s,S
Indian Health Service Children ages 5.9 (sample roughly representing total Native American population) —Niendorff, 1994 (*42*)	Mean dmfs: 9.54		Mean varied by ethnicities

NOTE: SES = socioeconomic status

dfs = decayed and filled surfaces of primary teeth

dft= decayed and filled primary teeth

dmfs = decayed, missing or filled primary teeth

s,S = primary tooth surfaces, permanent tooth surfaces

Numbers in parentheses are references

The 10 studies summarized present evidence of (*a*) a high prevalence of caries in young school age children, generally greater than 50 percent; (*b*) greater caries experience in certain subgroups, particularly those characterized by parents with lower income and educational status; and (*c*) extensive unmet treatment needs.

The finding that schoolchildren younger than age 9 demonstrate an average of nearly four carious or filled surfaces is cause for alarm.

U.S. Schoolchildren." The official publication did not provide estimates of the percent of children at each age who had experienced tooth decay in their primary dentitions. It did, however, report the average number of decayed primary teeth for 5–9 year olds. Primary tooth prevalence rates, released only in a 1990 abstract (*17*), revealed that 56 percent of U.S. schoolchildren had already experienced dental caries in the primary teeth by age 9 years. When caries experience in both the primary and permanent teeth is combined, the aggregate caries-free rate drops considerably below the 50 percent claim (fig. 1).

The commonly-cited 50-percent statistic was derived by averaging the percentage of children who were caries-free in only their permanent teeth at each age, 5 through 17 years. At the extremes, 5-year-olds, with a caries-free rate of 97.3 percent in their permanent teeth, were averaged with 17-year-olds who had a caries-free rate of 15.6 percent. This common method of describing prevalence data fails to convey the rapid progression of caries with increasing age.

Conventional methods of measuring and reporting juvenile dental caries in epidemiologic studies tend to mask its extent. Examples from the NIDR study include

1. Children too young to demonstrate lesions. Permanent tooth eruption is generally not complete until early adolescence. Caries development is commonly slow, requiring many months or years of decalcification before a cavity is evident.

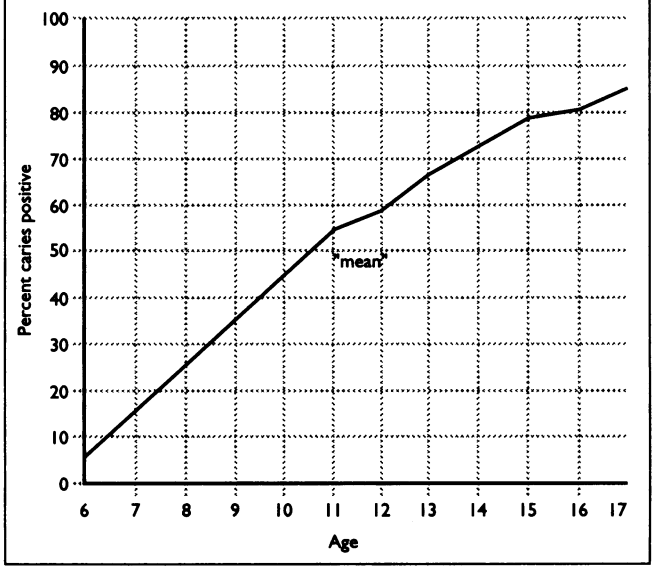
Therefore, many young children may not have had sufficient time to develop cavitation of their permanent teeth. In calculating a statistical mean, each subject contributes equal weight. Children too young to express disease drive down the mean. Attack rates adjusted for numbers of teeth at risk at each age would be more descriptive statistics.

2. Diagnostic methods and criteria. Diagnosing caries without radiographs and counting equivocal lesions as sound (*18*) tend to understate findings, especially compared to clinical assessments, while treatment effects among children who have had restorations tend to overstate findings. Since treatment rates for young children are low, a tendency toward disease understatement is likely.

3. Inappropriate application of the mean statistic. A mean is an average and is therefore an estimate of true central tendency. It is most descriptive for data that are normally distributed. Figure 2 highlights the problem with using the mean to reflect caries experience in growing children. Because caries experience is progressive with age, the mean for caries experience (50 percent) provides no more information than knowing that age 11 is the mean between ages 5 and 17. It fails to give any sense of range, progression or variation; all issues important to public policy deliberations and public health planners.

Additionally, NIDR's age cohort data are discrete and cross sectional, yet they are frequently portrayed as continuous and longitudinal by linear plotting of prevalence by age (fig. 2). This plot may be best characterized by its slope, which reflects increases in prevalence by age. The slope for NIDR's data suggest that as children get older, approximately 7 percent fewer will be caries free each year. Approximately 250,000 additional children are afflicted with tooth decay with each passing year of age.

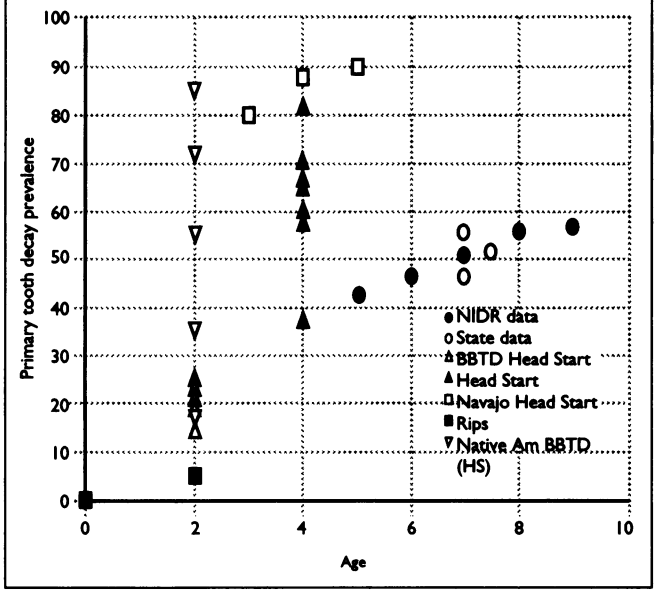
Figure 2. Percent of children with caries in permanent teeth (NIDR 1986–87)



This figure shows the customary method of portraying NIDR's data from the 1986–87 National Survey of Oral Health in US Schoolchildren. This presentation ignores findings for the primary (baby) teeth and averages five year olds' prevalence (2.7 percent) with 17 year olds' prevalence (84.4 percent) to derive a "mean caries prevalence" of 50 percent. This presentation fails to convey the progressive nature of dental caries which results in very high prevalence by late adolescence. The continuous line suggests that one group of children was followed sequentially although the study was conducted at one point in time by examining children of different ages.

Caries progression continues until an overwhelming majority of children have experienced disease. Most descriptive of permanent teeth caries prevalence in U.S. schoolchildren is the finding that 84.4 percent have experienced unequivocal, visually evident permanent tooth caries or fillings affecting, on average, more than eight tooth surfaces by age 17. With only one in six 17-year-olds caries free, the caries rate shows little evidence of "topping out."

Figure 3. Prevalence of primary tooth decay from collateral studies (NIDR 1986–87)



This scatterplot shows primary (baby) tooth decay prevalence from NIDR 86–87 [ref: NIDR #5] and from collateral studies conducted since that time. Taken together, these studies show that caries is a serious problem even among some groups of toddlers, that caries experience among young children may not be declining and that caries experience among population subgroups varies widely.

• State and regional surveys: (references *93–95*) findings cluster near the earlier NIDR findings suggesting that caries prevalence has not been decreasing during recent years.

• Head Start: (references *86, 90, 92, 94*) data show higher disease prevalence among low income preschoolers than among older children in the NIDR study. Head Start findings also reveal a wide range of caries experience even among low income groups. Data from Navajo Head Start (reference *93*) shows particularly high levels of disease prevalence.

• BBTD: (reference *28*) Baby bottle tooth decay at age two was approximated from Head Start examinations and estimated by Ripa (reference *28*). Findings show that BBTD is highly prevalent in some groups and that low income toddlers experience a very wide range of decay.

In contrast, earlier comparable national surveys showed that caries increments slowed during late adolescence. The failure of caries progression to slow during late adolescence in the most recent NIDR study may suggest that the incidence of caries is being delayed rather than prevented. This slowing of disease progression may be due to fluoride effects (*19*).

Data for Primary Teeth

Many countries maintain extensive data bases describing primary teeth caries (*20–22*). International reviews conclude that caries declines for primary teeth in industrialized countries may "well have ceased" (*23*) and that the distribution of early caries is increasingly skewed to smaller population segments.

Holm, reflecting on the Federation Dentaire Internationale–World Health Organization goal of less than 50 percent caries prevalence at age 5 by the year 2000, states that "in no country so far, where caries prevalence has been over 50 percent in this age group, has it yet been possible to achieve this reduction" (*22*). These reports further emphasize the tremendous contribution of primary tooth caries to the health burden of young children.

By age 17, 84 percent have experienced unequivocal, visually evident permanent tooth caries or fillings affecting, on average, more than eight tooth surfaces.

The 1986–87 NIDR official report does present the mean number of decayed and filled primary tooth surfaces (dfs) in 5–9-year-old children by age and sex. Mean dfs findings provide an indication of how extensively children's primary teeth are affected by caries. Reported mean dfs were 3.4 at age 5, 3.7 at age 6, 4.2 at ages 7 and 8, and 3.9 at age 9. The dfs index continues to increase over this age range until the numbers of primary teeth decrease due to exfoliation (the natural loss of primary teeth when replaced by secondary teeth). The finding that schoolchildren younger than age 9 demonstrate an average of nearly four carious or filled surfaces could be interpreted as cause for alarm. Documented implications of this morbidity include bed-days for preschool children and absenteeism for school children (*24*) and overuse of emergency room facilities for treatment of dental pain and infection (*25*).

In addition to not controlling for exfoliation which understates primary tooth caries, the NIDR study derives from two factors

1. Exclusion of all missing primary teeth from analysis: Missing teeth are regarded as sound despite extraction being a common therapy for primary teeth affected by advanced caries.

2. Understatement of cavities that occur between the primary teeth (proximal caries): Fluoride has not only decreased caries prevalence and incidence; it has also modified the appearance and progression of carious lesions.

Frank cavitation is less common today because fluoridated teeth are less likely to break down even when decay has significantly advanced into the tooth. This fluoride effect further masks visual identification of decay between teeth, especially for primary inter-tooth contacts that are broader, flatter, and less accessible than comparable permanent tooth surfaces. A study of understated primary tooth proximal caries among 5-year-olds (*26*) noted that clinical examination alone underestimates the correct caries status

of children by 2 contacting (proximal) surfaces. Applying this finding to NIDR primary tooth data for 5-year-olds, the under-estimate approximates 40–50 percent.

Stephen, summarizing issues of diagnostic validity in epidemiologic studies, states (*23*) "The accuracy of any 'caries-free' status accorded to deciduous teeth in 5–6-year-olds, on the basis of a clinical-only examination, must be questioned, in view of the publications which highlight deciduous caries underscoring (approximately 60 percent) in the absence of bitewing radiographs."

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NIDR's primary tooth caries prevalence reported by Brunelle in a 1990 International Association for Dental Research meeting poster (personal communication) among 5–9-year-olds is 42 percent at age 5, 46 percent at age 6, 54 percent at age 7, 55 percent at age 8, and 56 percent at age 9. Burnell concluded from this data that (*17*) "caries experience in primary teeth is still high compared to that of permanent teeth at risk for the same length of time."

Figure 3 shows the plots for NIDR caries positive rates by age in both primary and permanent teeth. It reveals that a consideration of primary teeth markedly increases the recognition of caries-afflicted children: more than 40 percent of 5-year-olds and nearly 85 percent of 17-year-olds are caries positive.

Statistics such as these represent more accurately the distribution of caries prevalence among schoolchildren than the oft-cited 50 percent caries-free.

Conclusions

1. The 50 percent caries-free characterization of U.S. schoolchildren is mythical because it fails to consider decayed primary teeth and because it inappropriately averages in children too young to have experienced decay in their permanent teeth.

2. When decay in primary teeth is also considered, roughly half of children have already experienced decay before first grade. The Healthy People 2000 Oral Health goal of 65-percent caries free children at ages 6–8 years remains a profound public health challenge.

3. Caries progresses unabated, increasing the caries-afflicted population each year until the overwhelming majority of children have experienced dental caries by the time they complete high school.

4. Caries declines noted for American schoolchildren over time may reflect a slowing of disease progression rather than true prevention.

Additionally, consideration of caries studies since 1986 (see accompanying sidebar article) confirms that (*a*) caries experience varies widely among individual children and (*b*) caries experience varies widely among population subgroups.

Caries remains the single most common disease of childhood that is neither self-limiting nor amenable to short term pharmacologic management. The popular statement that "50 percent of all U.S. school children have never experienced tooth decay" fails profoundly to reflect the extremity and severity of this still highly prevalent condition of childhood. This may lead to inappropriate policy and funding decisions that can put the health of children at risk. Clearly, childhood dental caries remains a sizable and significant personal and public health problem that will continue for the foreseeable future.

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