Ethnicity, Location, Age, and Fluoridation Factors in Baby Bottle Tooth Decay and Caries Prevalence of Head Start Children

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Synopsis

Baby bottle tooth decay (BBTD) is a term applied to a specific form of rampant decay associated with inappropriate bottle or breast feeding of infants and young children. Although the prevalence of BBTD has been studied in individual ethnic groups, comparison studies are rare. Head Start children have frequently served as study subjects for assessing the prevalence of BBTD.

The purpose of this study was to compare BBTD and caries prevalence among Head Start children who are members of four ethnic groups in five southwestern States. Age, residence, and fluoridation status were also compared for the total sample and ethnic categories. The sampling process was a stratified random site selection; it was used to obtain data on 1,230 children. This number constituted 3 percent of the children enrolled in Head Start in Public Health Service Region VI (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas) where the study was conducted. The criterion for determining the presence of BBTD was based on the number of carious deciduous maxillary incisors observed. The severity of the condition was reported as two of four and three of four of the target teeth affected. Thus, two levels of severity are reported.

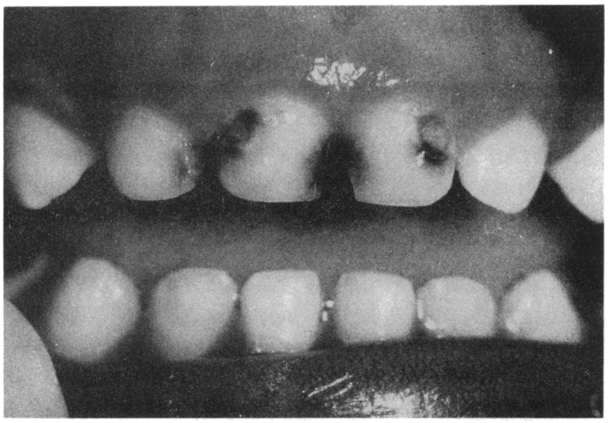
BBTD was prevalent in approximately 24 percent and 15 percent of the total sample, depending on the severity criterion used. Native American children had a significantly higher ($P < 0.05$) prevalence than Hispanic, white, and black subjects. Rural children had significantly higher ($P < 0.05$) prevalence of BBTD than nonrural children for all ethnic groups except whites.

The prevalence of decayed and filled (df) surfaces of primary dentition was significantly greater for all rural than for nonrural groups ($P < 0.05$). Children attending centers showed no significant differences based on fluoride status for the total sample or other variables. BBTD and caries prevalence increased with age. Studies are needed to identify predisposing factors among the ethnic groups and residence status in order for more effective preventive regimens to be developed, implemented, and evaluated.

NURSING BOTTLE CARIES, nursing caries, milk bottle syndrome, and baby bottle caries are all terms that have been used to identify a specific form of rampant caries in the primary teeth of preschool children. In 1986, the Healthy Mothers, Healthy Babies Coalition adopted the term "baby bottle tooth decay" (BBTD) to identify the condition (*1*). The characteristic features of BBTD include carious lesions that develop rapidly, the involvement of numerous primary teeth, and the occurrence of lesions on tooth surfaces generally thought to be at low risk for dental caries.

The decay pattern usually begins with the maxillary primary incisors followed by the primary molars and the other decidious teeth including the mandibular incisors (*2-9*). BBTD has been shown to be associated with inappropriate bottle feeding, such as giving infants a bottle containing a cariogenic liquid when they go to bed and prolonging bottle feeding past the age of 1 year. While the

Figure 1. Baby bottle tooth decay affecting 3 maxillary incisors



term BBTD does not specifically encompass breast feeding, inappropriate breast feeding (that is, at-will nursing for prolonged periods) is usually included as an etiologic factor (*3,10,11*). Derkson and Ponte (*8*) have suggested parents' educational status, infants' dietary fluoride consumption, and age of eruption of incisors as additional contributing factors. While inappropriate bottle feeding with milk has been shown to be potentially cariogenic, bottles containing fruit juices and other sweetened beverages also have been shown to be involved in early primary caries and BBTD (*12–15*).

Criteria for defining BBTD tend to vary among researchers. Kelly and Bruerd (*11*) initially defined their criterion as decay affecting two of the primary maxillary incisors. However, they also presented their data using a criterion of three or more decayed incisors, but found little difference in BBTD prevalence. Conversely, Broderick and coworkers (*16*) established criteria to categorize BBTD into four levels of severity depending upon the number of carious anterior tooth surfaces observed and the presence or absence of posterior carious teeth, teeth with pulpal involvement, and mandibular decay.

The prevalence of BBTD has been reported for both American children (*6,11,16*) and for children residing in other nations (*8,17–19*). In the United States, BBTD prevalence has been investigated among various ethnic groups including blacks and several Native American populations (*6,11,16*). However, comparisons of BBTD rates among the various ethnic groups are extremely scarce. Some investigations have been conducted in optimally fluoridated communities, while others give results from suboptimally fluoridated areas (*6,8,20*). Children enrolled in Head Start Programs have served as the sample subjects in several BBTD investigations (*11,16,21*). Additionally, these children have been the subjects of other oral health studies not involving BBTD per se (*20,22–24*). Johnsen and coworkers (*20*) reported the caries levels and patterns in Head Start children in fluoridated and nonfluoridated, urban and nonurban sites. Unfortunately their inclusion of cities with populations of 15,000 and 35,000 in the nonurban groups could possibly mask the caries rates that might be found in truly rural areas.

The purposes of this study were to determine and compare the BBTD prevalence and caries rates among four ethnic groups of Head Start children and to make these comparisons between rural and nonrural students. Additional aims included the determination of BBTD prevalence according to children's age and the comparison of these rates among children residing in areas where the water supply was optimally or suboptimally fluoridated.

Methods and Materials

Children enrolled in 37 Head Start sites throughout the five southwestern States comprising the Public Health Service Region VI served as the subjects of this survey. The sites were randomly selected following stratification according to State and location (rural and nonrural). The sample represented 5 percent of Head Start sites in the region and 3 percent of the enrolled children. Rural sites were defined as towns with populations of 10,000 or less. The 14 nonrural sites were located in six cities varying in population from 22,000 to 560,000 (median population size = 250,000). Among the 23 rural sites, 8 were located in areas varying in population from 50 to 200; 5 were in areas of 200 to 900 people; and 6 were in towns of 1,000 to 2,000. The population of the largest rural town was 8,500. The sample included 221 whites, 409 blacks, 449 Hispanics, and 151 Native American children.

Three clinicians trained in dental caries trials served as examiners in this survey. They were calibrated and standardized in the use of the decayed, indicated for extraction, and filled (def) index of primary dentition in a pilot study conducted at Head Start sites not included in the data collection phase. The standardization-calibration process included an extensive series of clinical caries examinations and resulted in each examiner having an intrarater reproducibility of at least 92 percent and interrater agreements of 87 percent or better.

During the data collection phase of the survey, intraoral examinations were conducted at the Head

Start sites using reflected light, mirrors, explorers, and gauzes for drying the teeth. Radiographs were not used. At each site, all children who were in attendance on the survey days were examined by one of the three clinicians.

For each child, the following information was recorded on data collection instruments coded to insure subject anonymity: age, sex, ethnic background, site location, def surfaces, teeth missing due to caries, and presence or absence of evidence of BBTD. BBTD was determined according to the criteria cited by Kelly and Bruerd (*11*) (that is, caries affecting two or more maxillary primary incisors, and caries affecting three or four maxillary primary incisors). Figure 1 depicts a child with BBTD involving three maxillary incisors.

BBTD prevalence was determined for the total sample and according to age, ethnicity, site location, and water fluoride concentration (optimal versus suboptimal). The water fluoride concentrations for the nonrural sites were obtained while on site from city officials. At rural sites, water samples were collected and analyzed for fluoride. However a detailed history of consumption since birth was not available from parents or caretakers. Mean ($\pm$ standard deviation [SD]) decayed and filled surfaces (dfs) and teeth (t) rates were determined for the total sample and according to ethnicity and site location. For the total sample and for each ethnic and residence group, determinations were made of the proportions of caries free children.

All frequency data, BBTD and caries free comparisons, were analyzed using chi-square analysis. Differences between the dfs and t rates exhibited by rural and nonrural groups were tested for statistical significance using a two-tailed *t*-test for independent samples. Comparisons of the dfs and t scores found among the four ethnic groups were analyzed using a one-way, two-tailed analysis of variance followed by Tukey's Honestly Significant Difference test. A probability of $P<0.05$ was considered significant for all inferential tests performed.

Results

The sample consisted of 1,230 Head Start children enrolled in programs in Public Health Service Region VI. Table 1 shows the prevalence of BBTD according to age. For the total sample, the BBTD prevalence was 23.8 percent and 15.2 percent depending upon the diagnostic criteria utilized. When two or more carious maxillary incisors was considered the criterion for BBTD, the rate for 3-year-old children was 18.5 percent; for 4-year-old children, 22.4 percent; and for 5-year-old children, 27.9 percent. The rate for 5-year-olds was significantly higher than for 3-year-olds ($P<0.05$). When the criterion was three or more involved incisors, the rate for 5-year-old children (19.2 percent) was significantly greater than for both the 3-year-old (11.1 percent) and the 4-year-old children (13.7 percent).

Table 2 shows the BBTD prevalence according to ethnicity. Using the criterion two or more carious maxillary incisors, the rates were white, 22.2 percent; blacks, 20.5 percent; Hispanics, 23.8 percent; and Native Americans, 35.1 percent. When the criterion was three or more carious incisors, the rates varied from 13.2 percent to 23.2 percent. Regardless of the criterion utilized, the BBTD prevalence among Native Americans was significantly greater than for any of the other ethnic groups ($P<0.05$).

The BBTD prevalence according to Head Start site location and ethnicity is shown in table 3. When two or more carious incisors was the criterion, the BBTD rate for 508 rural children was 34.1 percent and for 722 nonrural children, 16.6 per-

Table 1. Percentages of 1,230 Head Start children with baby bottle tooth decay, by age

		Baby bottle tooth decay involving—	
Age	Number	2 or more maxillary incisors [1]	3 or more maxillary incisors [2]
3 years	81	18.5	11.1
4 years	769	22.4	13.7
5 years	380	27.9	19.2
Total	1,230	23.8	15.2

[1] Rate for 5-year-olds was significantly higher ($P<0.05$) than the rate for 3-year-olds.
[2] Rate for 5-year-olds was significantly higher ($P<0.05$) than the rate for 3- and 4-year-olds.

Table 2. Percentages of 1,230 Head Start children with baby bottle tooth decay according to ethnicity

		Baby bottle tooth decay involving—	
Group	Number	2 or more maxillary incisors[1]	3 or more maxillary incisors[1]
White	221	22.2	14.5
Black	409	20.5	13.2
Hispanic	449	23.8	14.7
Native American	151	35.1	23.2
Total	1,230	23.8	15.2

[1] Rate for Native American children was significantly higher ($P<0.05$) than the rates for the white, black, and Hispanic groups.

Table 3. Percentages of rural and nonrural Head Start children with baby bottle tooth decay by ethnicity

Group and site location	Number	Baby bottle tooth decay involving— 2 or more maxillary incisors	Rural versus nonrural ($P<0.05$)	3 or more maxillary incisors	Rural versus nonrural ($P<0.05$)
White and nonrural	124	20.2		10.5	
White and rural	97	[1]24.7	No	19.6	No
Black and nonrural	267	15.4		9.7	
Black and rural	142	[2]30.3	Yes	19.7	Yes
Hispanic and nonrural	287	16.0		8.7	
Hispanic and rural	162	37.7	Yes	25.3	Yes
Native American and nonrural	44	18.2		11.4	
Native American and rural	107	42.1	Yes	28.0	Yes
Total nonrural	722	16.6		9.6	
Total rural	508	34.1	Yes	23.2	Yes

[1] White and rural differed significantly ($P<0.05$) from Hispanic and rural and Native American and rural.
[2] Black and rural differed significantly ($P<0.05$) from Native American and rural.

Table 4. Percentage of rural and nonrural Head Start children with baby bottle tooth decay by optimal and suboptimal fluoride concentration

Group	Water fluoride concentration	Number of sites	Number of children	Baby bottle tooth decay involving— 2 or more maxillary incisors	3 or more maxillary incisors
Nonrural	Optimal	8	493	[1]17.0	[1]10.3
Nonrural	Suboptimal	6	229	[1]15.7	[1]7.9
Rural	Optimal	3	77	28.6	20.8
Rural	Suboptimal	20	431	35.0	23.7
All	Optimal	11	570	[2]18.6	[2]11.8
All	Suboptimal	26	660	28.3	18.2

[1] Nonrural differed significantly ($P<0.05$) from rural. [2] Optimal differed significantly ($P<0.05$) from suboptimal.

Table 5. Prevalence of decayed and filled surfaces of teeth of rural and nonrural Head Start children, by ethnicity and significant differences ($P<0.05$)

Group	Nonrural Number	Mean	SD	Rural Number	Mean	SD	Rural versus nonrural ($P<0.05$)	Total Number	Mean	SD
White	124	5.71	±4.39	97	7.18	±6.01	Yes	221	6.3	±5.84
Black	267	[1]4.43	±3.98	142	6.49	±5.37	Yes	409	[2]5.14	±4.49
Hispanic	287	[3]3.38	±3.30	162	[4]9.67	±8.01	Yes	44	5.65	±5.16
Native American	44	5.25	±4.07	107	[5]14.25	±12.05	Yes	151	[6]11.63	±9.88
Total	722	4.28	±3.80	508	9.27	±8.11	Yes	230	6.35	±5.98

[1] Nonrural blacks differed significantly from whites.
[2] Combined black groups differed significantly from combined white and Hispanic groups.
[3] Nonrural Hispanics differed significantly from other nonrural ethnic groups.
[4] Rural Hispanics differed significantly from rural white and black groups.
[5] Rural Native Americans differed significantly from all other rural ethnic groups.
[6] Combined Native American groups differed significantly from all other combined ethnic groups.

cent. When the more stringent criterion was used, the rates for rural and nonrural children were 23.2 percent and 9.6 percent, respectively. Using both criteria, the BBTD rates among the total sample and among all ethnic groups except whites were significantly higher for rural than for nonrural children. For rural whites, the rates were slightly but not significantly greater than for their nonrural cohorts.

The BBTD rates for rural blacks, Hispanics, and Native Americans varied between 2 and 2.5 times greater than for their nonrural counterparts. When only nonrural children were compared, no significant differences were found in BBTD prevalence among the four ethnic groups. Among rural children, the rates varied from 24.7 percent for whites to 42.1 percent for Native Americans.

The prevalence of BBTD among rural and nonrural children attending Head Start sites in optimally and suboptimally fluoridated communities is shown in table 4. While the total sample data indicate significantly lower BBTD prevalence in optimally fluoridated communities, analyses of the data separately for rural and nonrural areas reveal no significant differences in BBTD rates in optimally and suboptimally fluoridated Head Start sites.

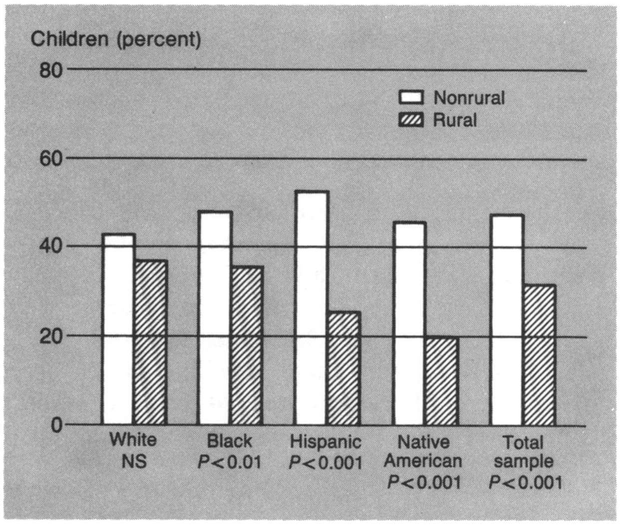
Table 5 reveals the dfs found among the various demographic groups of Head Start children. For the total sample, the mean dfs ($\pm$SD) was 6.35 $\pm$ 5.98. The caries experience for Native American children (11.63 $\pm$ 9.88) was significantly greater than for the other ethnic groups, and the black children exhibited a significantly lower dfs score ($\bar{X}$=5.14 $\pm$ 4.49) than their counterparts. The mean dfs for rural children (9.27 $\pm$ 8.11) was significantly greater than for nonrural children (4.28 $\pm$ 3.80). This same relationship in rural versus nonrural dfs scores existed among all ethnic groups.

Figure 2 relates the proportion of caries free children according to ethnicity and Head Start site location. For the total sample, the proportion of nonrural children who were caries free (49.4 percent) was significantly greater than the proportion of caries free rural children (29.5 percent). This statistically significant relationship (P<0.05) also existed among black, Hispanic, and Native American children.

Discussion

Due to methodological differences, it is difficult to compare the BBTD prevalence found in this study, 23.8 percent to 15.2 percent, with the BBTD rates reported by others. The current survey reveals rates much higher than the 3.2 percent reported by Derkson and Ponti (*8*). However, their survey was conducted among Canadian children having a much wider age range (9 months to 6 years). Likewise, our findings of 15.4 percent to 9.7 percent BBTD prevalence among nonrural black children is higher than the 5 percent reported among an inner-city population, 98 percent of whom were black (*6*). That survey included children ranging in age from 4 weeks to 9 years, while our survey was conducted among 3- to 5-year-old children. Broderick and coworkers (*16*) reported a BBTD prevalence of 70 percent among Native American Head Start children. Our findings among this ethnic group were 35.1 percent or 23.2 percent, depending upon the BBTD criteria. It should be noted, however, that their minimal criterion included two carious maxillary anterior tooth surfaces while our minimal criterion was the involvement of two maxillary anterior teeth.

Figure 2. Percentages of children who were caries free (no caries, no restorations) by ethnic group and residence and statistically significant differences between groups



NOTE: Differences by ethnic group—white rural vs. Native American rural P<0.01; black rural vs. Native American rural P<0.01.

In addition, the Broderick study included mostly Navajo children with a BBTD rate of 72 percent and a small proportion of Cherokee children having a 55 percent BBTD prevalence. The current study included no Navajo children. Approximately 50 percent of the Native Americans in the current study were rural Cherokees. Among these children, BBTD prevalence (40 percent) approached that previously reported among Cherokees. Using the same criteria used in this study, Kelly and Bruerd (*11*) reported BBTD rates of 55 percent (two

'The prevalence among rural children was more than double that of nonrural children for every ethnic group except whites. Rural whites exhibited a slightly higher rate than their cohorts.'

carious maxillary incisors) and 53 percent (three or more carious maxillary incisors) among Native American Head Start children. The only common group in their study and the current survey were Cherokee children in Oklahoma, and the BBTD rates found among these children in the two surveys were 31 percent and 34 percent, respectively. Thus BBTD prevalence is dependent upon the population studied.

Although the prevalence of BBTD increased significantly among the oldest children, it is noteworthy that a high percentage of 3-year-old children exhibited the condition. This implies that measures designed to prevent the syndrome, if they are to be successful, must be initiated prior to the child's enrollment in Head Start.

The variance in BBTD prevalence according to ethnicity, with Native American children having a higher rate than other ethnic groups, corroborates empirical reports of clinicians who have treated various groups of Head Start children. However, the data suggest that BBTD has a greater association with residence (and location of the Head Start site) than with ethnicity. The prevalence among rural children was more than double that of nonrural children for every ethnic group except whites. Rural whites exhibited a slightly higher rate than their cohorts. Indeed, while there were no differences in BBTD prevalence among nonrural ethnic groups, rural Native Americans exhibited significantly higher rates than whites and blacks, and rural whites showed a lower prevalence than Hispanics. Thus ethnicity's effect on BBTD prevalence is limited to rural children.

The reasons for rural children being affected to a greater extent than nonrural children is not completely understood. Initially, it was thought that the primary reason for this difference was access to optimally fluoridated water supplies, since 68 percent of the nonrural children consumed optimally fluoridated water as compared with 15 percent of the rural residents. However, while analysis of the total sample data indicated a significantly lower prevalence among children drinking optimally fluoridated water, separate analyses for rural and nonrural residents revealed no significant differences in the rates exhibited by optimally fluoridated water drinkers and their counterparts.

It appears that other etiologic and epidemiologic factors override, at least partially, the preventive effects of consuming optimally fluoridated water. Comparison of the relative importance of these factors on BBTD prevalence among rural and nonrural children of various ethnic groups should be the subject of further investigation.

Previous reports (*20, 23, 25*) concerning total caries rates for Head Start enrollees have indicated mean dfs scores of 3.30, 4.70, 5.85, and 9.99 for children in Ohio, Indiana, and Mississippi. The current finding for the total sample falls within the range of those study results.

The need to prevent BBTD among very young children who may become Head Start participants is well documented. Because the condition is evidenced in 3-year-old enrollees, an effective preventive approach must be implemented through parents or caretakers as early in the prenatal and postnatal educational cycles as possible. Head Start has been known to be an excellent environment for studying predisposing and epidemiologic factors, but it cannot be the primary educational program for controlling BBTD among enrollees. It does, however, provide an excellent environment for providing information to parents, guardians, and caretakers about prevention of BBTD that may control the condition in younger siblings of Head Start families. Further investigations are needed to determine an effective interagency and interdisciplinary approach to the prevention of BBTD in children of the disadvantaged segment of the population.

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Referrals of Participants in an Urban WIC Program to Health and Welfare Services

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Synopsis

The Special Supplemental Food Program for Women, Infants, and Children (WIC) provides supplemental food, nutrition education, and referrals to available health and welfare services. Recipients are income-eligible pregnant and postpartum women, their infants, and their children who are younger than 5 years of age. Although studies have documented the nutritional benefits of the program, the extent to which WIC nutritionists help eligible women to obtain available health and welfare services, and the degree to which this referral activity promotes health, is largely unknown.

The researchers examined the referral activity at one urban WIC clinic, but did not evaluate the outcomes. Of 1,850 persons seen, there were 762 referrals by WIC nutritionists for 597 persons at the Lawrence, MA, clinic during a 2-month period. Of the 597 persons, 494 (83 percent) were WIC participants and 103 (17 percent) were nonparticipants. The rate of referrals for WIC participants was 27 percent. Multiple referrals were common, with 127 people receiving more than one referral. WIC nutritionists at this site offered a variety of referrals to their clients. The majority of referrals (61.7 percent) were for supplemental food. Nonnutrition-related referrals were to medical and