

Scientific Article

Insurance Status and Untreated Dental Caries in Virginia Schoolchildren

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Abstract: Purpose: The purposes of this investigation were to: (1) provide a descriptive account of untreated dental caries for Virginia schoolchildren; and (2) examine the relationship between a child's insurance status and the presence of untreated dental caries. **Methods:** In 1999, the Virginia Department of Health completed an Oral Health Assessment on first-, third-, and 10th-grade children. The oral assessment used a probability proportional to size sampling scheme to obtain a representative sample of public schoolchildren. Descriptive and multivariable regression analyses were completed to examine the relationship between insurance status and the presence of untreated dental caries. **Results:** In the primary dentition, schoolchildren with no insurance had the highest prevalence of untreated dental caries (65%) compared to: (1) schoolchildren with medical insurance only (42%); and (2) those with both medical and dental insurance (25%). With the exception of children having only medical insurance, children enrolled in the free and reduced lunch program were more likely to have untreated dental caries. **Conclusions:** In the primary dentition, children with no insurance were more likely to have untreated dental caries than those with both medical and dental insurance. Insurance status does not appear to be associated with untreated dental caries in the permanent dentition. (*Pediatr Dent* 2007;29:493-9) Received October 2, 2006 / Revision Accepted January 24, 2007.

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Poor oral health and untreated dental caries can have a significant impact on quality of life. For an estimated 4 to 5 million children, tooth decay interferes with daily routine activities. It has been estimated that 51 million school hours per year are lost due to dental related illness.¹ The pain and infection of rampant dental disease can result in: (1) impaired speech development; (2) failure to thrive; (3) absences from school; (4) inability to concentrate in school; and (5) reduced self-esteem.^{1,2}

The availability of and access to quality health care directly affects the health of young children, especially those at high risk due to chronic health conditions or lower socioeconomic status.³ The distribution of health insurance coverage for children, varies according to family income levels.³ It has been reported that:

- a. 14% of children have no health insurance coverage;
- b. 25% of children are publicly insured, primarily through Medicaid; and
- c. 69% of children are covered by private insurance.³

Among low-income children (those from families with incomes less than 200% of the federal poverty level), the distribution of insurance changes, with: (a) 40% having Medicaid coverage; (b) 40% with private insurance coverage; and (c) 20% with no health insurance coverage.⁴

Health insurance coverage is a contributing factor in the decision to seek health care services.⁵ Children with health coverage, whether public or private, have been shown to have: (1) an increased access to care, (2) fewer reported unmet health care needs, and (3) improved utilization of health services.⁶⁻⁸

The relationship between health care coverage and dental health outcomes is unclear, because dental benefits do not exist uniformly across public and private insurance plans.³ According to the 1987 National Medical Expenditure Panel Survey (NMEPS), children covered by health insurance were 2.5 times more likely to obtain dental care than those without coverage.⁹ Additional studies of children's access to health care indicate that uninsured children are unable to get needed dental care, which is reported to be the most prevalent unmet need among children.^{10,11} For any demographic and socioeconomic category, children with dental insurance are much more likely to have had at least 1 dental visit compared to their noninsured counterparts.¹²

Disparities exist in the levels of dental insurance coverage for children. Data from the 1996 NMEPS indicated that

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only 37% of children younger than 12 years had private dental insurance coverage lasting an entire year.¹² According to the 1989 National Health Interview Survey, between 16% to 25% of children younger than 12 years of age were covered by dental insurance.¹³

The type of dental insurance coverage appears to also make a difference regarding the utilization of dental services and care. The RAND Health Insurance Experiment found that children enrolled in no-cost sharing plans had higher rates of dental visits, fewer decayed teeth, and more filled teeth at the end of the study compared to children in plans with higher cost sharing.¹⁴ Furthermore, preschoolers enrolled in no cost-sharing plans had lower levels of tooth decay compared to those enrolled in cost-sharing plans, this trend was most marked among middle- and low-income families.¹⁵ Although income is a strong predictor of dental insurance status, dental coverage also varies by race, with the percentage of uninsured children being highest (40%) among Caucasians and Hispanics.¹⁶

The Virginia Division of Dental Health has had a major role in the collection, analysis, and reporting of oral disease data in Virginia since the early 1950s. Long-term studies show that the oral health status of Virginia children has improved due to preventive measures such as fluoridation. The percentage of Virginia children with unmet dental needs, however, has not significantly improved.¹⁷ The assessment of the oral health status for Virginia's schoolchildren is very important in planning public programs that deliver dental services to Virginia children. This study used the Virginia Department of Health's 1999 Oral Health Assessment to examine differences in the levels of untreated dental caries for Virginia schoolchildren based upon their insurance status.

The purposes of this investigation were to:

1. provide a descriptive account of untreated dental caries for Virginia schoolchildren; and
2. examine the relationship between a child's insurance status and the presence of untreated dental caries.

Methods

Sample and data collection. The statewide oral health assessment was a stratified, multistage cluster study that incorporated a probability proportional to size sampling scheme for selecting public school Virginia children. This sampling approach was used to obtain a representative sample of schoolchildren at the state-level and is commonly used in community-based surveys.^{18,19}

The sampling involved 4 stages: (1) dividing the state into 6 health maintenance organization (HMO) regions; (2) selecting school districts within these 6 regions; (3) selecting schools; and (4) selecting classrooms within the schools. First, the frame was stratified according to the following 6 HMO regions: (1) Northern Va; (2) Blue Ridge-northwestern

Va; (3) southwest Va; (4) Roanoke area-south central; (5) central Va; (6) Hampton Roads, Va - Tidewater. School systems were identified within each geographical region, and 10 districts were systematically selected from each region. Within each of the selected districts, schools containing the grades of interest (first, third, and tenth) were classified according to metropolitan status. Four schools were systematically selected from each school district, and 2 classrooms from the eligible grades were randomly selected from each school.

Oral screenings were performed on children whose parents had completed the informed consent and questionnaire. This study was approved for human subjects by the Institutional Review Board of Virginia Commonwealth University, Richmond, Va. All examiners were trained and calibrated prior to the screenings. Each surveyed child was assigned a random identification number, and the data set contained no unique or individual identifiers. Licensed dentists conducted the oral health examination using explorers and mirrors, and no radiographs were taken during the dental assessment. Decayed, missing, and filled surface (DMFS/dmfs) and tooth (DMFT/dmft) level data were collected as indicators of dental disease in all children, according to the Radike criteria.²⁰ Child-level data were also recorded for each student, consisting of: (1) grade (first [6-8 years], third [8-9 years], and 10th [15-16 years]); (2) race (Caucasian vs non-Caucasian); (3) gender; (4) enrollment in the free and reduced lunch program; (5) medical insurance status; (6) dental insurance status; and (7) HMO region. School-level variables included the:

1. urban/rural location of the school; and
2. presence or absence of community water fluoridation at the school.

Statistical analysis. A descriptive analysis was completed to examine the relationship between insurance status and untreated dental caries at the tooth level. The outcome was the presence of "untreated dental caries" in the primary or permanent dentition (dt/DT). The independent variable was the individual's insurance status: whether the individual had: (1) medical insurance; (2) both medical and dental insurance; or (3) no insurance. For all analyses, a cut-point of $P = .05$ was used to determine the: (1) significance of the models; (2) variable terms; and (3) relationships between variables. All statistical calculations were performed using the Statistical Package for the Social Sciences (SPSS, v. 14.0, Chicago, Ill) and SUDAAN (v. 9.01, Research Triangle Park, NC).

Chi-square analyses were performed to compare:

1. untreated dental caries (DT, dt) across each category of insurance status; and
2. demographic factors to determine whether there was a significant relationship between insurance status/demographic factors and untreated dental caries.

The bivariate analysis examined the distribution of sampled children regarding previously described individual and school-level characteristics, such as: (1) grade; (2) race; (3) gender; (4) enrollment in a free and reduced lunch program; and (5) HMO region. School-level variables were the:

1. urban/rural location of the school; and
2. presence or absence of community water fluoridation at the school.

Finally, a multivariate logistic regression was performed to examine differences in untreated dental caries according to insurance status, with those children having both medical and dental insurance serving as the referent category. The multivariate logistic regression was used to determine the effect of insurance status on the likelihood of having untreated dental caries. Logistic regression models were built separately for primary and permanent teeth to examine and control for the effects of each covariate, such as: (1) sex; (2) race (non-Caucasian vs Caucasian); (3) enrollment in a free and reduced lunch program; and (4) HMO region. School-level variables were the urban/rural location of the school and the presence or absence of community water fluoridation at the school. Decisions to keep or remove variables in the logistic regression modeling process were made based on statistical significance at the $\alpha = .05$ level.

Results

Insurance status and untreated dental caries. Overall, in the oral health assessment:

- a. most children, 67% (N=3,650), had both medical and dental insurance;
- b. 17% (N=1,043) had only medical coverage; and
- c. 16% (N=576) reported having no insurance.

Table 1 displays the proportion of Virginia schoolchildren with untreated dental caries in their primary and permanent dentitions, according to insurance status. Regarding the primary dentition, the prevalence of untreated dental caries among schoolchildren was:

- a. 65% (N=232) for those with no insurance coverage;

- b. 42% (N=272) for those with medical insurance only; and
- c. 25% (N=765) for those with medical and dental insurance.

Regarding the permanent dentition, the prevalence of untreated dental caries among schoolchildren was:

- a. 24% (N=454) for those with medical and dental insurance;
- b. 23% (N=147) for those with medical insurance only; and
- c. 11% (N=106) for those with no insurance at all.

Demographic factors and untreated dental caries. Table 2 displays the relationship between each demographic factor and untreated dental caries for the primary and permanent dentitions. Free lunch status was the only statistically significant demographic factor associated with an increased likelihood of untreated dental caries in the permanent dentition. The demographic factor of race approached significance, with a trend of non-Caucasian children having a higher prevalence of untreated dental caries than Caucasian children in both the primary and permanent dentitions.

Multivariable regression of insurance status and untreated dental caries. A final regression model was constructed to examine the effect of insurance status on untreated dental caries in both the primary and permanent dentitions while controlling for demographic factors that remained significant in the regression model. In the primary dentition, after controlling for gender, race, HMO region, free and reduced lunch status, and metropolitan status (Table 3). There was a significant interaction between insurance status and free lunch enrollment status. Children enrolled in a free and reduced lunch program with no insurance were significantly more likely to have untreated dental caries than children who were not in a free and reduced lunch program and had both medical and dental insurance (odds ratio [OR]=24.19; 95% confidence interval [CI]=2.50-234.00). Children enrolled in a free and reduced lunch program with medical insurance only were significantly less likely to have untreated dental caries (OR=.01; 95% CI=0.00-0.11).

In the permanent dentition (Table 4), after controlling for grade, fluoridation status, free and reduced lunch status, and HMO region, there were no significant differences between insurance status and untreated dental caries. The odds of having untreated dental caries in the permanent dentition among children with medical coverage only or no insurance was not significantly different from that of children with both medical and dental insurance. The interaction between insurance status and the free and reduced

Table 1. THE PREVALENCE OF UNTREATED DENTAL CARIES ACCORDING TO INSURANCE STATUS FOR VIRGINIA SCHOOLCHILDREN

Insurance	Untreated caries (primary)		Untreated caries (permanent)		Untreated caries (total)	
	N	% ± SD	N	% ± SD	N	% ± SD
Neither	232	65 ± 1.47	106	11 ± 8.69	290	18 ± 9.07
Medical only	272	42 ± .74	147	23 ± 14.77	360	33 ± 9.44
Medical and Dental	765	25 ± .53	454	24 ± 9.26	1,074	27 ± 8.13
Total	1,269	34 ± 51	707	22 ± 10.06	1,724	27 ± 8.31

Table 2. DESCRIPTIVE STATISTICS OF DEMOGRAPHIC FACTORS AND UNTREATED DENTAL CARIES IN VIRGINIA SCHOOLCHILDREN

DEMOGRAPHIC FACTORS	UNTREATED DENTAL CARIES			
	Primary teeth Mean dt ± SD	P-value *	Permanent teeth Mean DT ± SD	P-value *
Gender		.32		.19
Male	19.9 ± 31.56		18.0 ± 17.35	
Female	43.9 ± 81.66		24.35 ± 12.17	
Race		.07		.09
Caucasian	33.0 ± 4.99		15.8 ± 97.84	
Non-Caucasian	42.0 ± 22.70		38.53 ± 10.99	
Metropolitan status		.22		.21
Urban	28.16 ± 2.83		25.47 ± 10.65	
Rural	34.4 ± 4.19		4.88 ± 4.55	
Free and reduced lunch program		.29		.04
Enrolled	62.53 ± 2.82		37.17 ± 13.29	
Not enrolled	24.75 ± 0.17		19.28 ± 9.68	
School receiveds fluoridated water		.31		.61
Yes	33.58 ± 0.51		21.88 ± 10.38	
No	29.30 ± 3.34		15.75 ± 5.73	
HMO region		.16		.48
Blue Ridge	28.46 ± 3.45		3.73 ± 2.35	
NOVA	26.80 ± 0.75		56.63 ± 3.42	
Southwestern	26.84 ± 3.87		19.25 ± 5.36	
Roanoke	28.81 ± 2.79		17.26 ± 2.11	
Hampton	34.10 ± 0.14		15.06 ± 6.50	
Central	31.76 ± 7.09		2.46 ± 1.09	

* Derived from a chi-square analysis

lunch enrollment in the primary dentition and the lack of a relationship between insurance status and untreated dental caries in the permanent dentition are more thoroughly addressed in the next section.

Discussion

Insurance status and untreated dental caries. Overall, a higher percentage of Virginia schoolchildren had untreated dental caries in their primary dentition (34%) compared to those with untreated dental caries in the permanent dentition (22%). In the primary dentition, those with medical and dental insurance had the lowest percentage of untreated decay (25%), compared to those with only medical coverage (42%), and those with no insurance (65%). This relationship was not true for the permanent dentition, where the le-

vels of untreated dental caries were not significantly different, according to insurance status. Those that reported having no insurance had lower levels of untreated dental caries (11%) compared to those with medical only or both medical and dental insurance (23%). This discrepancy between the primary and permanent dentitions is complex and most likely caused by multiple factors. One of these factors may be the sample’s variability and limited size, especially among the 10th-grade children (15-16 years).

The standard deviations associated with the prevalence of untreated dental caries in the permanent dentition were much larger than those in the primary dentition, as noted in Table 1. This amount of variability demonstrates that the estimates for the permanent dentition vary widely across this schoolchildren population, making it very difficult to find a statistically significant difference between categories of insurance status. In the permanent dentition, there was half the number of children with no insurance vs those in the primary dentition. Another factor that was not measured by the oral assessment was actual dental utilization. It could be that older children with permanent dentitions may have increased access to dental services through safety-net providers or philanthropic dental care simply because of their age, which would reduce their levels of untreated dental caries. Younger children in the primary dentition stage often require more behavior management or specialty care, which has been shown to significantly limit their access to dental services compared to older children.^{21,22}

Demographic factors and untreated dental caries.

The proportion of surveyed Virginia schoolchildren with untreated dental caries did not significantly vary by: (1) gender; (2) metropolitan status; (3) water fluoridation; or (4) geographic HMO region (Table 2). Non-Caucasian children had an increased prevalence of untreated dental caries, compared to their Caucasian counterparts, which approached significance. In general, children enrolled in the free and reduced lunch program were significantly more likely to have untreated dental caries than non-enrolled children. In the primary dentition, however, after adjusting for the effect of insurance status through stratification, we found that the increased prevalence of untreated dental caries did not hold true for those children with only medical insurance. Children enrolled in the free and re-

duced lunch program with only medical coverage had less untreated dental caries than nonparticipating children (9% vs 48%, respectively), which is inconsistent with the findings of the other insurance status categories and the permanent dentition. This resulted in an interaction between insurance status and the free and reduced lunch enrollment for the primary dentition, which was further analyzed in the multivariate regression model.

Multivariable regression. Due to the interaction found between insurance status and the free and reduced lunch program in the primary dentition, these variables can no longer

be interpreted individually in the regression model (Table 3). For the primary dentition, children enrolled in a free and reduced lunch program with no insurance coverage were significantly more likely to have untreated dental caries relative to nonenrolled children with both medical and dental insurance. Other possible factors that may account for the counter-intuitive results among children with only medical insurance and enrolled in free and reduced lunch include:

1. these children actually had less demand for dental services and, therefore, were not enrolled in a dental insurance program.
2. there could be a selection bias working in the opposite direction, where families may only seek insurance coverage when there is a demand for dental services.
3. the very wide confidence intervals and small sample sizes in certain stratum levels, such as those with only medical insurance, indicating a large variance in the data and resulting in inconsistent findings.

In permanent dentition, the multivariate regression model had more consistent results regarding participation in the free and reduced lunch program, but no significant effect of insurance status on the presence of untreated dental caries (Table 4). Children enrolled in the free and reduced lunch program had significantly more untreated dental caries than nonenrolled children.

The literature has repeatedly documented the relationship between insurance coverage and access to dental services, such as dental visits and utilization. Very few studies, however, report the effects of insurance coverage and actual dental health outcomes, such as untreated dental caries.²³⁻²⁵ Policy to improve access to health services is predicated on the belief that the timely use of health services provides the opportunity to achieve the best possible health outcomes.²⁶ These health outcomes are an important yardstick for judging whether access has been achieved. "Untreated dental caries" was chosen as the primary focus of this study due to the volume of literature suggesting that unmet dental needs are serious among children living in poverty and one of the most prominent unmet health needs reported by families.^{10,11}

A few examples of the limited evidence examining the relationship between dental health outcomes and insurance coverage have been found. Eklund et al reported higher levels of restorative treatment and tooth loss for a Delta Dental Medicaid program vs a traditional Medic-

Table 3. REGRESSION MODEL OF UNTREATED DENTAL CARIES IN THE PRIMARY DENTITION FOR VIRGINIA SCHOOLCHILDREN

Untreated dental caries in the primary dentition (dt>1)	Parameter estimate ± SD	P-value *	Odds ratio	95% confidence interval
Intercept	-2.67 ± 0.38	<.001		
Individual level variables				
<i>Insurance status</i>				
No insurance	0.28 ± 0.21	.20	1.32	0.86-2.02
Medical insurance only	1.81 ± 0.27	<.001	6.12	3.58-10.47
Medical and dental insurance (reference)	0.00 ± 0.00		1.00	
Gender				
Female	1.56 ± 0.38	.001	4.76	2.22-10.23
Male (reference)	0.00 ± 0.00		1.00	
Race				
Non-Caucasian	0.81 ± 0.28	.006	2.24	1.28-3.93
Caucasian (reference)	0.00 ± 0.00		1.00	
Metropolitan status				
Urban	-0.21 ± 0.08	.009	0.81	0.69-0.95
Rural (reference)	0.00 ± 0.00		1.00	
Free and reduced lunch program				
Enrolled	1.66 ± 0.13	<.001	5.24	4.07-6.76
Not enrolled (reference)	0.00 ± 0.00		1.00	
Interaction term (Insurance status by free and reduced lunch program)				
No insurance and enrolled	3.19 ± 1.13	.007	24.19	2.50-234.00
Medical insurance only and enrolled	-4.67 ± 1.21	.001	0.01	0.00-0.11
Medical and dental and enrolled (reference)	0.00 ± 0.00		1.00	
No insurance and not enrolled (reference)	0.00 ± 0.00		1.00	
Medical insurance only and not enrolled (reference)	0.00 ± 0.00		1.00	
Medical and dental and not enrolled (reference)	0.00 ± 0.00		1.00	

* Derived from the logistic regression model.

Table 4. REGRESSION MODEL OF INSURANCE STATUS UNTREATED DENTAL CARIES IN THE PRIMARY DENTITION FOR VIRGINIA SCHOOLCHILDREN

Untreated dental caries in the primary dentition (DT>1)	Parameter estimate ± SD	P-value *	Odds ratio	95% confidence interval
Intercept	-5.17 ± 0.44	<.001		
Individual level variables				
<i>Insurance status</i>				
No insurance	-1.00 ± 0.61	.11	0.37	0.11-1.27
Medical insurance only	-0.56 ± 0.44	.20	0.57	0.24-1.37
Medical and dental insurance (reference)	0.00 ± 0.00		1.00	
Grade				
10 th	1.81 ± 0.20	<.001	6.13	4.07-9.25
Third	-1.28 ± 0.86	.14	0.28	0.05-1.58
First (reference)	0.00 ± 0.00		1.00	
HMO region				
Blue Ridge	0.16 ± 0.84	.85	1.18	0.21-6.43
NOVA	3.79 ± 0.42	<.001	44.11	18.82-103.38
Southwestern	1.88 ± 0.56	.002	6.58	2.14-20.22
Roanoke	1.84 ± 0.45	.001	6.31	2.52-15.78
Hampton Roads	1.84 ± 0.63	.001	6.30	1.77-22.42
Central (reference)	0.00 ± 0.00		1.00	
School fluoridation status				
Nonfluoridated	0.82 ± 0.16	<.001	0.44	0.32-0.61
Fluoridated (reference)	0.00 ± 0.00		1.00	
Free and reduced lunch program				
Enrolled	1.46 ± 0.49	.005	4.31	1.61-11.57
Not enrolled (reference)	0.00 ± 0.00			

* Derived from the logistic regression model.

aid program.²⁷ This statewide assessment incorporated some unique features not typically reported at the child level in other statewide assessments. A strength of this study is that it provides data on insurance coverage and a dental health outcome (untreated dental caries) for a statewide representative sample of Virginia schoolchildren. Hence, there is the ability to generalize to other statewide populations of children, as reported in the literature.^{24,28} In addition, the presence of untreated dental caries, a dental health status indicator, is then examined according to insurance status while controlling for certain demographic variables. The ability to generalize results from state to state depends on the comparisons one wants to make but remains extremely valuable in measuring the dental health status of children. There could be limitations in generalization from state to state when in-

terpreting access to care issues due to the variability of state insurance programs and the availability of dental providers.

A limitation of this study was that, regarding the child's insurance status, the parental questionnaire did not differentiate between individuals receiving private insurance coverage vs those with Medicaid or S-CHIP (State Children's Health Insurance Program) coverage. The relationship between insurance status and untreated dental caries was significant for the primary dentition and not the permanent dentition. The significant role that the availability of providers for particular age groups may play in the access to dental care and the treatment of disease has strong policy implications.

Also, this study was nonrandomized and could be affected by a selection bias of the children who participated in the survey. It is not known if children who did not participate in the survey had more or less untreated dental caries, and the distribution of their insurance status is also unknown. The prevalence of untreated dental caries can also be affected by more than what happens at a dental office. Uninsured children can sometimes get dental services through the Special Supplement Nutrition Program for Women Infants and Children, Head Start programs, and now some physicians' offices simply because they are high risk or in public insurance programs with these benefits.²⁹⁻³¹ In documenting the oral health needs of children, this study demonstrates the complexity of the relationship between insurance status and untreated dental caries with differing effects on the primary and permanent dentitions.

Conclusions

In a statewide oral health assessment of school-aged Virginia children, it was found that:

1. In the primary dentition, children with no insurance were more likely to have untreated dental caries than those with both medical and dental insurance.
2. With the exception of children having only medical insurance, children enrolled in the free and reduced lunch program were more likely to have untreated dental caries.
3. Insurance status does not appear to be associated with untreated dental caries for the permanent dentition.

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