Oral Health Status of Children and Adolescents by Rural Residence, United States

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ABSTRACT: Context: The limited information available on the oral health status of rural children in the United States makes it difficult to devise policy strategies to address perceived problems. Purpose: To document the oral health status and dental care utilization of US children by place of residence. Methods: Data from National Health Interview Surveys for 1995, 1997, and 1998, and from the third National Health and Nutrition Examination Survey (1988-1994) were analyzed. Findings: Children residing in rural areas were more likely to be uninsured for dental care than were children from urban areas (41.1% versus 34.7%). A greater percentage of rural than urban children reported unmet dental needs (7.5% versus 5.6%); there was no difference in selfreported poor dental status. Urban children were more likely than rural children to have visited the dentist in the past year (73.6% versus 69.9%) and were also more likely to be regular users of dental care (61.7% versus 51.4%). Differences in percentage of rural and urban children with caries lesions and caries experience were not significant. Conclusions: Children residing in rural areas have less access to and utilization of dental care compared to children residing in urban areas. Moreover, poor rural children display less utilization of dental services than poor urban children. Differences in the sum of decayed and filled primary teeth and the sum of decayed, missing, and filled permanent teeth were not significant.

he 1990 US census indicated that over 61 million people (24.8%) are classified as the rural population.¹ Approximately 21% of all US children live in rural areas and represent 31% of the rural population.² Although the rural population is ethnically, culturally, and economically diverse, children from rural areas have a greater likelihood than urban children of being poor, non-Hispanic white, and of residing in larger families with both parents present.²

National data have shown that poor children have less access to dental care³ and have more oral health needs than their more economically privileged counterparts,³⁻⁵ yet little is known about the oral health status or dental care utilization of children residing in the rural United States. Several reports from specific states have concentrated on the oral health status of preschool children attending Head Start Centers, ^{6,7} but to the best of our knowledge, there are no reports on children of all ages or on children at the national level.

There has been little quantification of the oral health status of rural children in the literature to date. The inability to quantify anecdotal reports of rural health disparities has made it more difficult to devise policy strategies to address perceived problems. This study was undertaken to document the oral health status and dental care utilization of rural children in the United States. This information is necessary to plan programs that target rural populations and to monitor changes in disparities between urban and rural groups. Understanding the oral health status of the rural population furthers the understanding of oral health disparities associated with sociodemographic characteristics in the United States.

Methods

Data Sources. Those data used for this report come from the third National Health and Nutrition Examination Survey (NHANES III, 1988–1994) and

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from the 1995, 1997, and 1998 National Health Interview Surveys (NHIS). Because of similar survey design, it was possible to combine the data from NHIS 1997 and NHIS 1998 to increase the sample size.

These surveys, representative of the US noninstitutionalized population, were conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention. The NHANES collects data via face-to-face interviews at the participant's home and via clinical examinations and laboratory analyses conducted at mobile examination centers; the NHIS collects data via face-to-face interviews only. In addition to overall sociodemographic and health indicators, both surveys provide specific information on oral health for the population that is aged 2 years and older. The surveys oversample racial/ethnic minority populations to allow for the calculation of reliable estimates. Non-Hispanic blacks were oversampled in all surveys, all Hispanics were oversampled in NHIS 1997 and NHIS 1998, and Mexican-Americans were oversampled in NHANES III. Details of the sample design and survey operation have been published previously.^{8,9}

We analyzed the surveys separately and for different variables because neither survey provides complete information on oral health. Each survey answers different questions on oral health status and access to dental services. For example, NHANES III and NHIS 1997 and 1998 do not have any questions about dental insurance, which limited us to using NHIS 1995 only for analyses of insurance coverage. In the case that both NHIS and NHANES provided relevant data, NHIS generally was the default; NHIS has a greater sample size, which yields reliable information and often more detail.

Population. The population included in this study comprised children ranging in age from 2 to 17 years. Modifications in the age group chosen for analysis of specific variables included selection of children aged 8 to 19 years for sealants and children aged 0 to 17 years for dental insurance. The sample size of children aged 2 to 17 years for each survey was 24 443 in NHIS 1997 and 1998, 10 327 in NHANES III, and 27 060 children aged 0 to 17 years in NHIS 1995. To maximize the use of available data, cases with missing information for specific variables were excluded from analyses of those variables only.

Variables. In both surveys, rural residents were defined following the Bureau of the Census definition, which classifies rural areas as those places with less than 2500 inhabitants that are not part of an urbanized area.¹⁰

The outcome variables were dental insurance coverage, perception of oral health, dental care utiliza-

tion (including orthodontic treatment), and dental status (defined as caries experience and report of having received sealants). We selected the source of the outcome variables based on the availability of the questions and sample-size considerations that allowed for more detailed analyses.

- 1. Dental insurance. Data on all types of dental insurance were available only from NHIS 1995 for all age groups. Dental insurance was categorized as no insurance, public insurance, or private insurance.
- 2. Unmet needs and perceived oral health status. Information on unmet dental needs was collected in NHIS 1997 and 1998 with the following question: "During the past 12 months, was there any time when you needed any of the following (ie, dental care, vision care), but didn't get it because you could not afford it?" Self-reported dental status was asked in NHANES III with the question "How would you describe the condition of [child's name] natural teeth?"
- 3. Dental care utilization. Utilization was measured as the presence of at least one dental visit in the past year (NHIS 1997 and 1998), frequency of visits (NHANES III), and history of orthodontic treatment. Past year visit is ascertained by the following question: "About how long has it been since you last saw or talked to a dentist? Include all type of dentists ... as well as dental hygienists." Data from NHIS have been used regularly to determine dental care utilization in the past year. Children who have never visited a dentist were analyzed separately. Frequency of dental care utilization was analyzed from NHANES III; the question asked-"How often do you go to the dentist?" We collapsed the response categories "at least once a year" and "every 2 years" into "regular users." Those who responded "whenever needed or no schedule" were classified as episodic users. Self-report of having ever had orthodontic treatment was questioned in the NHANES III.
- 4. Dental status. Caries experience was determined in a clinical examination by trained dentists in NHANES III; data are presented using the sum of decayed and filled primary teeth (dft) and sum of decayed, missing, and filled permanent teeth (DMFT) indexes and using the percentage of children with at least one decayed tooth. Presence of sealants was determined by self-report of having sealants for children aged 8 to 19 years; this age group was selected because sealants are still rarely applied in primary teeth, and in permanent teeth they are applied after full eruption of the first molars, which occurs around 8 years of age. Both NHIS 1998 and

NHANES III provided information on dental sealants. Data from NHIS 1998 were preferred here because the larger sample size of NHIS 1998 yielded more reliable estimates. Additionally, prevalence of sealants, although higher in NHIS 1998 than in NHANES III, showed similar distribution by place of residence in both surveys. The dental sealant question was "Has [child's name] had dental sealants painted on his/her teeth?" This question followed a description of a dental sealant.

Stratification Variables. Age was categorized in different groups depending on the variable of interest, but most analyses are presented for children aged 2 to 17 years. Analyses of dental caries are presented for 2–5- and 6–17-year-olds; these groups represent the ages relevant for primary and permanent dentitions. Insurance is present for all children under 18 years of age because NHIS 1995, the originating survey, is the only survey to have dental information for children under the age of 2 years. As the recommended age for a first dental visit is 1 year of age,¹¹ dental insurance coverage starting at infancy is appropriate.

Gender was not included in analyses because analyses of most variables showed no significant differences by gender; it has been found that, generally speaking, child oral health status tends not to vary by gender.¹²

Indicators of socioeconomic status (SES) have been demonstrated to be strongly associated with oral health status.^{4,5} We included SES indicators as the data allowed; the large sample size of NHIS 1997 and 1998 allowed stratification by race/ethnicity and by 3 levels of poverty status. The more limited sample size of NHANES III allowed for stratification only to 2 levels of poverty status. Using the same poverty categories for both surveys would enhance comparability; however, collapsing "poor" and "near-poor" in NHIS would represent a significant loss of information, since the 2 groups are, in most cases, fairly different. Poverty is defined by the ratio of family income to the Federal Poverty Level (FPL), which is a threshold of family income that varies by family size and composition. For example, the threshold for 1997 was \$16 400 for a family of 4; a participant with this family income and this family size was classified to be at 100% of the FPL. Poverty status in NHIS was classified into 3 levels: poor (0%-99% of the FPL), near poor (100%-199% of the FPL), and non-poor (200% of the FPL and over); in NHANES III, poverty was classified as poor/near poor (less than 200% of the FPL) and non-poor (at or over 200% of the FPL).

Race/ethnicity classification from NHIS in non-Hispanic whites, non-Hispanic blacks, and Hispanics is based on self-report or parent/guardian report. NHANES III did not have adequate sample sizes of rural race/ethnic minorities to yield reliable estimates. Therefore, despite the importance of race/ethnicity in the distribution of oral health status, race/ethnicity was not included in data derived from NHANES III.

Statistical Methods. Statistical analyses included bivariate analyses of outcome variables and independent variables. Differences between groups were approximated with 95% confidence intervals (CI), which were calculated with the formula 95% CI = estimate + / -(standard error * 1.96); overlapping of confidence intervals indicates that the estimates are not statistically different. Each survey from which the data come was analyzed independently; all estimates include the sample weights provided in the corresponding data set to obtain national representation by accounting for oversampling and nonresponse. Standard errors to derive confidence intervals were calculated in SUDAAN,¹³ a statistical package that takes into consideration the surveys' complex sample design. Low power of the estimates was determined when the relative standard error of an estimate was higher than 30% of that estimate. Variables used to classify rural status in the surveys are not included in the data set files released for public use; therefore, analyses were conducted at the National Center for Health Statistics' Research Data Center; their requirements were followed to assure the confidentiality of survey participants.

Results

A full 26.2% of children aged 2 to 17 years in the United States reside in rural areas. Rural children were more likely to be non-Hispanic white; urban children were more likely to be non-poor compared with rural children (Table 1).

Table 2 presents dental insurance and poverty status for children aged 17 years and younger. Overall, over a third of the children were uninsured for dental care. We saw statistically significant differences between urban and rural children; children residing in rural areas were more likely to be uninsured for dental care than were children residing in urban areas (41.1% versus 34.7%). However, analyses by poverty indicate that most of the differences in dental uninsurance by place of residence are found among poor children; differences between near-poor and non-poor children by place of residence were not statistically significant. Among both urban and rural residents, the lack of insurance was significantly greater among the near-poor children (47.2% and 42.2%, respectively) than among either poor or non-poor children. There was no difference in private

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Table 1.Sociodemographic Characteristics of
Children Aged 2–17 Years by Residence
Status, United States

	Total	Rural	Urban
Characteristics	Percentage (SE*)	Percentage (SE)	Percentage (SE)
Total	100 (0.0)	26.2 (0.8)	73.8 (0.8)
Gender (boys)	51.2 (0.4)	51.3 (0.6)	51.2 (0.4)
Race/ethnicity			
NH† white NH black Hispanic	65.4 (0.6) 15.2 (0.5) 14.8 (0.4)	83.9 (1.5) 9.0 (1.2) 4.3 (0.8)	62.4 (0.6) 16.3 (0.5) 16.6 (0.4)
Poverty			
Poor Near-poor Non-poor	18.5 (0.5) 21.6 (0.4) 59.9 (0.6)	19.9 (1.3) 28.3 (1.2) 51.8 (1.5)	18.3 (0.5) 20.4 (0.4) 61.3 (0.6)

* SE indicates standard error. Source: NHIS 1997 and 1998. † NH indicates non-Hispanic.

dental insurance coverage between rural and urban children, but poor and near-poor urban children were more likely to be covered by public dental insurance than were their rural counterparts.

The perception of oral health, approximated with parent or self-report of unmet dental needs and poor dental status, is presented in Table 3. Overall, 5.8% of all children reported unmet dental needs. Children from rural areas were more likely to report unmet dental needs than were children from urban areas (7.5% versus 5.6%, respectively). The difference in unmet needs by rural residence was observed among non-Hispanic whites and non-Hispanic black children, but no difference was observed within levels of poverty. Close to 15% of children reported poor dental status. Although not statistically different, there was a consistent trend for rural children to be more likely than urban children to report poor dental status (16.9% versus 14.6%).

Table 4 shows indicators for dental care utilization. Rural children were less likely than urban children to report a dental visit in the past year (69.9% versus 73.6%); this difference was found within ethnic/race groups and among poor children. Most children aged 2 to 17 years have had a dental visit (only 13% reported no visits ever); however, preschool children (2 to 5 years of age) from rural areas were more likely than those from urban areas to report never having been to the dentist (49.7% versus 41.6%). Overall, children from urban areas were more likely to be regular users of dental care. Among children 2 to 17 years of age, 19.5% report episodic use of dentists (ie, they use the dentist 'as needed'). Children 6 to 17 years of age from rural areas were more likely to be episodic users compared with their counterparts from urban areas.

History of orthodontic treatment is also presented in Table 4. Differences in report of orthodontic treatment between rural and urban children 8 to 17 years of age (12.7% and 18.3%, respectively) were not statistically significant. Among both urban and rural children, the

Variable	Total Percentage (CI*)	Rural Percentage (CI)	Urban Percentage (CI)
Uninsured	36.4 (35.0, 37.7)	41.1 (39.1, 43.1)	34.7 (32.9, 36.4)
Poverty			
Poor	28.2 (26.2, 30.3)	37.1 (32.6, 41.7)	25.6 (23.1, 28.0)
Near-poor	43.8 (41.4, 46.2)	47.2 (43.4, 51.0)	42.2 (39.0, 45.4)
Non-poor	34.7 (32.6, 36.7)	36.5 (33.9, 39.0)	34.0 (31.5, 36.5)
Private insurance	44.6 (42.4, 46.8)	43.9 (41.4, 46.5)	44.8 (42.3, 47.4)
Poverty			
Poor	12.6 (10.9, 14.3)	9.9 (7.0, 12.9)	13.4 (11.4, 15.5)
Near-poor	38.1 (35.4, 40.7)	38.9 (34.7, 43.0)	37.7 (34.4, 41.1)
Non-poor	62.0 (59.9, 64.1)	60.2 (57.5, 62.9)	62.7 (60.1, 65.3)
Public insurance	16.9 (15.6, 18.2)	12.8 (11.1, 14.4)	18.4 (16.9, 20.0)
Poverty			
Poor	58.1 (55.3, 60.8)	51.1 (46.7, 55.6)	60.1 (56.9, 63.4)
Near-poor	14.7 (13.0, 16.4)	11.2 (8.8, 13.6)	16.3 (14.2,18.4)
Non-poor	1.4 (1.1, 1.6)	1.2 (0.7, 1.7)	1.4 (1.1, 1.8)

Table 2. Dental Insurance Among Children Aged 0-17 Years, United States

* Cl indicates 95% confidence interval. Source: NHIS 1995.

Variable	Total Percentage (CI*)	Rural Percentage (CI)	Urban Percentage (Cl)
A. Unmet dental needs			
All	5.8 (5.4, 6.2)	7.5 (6.3, 8.8)	5.6 (5.2, 5.9)
Age in years			
2-5	3.7 (3.1, 4.2)	4.7 (3.0, 6.3)	3.5 (2.9, 4.0)
6-17	6.6 (6.1, 7.0)	8.4 (7.0, 9.8)	6.3 (5.8, 6.7)
Race/ethnicity			
NH† white	5.3 (4.8, 5.7)	7.0 (5.7, 8.3)	4.9 (4.4, 5.4)
NH black	6.7 (5.6, 7.7)	13.5 (7.8, 19.2)	6.0 (5.1, 6.9)
Hispanic	7.9 (7.0, 8.8)	7.5 (3.0, 12.0)	7.9 (7.0, 8.8)
Poverty			
Poor	9.1 (7.8, 10.3)	13.6 (9.4, 17.8)	8.2 (7.0, 9.4)
Near-poor	11.4 (10.2, 12.6)	12.7 (9.7, 15.7)	11.6 (9.8, 12.3)
Non-poor	3.4 (3.0, 3.7)	3.5 (2.5, 4.6)	3.4 (2.9, 3.8)
B. Self-reported poor der	ntal status		
All	15.0 (13.3, 16.6)	16.9 (14.1, 19.7)	14.6 (12.8, 16.4)
Age in years		-	
25	11.2 (9.7, 12.7)	8.7 (7.3, 10.0)	11.7 (9.9, 13.4)
6–17	16.3 (14.2, 18.4)	19.9 (16.7, 23.2)	15.6 (13.2, 18.0)
Poverty			
Poor/near-poor	21.3 (19.2, 23.5)	21.0 (18.1, 23.9)	21.4 (18.9, 24.0)
Non-poor	8.1 (6.6, 9.5)	10.6 (7.1, 14.0)	7.7 (6.0, 9.3)

Table 3. Self-Perception of Oral Health Status Among Children Aged 2–17 Years, United States

* CI indicates 95% confidence interval. Sources: A: NHIS 1997 and 1998; B: NHANES III, 1988-1994.

† NH indicates non-Hispanic.

percentage of non-poor children reporting orthodontic *treatment* was almost 3 times that of poor children (25.8% versus 8.8%).

Dental status of children in the United States by place of residence is presented in Table 5. Almost a quarter of children had untreated decay (22.9%). Differences in untreated decay between rural and urban children did not reach statistical significance. In both rural and urban areas, poor children were more than twice as likely to have untreated decay. The dft and DMFT indexes indicate the sum of decayed and filled primary and permanent teeth, respectively; children 2 to 10 years of age had an average of 1.4 teeth with history of caries, and children 6 to 17 years of age had an average of 1.6 teeth with history of caries. There were no differences in dft or DMFT by place of residence; there were no differences either in mean decay or filled teeth (data not shown). Differences were present by poverty status; poor children aged 2 to 10 years had double the mean number of teeth with caries experience compared with non-poor children (1.9 versus 0.9). Differences by poverty were not statistically significant among rural children.

Self-reported presence of sealants is also presented in Table 5. Over a third of children reported having had sealants applied on their teeth (35.7%); differences by place of residence were not statistically significant. The report of having received sealants was twice as common among non-poor as it was among poor children (47.2% versus 20.9%).

Discussion

This study compares the overall oral health status and dental service utilization of children living in rural and urban areas. Children residing in rural areas were significantly more likely to be uninsured for dental care and more likely to report oral health dissatisfaction than were children residing in urban areas. We did not find significant differences in untreated caries or overall caries experience between rural and urban children.

The lower dental care utilization found among rural children is consistent with the distribution of dentists. Freedom of dentists to choose where to practice at the state level is reflected in concentration of dentists in places with a favorable economic environment.¹⁴ Consequently, fewer dentists work in rural than in urban areas,^{15,16} and their concentration per 100 000 population members declines as areas become more isolated from metropolitan areas.¹⁶ Access to dental care is also possibly limited among rural children by low rates of insurance coverage; dental insurance has been

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Characteristics	Total Percentage (CI*)	Rural Percentage (CI)	Urban Percentage (CI)
A. Dental visits in past year			
All	73.1 (72.4, 73.8)	69.9 (68.0, 71.7)	73.6 (72.8, 74.4)
Age in years			
2-5	51.8 (50.8, 53.3)	45.7 (42.4, 49.0)	53.3 (51.7, 54.9)
6-17	80.2 (79.5, 81.0)	76.7 (74.9, 78.4)	81.2 (80.4, 82.0)
Race/ethnicity			,
NH+ white	76.8 (75.9, 77.6)	72.0 (70.2, 73.7)	77 8 (76.8, 78.8)
NH black	69.3 (67.6, 71.1)	60.3 (51.4, 69.2)	70.1 (68.3, 72.0)
Hispanic	61.7 (60.1, 63.3)	52.6 (43.4, 61.8)	62,1 (60,5, 63,6)
Poverty			
Poor	62.8 (61.0, 64.6)	56.5 (51.8, 61.1)	64 0 (62 0 66 0)
Near-poor	61.4 (59.7, 63.1)	61.9 (58.3, 65.5)	61.3 (59.3, 63.2)
Non-poor	80.1 (79.3, 80.9)	79.3 (76.5, 82.0)	80 1 (79.2, 81.0)
B Never visited a dentist			
	13 4 (12 0 14 0)	14 0 (17 E 46 A)	42 0 (40 6 42 7)
All Age in years	15.4 (12.9, 14.0)	14.9 (15.5, 16.4)	15.2 (12.0, 15.7)
2_5	127 (112 112)	107 (156 538)	A1 6 (A0 1 A3 2)
2J 6-17	36 (32 / 0)	49.7 (45.0, 55.0)	z / (Z O Z O)
Poverty	5.0 (5.2, 4.0)	4.0 (3.0, 3.3)	5.4 (5.0, 5.6)
Boor	16 9 (15 2 49 30)	20.0 (46.4.25.4)	16 O (11 A 17 E)
Near-poor		20.9 (10.4, 23.4)	
Non-poor	11.0 (15.7, 10.2)		
C Dattern of dental visita	11.2 (10.6, 11.9)	11.1 (6.9, 13.3)	11.2 (10.6, 11.9)
Regular users			
All	60.1 (57.7, 62.5)	51.4 (45.4, 57.3)	61.7 (59.2, 64.2)
Age in years			
2–5	36.8 (34.2, 39.4)	37.8 (30.1, 45.5)	36.6 (33.9, 39.3)
6-17	68.4 (65.7, 71.2)	56.4 (51.7, 65.1)	70.6 (67.7, 73.4)
Poverty			
Poor/near-poor	46.6 (43.2, 50.0)	39.3 (34.4, 44.2)	48.2 (44.2, 52.1)
Non-poor	74.3 (71.9, 76.7)	69.4 (59.3, 79.5)	75.0 (72.8, 77.3)
Episodic users			
All	19.5 (17.8, 21.2)	24.0 (19.8, 28.3)	18.7 (16.9, 20.5)
Age in years			
2–5	8.7 (7.5, 9.8)	6.5 (4.3, 8.7)	9.1 (7.7, 10.4)
6–17	23.4 (21.2, 25.5)	30.5 (26.1, 34.9)	22.1 (19.8, 24.4)
Poverty			
Poor/near-poor	26.9 (23.8, 30.1)	29.3 (23.5, 35.0)	26.4 (22.9, 30.0)
Non-poor	11.8 (9.6, 14.1)	15.9 (7.0, 24.9)	11.2 (8.9, 13.4)
D. History of orthodontic tre	atment, children 8–17 years of age		
All	17.7 (16.1 19.4)	14.7 (11.2, 18.3)	18.3 (16.4, 20.1)
Poverty			
Poor/near-poor	8.8 (6.9 10.7)	9.7 (6.6, 12.7)	86 (6.4 10.8)
Non-poor	25.8 (23.3 28.2)	20.4 (12.5, 28.3)	26.6 (24.1, 29.1)
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Table 4. Dental Care Utilization Among Children Aged 2–17 Years, United States

* CI indicates 95% confidence interval. Sources: A: NHIS 1997 and 1998; B-D: NHANES III, 1988–1994.

† NH indicates non-Hispanic.

demonstrated to be a strong enabler of dental care for near-poor and poor populations.¹⁷ The main obstacle for coverage in rural areas is that dental insurance is usually associated with employment in large companies,¹⁴ and rural adults are usually self-employed or employed by small companies.¹⁸ Additionally, 2-parent families, which are more common among the rural poor, are usually not eligible for Medicaid. The State Children's Health Insurance Program (SCHIP) was implemented to increase access to health care among near-

	Total Rural Estimate (CI*)	Urban Estimate (CI)	Estimate (CI)
A. Percentage of children v	vith untreated caries, 2–17 years of age		
All	22.9 (21.1, 24.7)	25.6 (20.0, 31.2)	22.3 (20.4, 24.2)
Age in years			
2–5	19.6 (17.3, 21.9)	17.5 (10.9, 24.1)	20.0 (17.6, 22.5)
6–17	23.9 (21.6, 26.2)	29.0 (23.9, 34.1)	22.9 (20.5, 25.3)
Poverty			
Poor/near-poor	32.1 (29.7, 34.5)	33.5 (27.6, 39.4)	31.7 (29.2, 34.2)
Non-poor	13.8 (11.9, 15.7)	14.8 (9.5, 20.1)	13.7 (11.7, 15.7)
B. DMFT [†] and dft [‡]			
Mean dft, children 2-10 ye	ars old		
All	1.4 (1.3, 1.5)	1.4 (1.0, 1.7)	1.4 (1.2, 1.5)
Poverty			
Poor/near-poor	1.9 (1.6, 2.1)	1.6 (1.2, 2.0)	1.9 (1.7, 2.2)
Non-poor	0.9 (0.7, 1.0	1.0 (0.6, 1.4)	0.8 (0.7, 1.0)
Mean DMFT, children 6–17	years old		
All	1.6 (1.4, 1.8)	1.3 (1.2, 1.5)	1.6 (1.4, 1.9)
Poverty			
Poor/near-poor	1.7 (1.5, 1.9)	1.4 (1.2, 1.6)	1.8 (1.5, 2.1)
Non-poor	1.5 (1.2, 1.7)	1.3 (1.0, 1.7)	1.5 (1.3, 1.8)
C. Percentage of children s	self-reporting sealants, 8–19 years of age		
All	35.7 (34.2, 37.2)	33.5 (29.2, 37.7)	36.1 (34.4, 37.7)
Poverty			
Poor/near-poor	20.9 (18.8, 23.1)	21.5 (16.5, 26.4)	20.8 (18.5, 23.2)
Non-poor	47.2 (45.1, 49.3)	44.7 (38.6, 50.8)	47.6 (45.3, 49.8)
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Table 5. Dental Status Among Children in the United States

Cl indicates 95% confidence interval. Sources: A, B: NHANES III, 1988–1994; C. NHIS 1998.

+ DMFT indicates sum of decayed, missing, and filled permanent teeth.

t dft indicates sum of decayed and filled primary teeth.

poor children; however, if there are no dentists available, having insurance is unlikely to alter dental care utilization.

To help address the low availability of dental providers in rural areas, specific programs to motivate dentists to serve needy rural populations have been developed. The Community Health Center program supports community and migrant health centers in underserved areas, including rural areas. The Health Resources and Services Administration's National Health Service Corps offers economic incentives to health professionals who go to work in underserved rural areas; incentives can be scholarships enabling the health professional to finish the degree or loan repayment, in which student loans are forgiven based on the time worked in the underserved area.¹⁹⁻²¹ The Indian Health Service also offers loan-repayment programs. Unfortunately, these programs are not producing the expected increase on health care availability because, despite these incentives, few health professionals choose to work in underserved areas.¹⁹

As Healthy People 2010 objective 21.13 indicates,

dental care in schools may be a viable option to provide care to underserved children, particularly those in rural areas.³ The American Academy of Pediatrics also recommends the expansion of school health services, including dental care, as a mechanism to provide access to health care to all children.²² Since the need in less populated areas is not usually for a full dentist position,²³ there are alternatives to make best use of resources, such as portable dental clinics installed in rural schools or dental clinics with rotating dentists and dental hygienists.

If poor and or minority children living in rural areas have less access to dental care, then oral disease prevention programs are critically needed to reduce future needs for care. Fluoride in water, the best caries prevention community intervention,²⁴ is not feasible for most rural areas because of small water treatment plants or dependence on well water. Therefore, fluoride in other forms needs to be explored; fluoride varnish is an alternative for preschool children. Also, sealants are being efficiently applied at schools²⁵; to date, sealants are the most common preventive dental program in schools. Children attending schools with sealant programs are 2 to 3 times as likely to have sealants than their counterparts who are attending schools without sealant programs, independent of health insurance status or eligibility for reduced lunch. Moreover, within schools with sealant programs, there was no difference in presence of sealants by insurance status.²⁵ These programs, when targeted to high-risk children, have been found to provide significant protection against caries to the children involved. A recent study reported expenditure savings for Medicaid when children who are at high risk for caries received sealants.²⁶

The fact that there was no difference in dental care utilization between non-poor rural and urban children—whereas there was a difference between poor urban and rural children—indicates that the most disadvantaged rural children do not get access to the few available dentists. Children from economically more fortunate rural families possibly are receiving dental care in a nearby city.

The lack of difference in caries prevalence between rural and urban children is puzzling because, in addition to lower dental care utilization, children residing in rural areas are more likely than urban children to use well water,² which usually has a low fluoride content. Results from a study on Maryland Head Start children indicated that children residing in rural areas were more likely to have untreated caries and more likely to have had caries experience than were urban children.⁷ However, a study of Arizona preschool children found no association between presence of caries and rural status.⁶

Our findings to the effect that there are no differences in clinical indicators between rural and urban children suggest that there is an equal need for dental care services in both rural and urban children. The alternative interpretation—that no additional dental services are required for rural children—conveys complacency with regard to current levels of oral health needs and services.

The data used for this study do have at least one limitation. The national data sets are not designed to oversample rural populations because of the costs associated with collecting data in rural areas. This limitation is stronger regarding the data from the NHANES III, because the mobile examination centers used to collect the clinical data were located in populated areas to increase the survey's efficiency. However, in the case of the NHIS, large sample sizes and the possibility of collapsing several years' worth of data compensate for this limitation. Nonetheless, national classifications do not fully capture levels of variation within rural areas and populations; we know that poverty and lack of access to basic services are significant public health concerns for most rural areas, particularly for those areas that are more isolated and sparsely populated.¹⁶ Therefore, our results reveal only the tip of the iceberg, because the surveys only reach the most accessible rural residents, who have better access to health care and are in better SES circumstances and, consequently, who have better overall health status.

Poverty had a strong effect on oral health status and underutilization of dental services. It is possible that disadvantages of living in isolated areas can be overcome with resources that cost money; for example, owning a car, hiring a babysitter, buying bottled water, having appropriate plumbing, Internet access, etc. However, poverty has been demonstrated not to be completely independent from rural status: poverty increases with the increasing degree of rurality.²⁷ This suggests the need for programs that primarily focus on poor populations but that include the assessment of local needs and assurance of adequate local resources. More efforts to collect oral health information from rural populations are needed, since these data are necessary to plan and monitor programs that effectively reach the poor rural children.

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