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Oral Health Needs of Virginia Schoolchildren by HMO Regions

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This is to certify that the thesis prepared by Holly C. Hall, B.S., D.M.D., entitled ORAL HEALTH NEEDS OF VIRGINIA SCHOOLCHILDREN BY HMO REGIONS has been approved by her committee as satisfactory completion of the thesis requirement for the degree of Master of Science

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ORAL HEALTH NEEDS OF VIRGINIA SCHOOLCHILDREN BY HMO REGIONS

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University.

by

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Abstract

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By Holly C. Hall, D.M.D.

A Thesis submitted in partial fulfillment of the requirements for the degree of Masters of Science at Virginia Commonwealth University.

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Purpose: This study examined differences in oral health status and dental treatment needs by HMO regions in Virginia.

Methods: The Division of Dental Health (DDH), Virginia Department of Health (VDH), completed the 1999 Virginia Oral Health Needs Assessment (VSOHNA) with the cooperation of the Virginia Department of Education. The survey used a probability proportional to size (PPS) sample design in selecting school children from public schools in the Commonwealth of Virginia. Surface (DMFS/dfs) and tooth-level (DMFT/dft) data were collected as indicators of dental disease on all children. Child-level data was also recorded for each student consisting of age, race, gender, enrollment in a free and

reduced lunch program, medical insurance status, dental insurance status, and history of dental visits. A descriptive and regression analysis was completed to examine the relationship between HMO regions and oral health status indicators.

Results: The survey included more than 5,000 children in 200 schools and 52 school districts. The mean DMFT/dft levels were 1.47 (.33) and 1.7 (.03), respectively. The mean level of untreated decay (dt) for all schoolchildren was 0.66 (0.01). First graders had the highest levels of untreated disease at 0.71, while third graders had a mean of 0.66. The Central region of the state appeared to have the highest level of untreated decay.

Conclusion: There were no significant differences in the percentage of "caries-free" children between the HMO regions. Untreated dental disease of Virginia schoolchildren varied according to the region in which they lived.

INTRODUCTION

Poor oral health and untreated oral diseases and conditions can have a significant impact on quality of life. Dental caries is the single most chronic disease of childhood, occurring five to eight times as frequently as asthma, which is the second most common chronic disease in children (1). Among 5- to 17-year-olds, dental caries is more than 5 times as common as a reported history of asthma and 7 times as common as hay fever. Prevalence increases with age (2). Over 22 million children of school age or younger are affected with tooth decay, making it the single most common disease of childhood that is either not self-correctable or amenable to a course of antibiotics (1). Twenty million children or 25% of children under 19, suffer 80% of all tooth decay (3). For an estimated 4-5 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 (4). In general, the literature shows that the prevalence of dental caries is less than 10% during the first twelve months of life and increases with age (5). Despite the reduction in cases of caries recently, more than half of all children have caries by the second grade and about eighty percent have caries by the time they finish high school. Since the early 1970's, the cases of dental caries in permanent teeth have declined tremendously among school-aged children. This decline is the result of various preventive regimens such as community water fluoridation and increased use of fluoridated toothpastes and rinses.

However, the proportion of untreated dental caries of school-aged children has increased in the primary dentition among children aged 6 to 8 years old. 52% of children aged 6 to 8 years had dental caries experience in 1988-94. By 1986-87, approximately 90% of the decay in children's teeth occurred in tooth surfaces with pits and fissures, and almost two-thirds were found in the chewing surfaces alone. In certain populations, such as minority groups and poor children, dental caries remains a significant problem (6). Children from low-income families experience more dental caries and are less likely to receive dental treatment than children from middle- and high- income families (7). Furthermore, the caries seen in these individuals is more likely to be untreated than caries in those living above the poverty level; more than one third (36.8%) of poor children aged 2 to 9 have one or more untreated decayed primary teeth, compared to 17.3% of children that are not poor (2). The pain and infection of rampant dental disease can result in impaired speech development, failure to thrive, absences from and inability to concentrate in school, and reduced self-esteem (8, 9).

In addition to poverty level, the proportion of teeth affected by dental caries also varies by age and race/ethnicity. According to the National Health and Nutrition Examination Survey III (NHANES III), poor Mexican American children aged 2 to 9 have the highest number of primary teeth affected by dental caries (dft=2.4) compared to poor non-Hispanic blacks (dft=1.5) and non-Hispanic whites (dft=1.9). Among the non-poor, Mexican American 2- to 9- year-olds have the highest number of affected teeth (dft=1.8), followed by non-Hispanic blacks (dft=1.3) and non-Hispanic whites (dft=1.0).

There are also differences by race/ethnicity and poverty level in the proportion of untreated decayed teeth for all age groups. Poor was defined as a family income being below the Federal Poverty Level. Poor Mexican American children aged 2 to 9 have the highest proportion of untreated decayed teeth (70.5%), followed by poor non-Hispanic black children (67.4%). Non-poor children have lower proportions of untreated decayed teeth. The non-Hispanic whites, which have the lowest proportion, still have an average of 37.3% of decayed teeth untreated.

Poor adolescents aged 12 to 17 in each racial/ethnic group have a higher percentage of untreated decayed permanent teeth than the corresponding non-poor adolescent group. Poor Mexican American (47.2%) and poor non-Hispanic black adolescents (43.6%) have more than twice the proportion of untreated decayed teeth than poor non-Hispanic white adolescents (20.7%). The proportion of untreated decayed permanent teeth for non-poor adolescents is highest in non-Hispanic black adolescents (41.7%), which is only slightly lower than this group's poor counterparts (43.6%). The mean number of permanent teeth affected by dental caries (decayed or filled) for this age group is similar among Mexican Americans (2.7), non-Hispanic whites (2.5), and non-Hispanic blacks (2.3) (10).

The assessment of oral health status for Virginia's schoolchildren is very important in planning public programs that deliver dental services to children in this state. The Division of Dental Health has had a major role in the collection, analysis and reporting of oral disease data in Virginia since the early 1950's. Long-term studies show that the oral health status of children in Virginia has improved due to preventive

measures such as fluoridation. However, the percentage of children with unmet dental needs met has not significantly improved. Additionally, studies continue to show that decay is disproportionately distributed with more than 80% of the decay in only 20% of the child population (11). The Division of Dental Health supports the collection, analysis and reporting of oral disease data through: collection and analysis of the oral disease status of school children through statewide and community surveys, collection and analysis of adult oral disease status through the Center's for Disease Control and Prevention Behavioral Risk Factor Surveillance System, assisting in the determination of Dental Health Professions Shortage Areas, and evaluation of population-based programs, such as the school fluoride mouth rinse program (12).

A needs assessment process seeks to identify the following: (1) the extent and types of existing and potential problems in a community (2) the current system of services available (3) the extent of unmet needs, underutilized resources or short coming of the service delivery system. It is the initial step in the development of a comprehensive oral health program. The assessment process is used to identify target populations at greatest risk for oral disease and which face geographic and cultural barriers to accessing oral health care. Determining oral health status is a necessary step in improving comprehensive, community-specific oral health programs for populations (13).

The purpose of this study is to examine differences in the oral health status of Virginia schoolchildren by Health Maintenance Organization (HMO) region as defined by the Virginia Department of Medical Assistance Services.

METHODS

The Division of Dental Health (DDH), in the Virginia Department of Health (VDH), completed the 1999 Virginia Oral Health Needs Assessment (VSOHNA) with the cooperation of the Virginia Department of Education. The aim of this study was to provide a descriptive account of the oral health status for Virginia schoolchildren. Secondly, a cross-sectional study design was used to examine the relationship between dental caries levels and unmet dental needs of schoolchildren in different geographic regions of the state of Virginia.

Sample and Data Collection

This study is a secondary data analysis utilizing a pre-existing data set to examine dental caries, fluorosis, and oral hygiene in Virginia's schoolchildren. The dental disease data came from the 1999 Virginia Statewide Oral Health Needs Assessment. The sampling strategy used for the oral health survey of Virginia schoolchildren was a multistage cluster sample with both systematic and random sampling. The sampling involved three stages: 1) Dividing the state into six HMO regions 2) Selecting schools within these six regions 3) Selecting classrooms within the schools. The frame was stratified according to the six HMO regions. First, strata were formed by assigning school systems to one of the six regions: 1) Northern VA (NOVA) 2) Blue Ridge-Northwestern VA 3) Southwest VA 4) Roanoke Area-South central 5) Central VA 6) Hampton Roads VA-Tidewater. Within each of these strata, schools were subdivided

into rural or urban. The sampling methods were based on ten school districts which were selected from six regions. Four schools were systematically selected from each school district, and two classrooms were randomly selected from each school. Informed consent and questionnaire data was obtained from parents with participating children. Figure 1 represents the existing HMO regions in Virginia.

This data set contains no unique or individual identifiers. An oral health examination of n=5360 school children in Grades 1, 3, and 10 was conducted. The survey included more than 5,000 children in 200 schools and 52 school districts. Each child received an oral health examination by a dentist using explorers and mirrors and no radiographs were taken. Surface (DMFS/dfs) and tooth-level (DMFT/dft) data were collected as indicators of dental disease on all children. Decayed, Missing and Filled teeth/surfaces were documented for the permanent dentition, while only decayed and filled teeth were documented for the primary dentition. This difference in documentation was due to the inability to distinguish between exfoliating primary teeth versus those extracted due to decay. Examiners were trained and calibrated. Child-level data was also recorded for each student consisting of age, race, gender, enrollment in a free and reduced lunch program, medical insurance status, dental insurance status, and history of dental visits.

Statistical Analysis

A descriptive analysis was used to measure the prevalence of aspects of dental disease in Virginia in comparison to national statistics. A descriptive and a regression analysis were completed to examine the relationship between HMO regions and oral

health status indicators. In the regression analysis, the dependent variables were the prevalence of caries (DMFT/dft) and dental needs (DT/dt). The independent variable was the HMO region. The Central region was assigned to be the referent category for comparisons.

RESULTS

Primary Dentition

In Table 1, dental caries in the primary dentition is described according to grade and gender. 41% (se=1.50) of all schoolchildren were caries-free in their primary dentition. 56% (se=1.84) of all first graders were caries-free, and 39% (se=0.96) of all third graders were caries-free. The mean levels of decayed filled teeth (dft) for all schoolchildren were 1.70 (se=0.03). Males had higher levels of decayed filled teeth than females. Third graders had the highest levels of dft at 1.71 when compared to the first graders who had a mean of 1.56. The mean level of filled teeth (ft) in the primary dentition was 1.04 (se=0.04). Males had the highest number of filled teeth with a mean level of 1.44 (se=0.09), while females had a mean of 0.73 (se=0.01). Third graders had the highest levels of filled teeth at 1.06 (se=0.02), while first graders had a mean of 0.85 (se=0.07). The mean level of untreated decay (dt) for all schoolchildren in the primary dentition was 0.66 (se=0.01). First graders had the highest levels of untreated disease at 0.71 (se=0.08), while third graders had a mean of 0.66 (se=0.01). Overall, females had higher levels of untreated disease at 0.73 (se=0.01) when compared to males at 0.57 (se=0.03).

Permanent Dentition

Table 2 describes dental caries in the permanent dentition according to grade and gender. 53% (se=8.14) of all schoolchildren in the permanent dentition were caries-free. More females were caries-free at 57% (se=10.17), while 48% (se=11.96) of males were caries-free. 46% (se=5.70) of all tenth graders were caries-free, while 91% (se=1.81) and 88% (se=2.38) of all third graders and first graders were caries-free, respectively. Females in the third grade were 92% (se=1.94) caries-free. However, only 39% (se=10.12) of males in the tenth grade were caries-free. The mean level of decayed missing filled teeth (DMFT) for all schoolchildren in the permanent dentition was 1.47 (se=0.33). There was no difference between females and males overall. Tenth graders had the highest level of DMFT with a mean of 1.73 (se=0.27). Third graders had a mean DMFT of 0.11 (se=0.04), and first graders had a mean of 0.17 (se=0.04). The mean level of filled teeth (FT) for all schoolchildren was 0.93 (se=0.09). Overall, males had a higher number of filled teeth with a mean of 1.18 (se=0.33) than females who had a mean of 0.76 (se=0.10). Males in the tenth grade had the highest level of filled teeth with a mean of 1.42 (se=0.33). Tenth graders had the highest level of filled teeth at 1.09 (se=0.07). The mean level of missing teeth (MT) for all schoolchildren was 0.06 (se=0.02). There was no difference between males and females. Females in the tenth grade had the highest number of missing teeth with a mean of 0.12 (se=0.03). The mean level of untreated decay (DT) for all schoolchildren in the permanent dentition was 0.47 (se=0.28). Tenth graders had the highest levels of untreated disease at 0.56 (se=0.30), while third graders had the least with a mean of 0.03 (se=0.03). Overall, females had the highest level of

untreated disease with a mean of 0.60 (se=0.37) when compared to males who had a mean of 0.28 (se=0.14).

HMO Regions

Table 3 describes dental caries in the primary dentition according to HMO region and grade. 41% (se=1.50) of all schoolchildren in the primary dentition were caries-free for all HMO regions. 56% (se=1.84) of all first graders were caries-free and 39% (se=0.96) of all third graders were caries-free. Third graders in Hampton Roads represented the group with the lowest percentage of children who were caries-free at 39% (se=0.16). First graders in NOVA had the highest percentage of children who were caries-free at 59% (se=1.35). For all HMO regions the mean level of decayed filled teeth (dft) was 1.70 (se=0.03). The Southwest region of the state had the highest level of decayed filled teeth with a mean of 1.99 (se=0.13). Third graders in the Southwest region had the highest level of dft with a mean of 2.20 (se=0.29). The mean level of filled teeth for all schoolchildren in the primary dentition was 1.04 (se=0.04). Third graders in the Southwest region had the highest level of filled teeth with a mean of 1.65 (se=0.41). NOVA had the lowest level of filled teeth with a mean of 0.73 (se=0.03). The mean level of untreated decay (dt) for all HMO regions was 0.66 (se=0.01). The Central region of the state appeared to have the highest level of untreated decay in the primary dentition with a mean of 0.72 (se=0.18).

Table 4 describes dental caries in the permanent dentition according to HMO region and grade. 53% (se=8.14) of all schoolchildren in the permanent dentition were caries-free for all HMO regions. Tenth graders in NOVA had the lowest percentage,

which were caries-free at 31% (se=3.22). First graders in Blue Ridge had the highest percentage, which were caries-free at 94% (se=2.15). For all HMO regions the mean level of Decayed Missing Filled teeth (DMFT) was 1.47 (se=0.33). NOVA had the highest level of DMFT with a mean of 2.48 (se=0.18). Tenth graders in NOVA had the highest level of DMFT with a mean of 2.56 (se=0.18). Tenth graders had the highest level of Filled teeth with a mean of 1.09 (se=0.07). Tenth graders in the Central region had the highest level of Filled teeth with a mean of 1.41 (se=0.06). Roanoke had the lowest level of Filled teeth with a mean of 0.67 (se=0.19). NOVA had the highest level of Missing teeth with a mean of 0.12 (se=0.01). The mean level of untreated decay (DT) for all HMO regions was 0.47 (se=0.28). NOVA appeared to have the highest level of untreated decay with a mean of 1.45 (se=0.11). The Central region appeared to have the lowest level of untreated decay at 0.03 (se=0.01).

Ethnicity and HMO Regions in the Primary Dentition

Table 5 describes the dental caries rates in the primary dentition for varying ethnicities and HMO regions. Of all the races, Asians had the highest level of untreated decay with a mean of 1.78 (se=0.11), followed by Hispanics 1.18 (se=0.27), Blacks 1.05 (se=0.07), Whites 0.63 (se=0.01), “Other” 0.60 (0.24), and Native Americans 0.09 (se=0.08). In the Central region of the state, blacks had the highest level of untreated disease with a mean of 1.00 (se=0.16). In the white population, Blue Ridge and Hampton Roads had the highest levels of untreated decay, both with means of 0.65 (se=0.15, 0.00). In the black population, the Southwest region had the highest level of untreated decay with a mean of 2.01 (se=0.79). In the Asian population, Hampton Roads had the highest

level of untreated decay with a mean of 2.15 (se=0.29). In the Hispanic population, Blue Ridge had the highest level of untreated decay with a mean of 1.79 (se=0.66). In the Native American population, the Southwest region of the state had the highest level of untreated decay with a mean of 1.08 (se=0.11). In the population of children designating "other" ethnicity, Blue Ridge had the highest level of untreated decay with a mean of 2.39 (se=1.56).

Ethnicity and HMO Regions in the Permanent Dentition

Table 6 describes the dental caries rates in the permanent dentition for varying ethnicities and HMO regions. Of all the races, Native Americans had the highest level of untreated decay with a mean of 3.43 (se=1.77), followed by Hispanics 2.25(se=0.16), Asians 1.41 (se=0.50), "Other" 0.76 (se=0.28), Blacks 0.54 (se=0.20), and Whites 0.27 (se=0.16). In the white population, NOVA had the highest level of untreated decay with a mean of 1.06 (se=0.08). In the black population, the Southwest region had the highest level of untreated decay with a mean of 0.85 (se=0.46). In the Asian population, NOVA had the highest level of untreated decay with a mean of 1.96 (se=0.00). In the Hispanic population, NOVA had the highest level of untreated decay with a mean of 2.39 (se=0.03). In the Native American population, NOVA had the highest level of untreated decay with a mean of 5.97 (se=0.05). In the population of children designating "other" ethnicity, Hampton Roads had the highest level of untreated decay with a mean of 1.32 (se=0.32).

Differences in Dental Caries Outcomes by HMO Region

A regression analysis was completed to make statistical comparisons between the HMO regions and dental caries outcomes. Table 7 summarizes the primary dentition, where there were significant differences between regions with the Southwestern region having significantly more decayed, missing, and filled (dft) teeth (p=0.0323) than the other HMO regions. There were no differences between regions for untreated dental decay in the primary dentition.

Table 8 is a summary of the permanent dentition with the NOVA region (p=0.0000) having significantly more Decayed, Missing, and Filled teeth, while the Roanoke region (p=0.0442) had significantly less Decayed, Missing, and Filled teeth than the other HMO regions. In terms of untreated dental disease, the NOVA region (p=0.0000) had the highest levels of Decayed teeth, followed by the Southwestern region (p=0.0020), and then the Roanoke region (p=0.0004). The Blue Ridge, Central, and Hampton Roads regions did not significantly differ from one another.

DISCUSSION

This study examined differences in the oral health status of Virginia schoolchildren by HMO region as defined by the Virginia Department of Medical Assistance Services. According to the Virginia Statewide Oral Health Needs Assessment (VSOHNA), Virginia schoolchildren experienced similar levels of dental caries as schoolchildren nationwide.

In the VSOHNA results, 53% (se=8.14) of all schoolchildren in the permanent dentition were caries-free. 46% (se=5.70) of all tenth graders were caries-free, while 91% (se=1.81) of all third graders were caries-free. The mean level of Decayed, Missing, Filled Teeth (DMFT) for all schoolchildren in the permanent dentition was 1.47 (se=0.33). Overall, there was no difference between males and females. Tenth graders had the highest level of DMFT.

According to Healthy People 2010, 52% of children aged 6 to 8 years had dental caries experience in 1988-94. In this Virginia Statewide Oral Health Needs Assessment (VSOHNA), 41% (se=1.50) of all school children in the primary dentition were caries-free. 56% (se=1.84) of all first graders were caries-free, and 39% (se=0.96) of all third graders were caries-free. Third graders had the highest dft. The differences in levels of caries-free teeth between the primary and permanent dentitions could be the result of several mechanisms; the longer duration of the primary teeth in the mouth, the child's increasing dental IQ with age, and increasing parental oral health education.

Dental Caries and Ethnicity

In certain populations, such as minority groups and poor children, dental caries remains a significant problem. Millions of children have significant levels of dental caries. 75% of children's dental caries are concentrated in 25% of the population. Higher disease levels are usually found among minorities (10). The findings from this VSOHNA showed that dental caries levels varied according to ethnicity in both the primary and permanent dentitions.

According to the National Health and Nutrition Examination Survey III (NHANES III), poor Mexican American children aged 2 to 9 have the highest number of primary teeth affected by dental caries compared to poor non-Hispanic blacks and non-Hispanic whites. Among the non-poor, Mexican Americans 2- to 9- year-olds have the highest number of affected teeth, followed by non-Hispanic blacks and non-Hispanic whites. The findings from this VSOHNA showed that Asians had the highest level of decayed filled teeth (dft), followed by Native Americans, Blacks, Hispanics, Whites, and "Other" ethnicity.

In the VSOHNA study, Native Americans had the highest level of Decayed Missing Filled Teeth (DMFT) in the permanent dentition, followed by Hispanics, Asians, Blacks, "Other", and Whites. In the NHANES III, the mean number of permanent teeth affected by dental caries (decayed or filled) was similar among Hispanics, Whites, and Blacks. In comparison, VSOHNA had more variation among ethnic groups for caries experience than NHANES III.

Untreated Dental Disease and Ethnicity

When comparing the NHANES III and the VSOHNA studies, several conclusions can be made. In the NHANES III, Hispanics were found to have the highest levels of untreated decay in children aged 2 to 9, with Blacks having the highest levels of untreated decay in the permanent dentition. In contrast, in the VSOHNA study, Asians were found to have the highest level of untreated decay in the primary dentition, and Native Americans were found to have the highest level of untreated decay in the permanent dentition. Similar to caries experience, VSOHNA had more variation among ethnic groups for untreated decay than NHANES III, while both surveys show the predominance of increased dental disease in minority ethnic groups.

Dental Disease and HMO Regions

The VSOHNA study found that the Southwestern region had significantly more decayed and filled (dft) teeth ($p=0.0323$) than the other HMO regions in the primary dentition. There were no differences between regions for untreated dental decay in the primary dentition.

However, in the permanent dentition there were significant differences between regions for both caries experience and untreated decay. The following differences were noted: NOVA ($p=0.0000$) had significantly more Decayed, Missing, and Filled teeth, while the Roanoke region ($p=0.0442$) had significantly less Decayed, Missing, and Filled teeth than the other HMO regions. In contrast to the primary dentition in terms of untreated dental disease, significant differences were observed between HMO regions. Specifically, NOVA region ($p=0.0000$) had the highest levels of Decayed teeth, followed

by the Southwestern region (p=0.0020), and the Roanoke region (p=0.0004). The Blue Ridge, Central, and Hampton Roads regions did not significantly differ from one another.

The differences noted between the results from the primary and the permanent dentition could be attributed to preventive regimens such as water fluoridation, which varies among the different geographic regions of the state, could contribute to lower levels of tooth decay in the permanent dentition. Also, access to providers who care for younger children may be lacking uniformly amongst the different HMO regions. This could be a reason why there were no significant differences noted for untreated dental caries in the primary dentition.

Untreated Dental Disease and HMO Regions

The oral health assessment results helped us identify target populations within different geographic regions of the State. The Central region of the state appeared to highest level of untreated decay in the primary dentition. In the permanent dentition, NOVA appeared to have the highest level of untreated decay, while the Central region had the lowest level.

According to the VSOHNA, dental caries levels varied according to ethnicity and HMO region. Therefore, the populations, which are most at-risk for untreated decay, such as Asians in the primary dentition and Native Americans in the permanent dentition, can be targeted. Also, different geographic regions can be targeted which have higher levels of untreated decay. According to the survey data results, there were no differences between regions for untreated dental decay in the primary dentition. However, in the

permanent dentition, NOVA (p=0.0000) had the highest levels of untreated decayed teeth.

Limitations of this study consisted of very small sample sizes and large variability of some ethnic subgroups such as the Native Americans and Hispanics for certain grade levels and regions of the state. As a result, caution should be taken when generalizing results to other populations.

The 1999 Virginia Statewide Oral Health Needs Assessment (VSOHNA) measured the burden and distribution of oral health disease. The oral health assessment process sought to identify the extent and types of existing and potential problems in a community or geographic regions, the current system of services available, and the extent of unmet needs, underutilized resources, or barriers to the service delivery system. Preventive programs to help reduce overall caries experience could be implemented in specific Virginia geographic regions. Examples of these programs consist of community water fluoridation, rural school water fluoridation, application of dental sealants, fluoride mouth rinse in elementary schools, and integration of educational activities for schoolchildren, teachers, and dentists. Treatment programs for untreated decay could also be established, such as mobile vans at schools and treatment provided through local health departments or community health centers. This will help build comprehensive, community-specific oral health programs for the target populations, and aid in the education, prevention, and treatment programs that target children at greatest risk for oral diseases.

CONCLUSIONS

- Dental caries levels varied according to ethnicity in both the primary and permanent dentitions.
- Dental caries levels varied according to ethnicity and HMO region.
- Dental Caries rates (dft/DMFT) of Virginia schoolchildren significantly differed according to HMO region.
- In the permanent dentition, untreated dental disease significantly differed according to HMO region, while it did not differ in the primary dentition.

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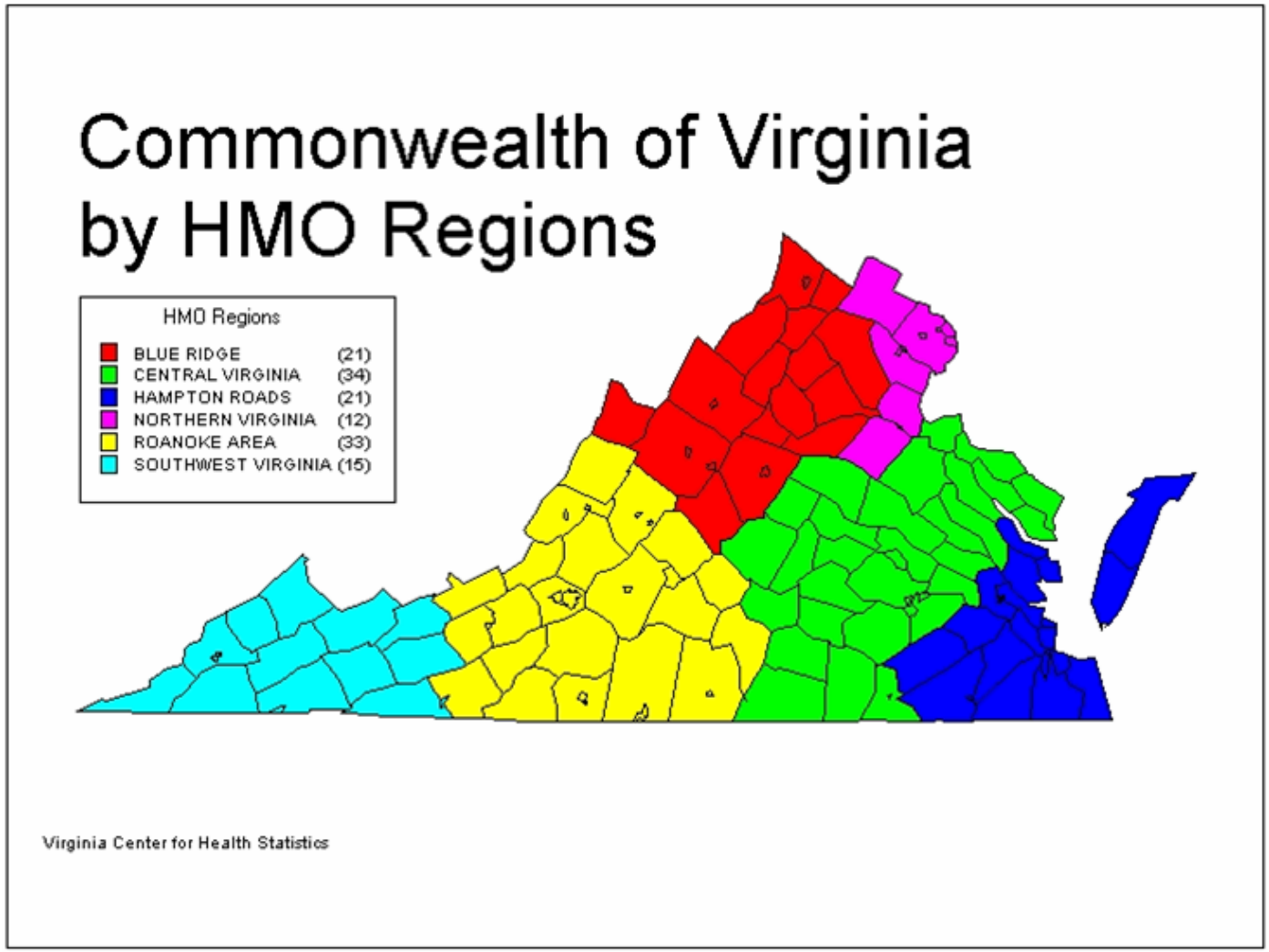

Figure 1. HMO regions of Virginia

Table 1. Dental caries in the primary dentition according to grade and gender.

				Teeth						Surfaces					
Grade	**Gender**	**Caries Free (%)**	**(se)**	**dt**	**(se)**	**ft**	**(se)**	**dft**	**(se)**	**ds**	**(se)**	**fs**	**(se)**	**dfs**	**(se)**
Total	All	41	1.50	0.66	.01	1.04	.04	1.70	.03	1.13	.03	2.34	.06	3.47	.04
	Male	46	0.57	0.57	.03	1.44	.09	2.01	.06	.89	.06	2.98	.12	3.87	.07
	Female	37	2.16	0.73	.01	.73	.01	1.46	.01	1.32	.01	1.84	.03	3.17	.02
First	All	56	1.84	0.71	.08	.85	.07	1.56	.04	1.25	.16	2.12	.23	3.37	.16
	Male	57	1.32	0.68	.09	.93	.15	1.61	.09	1.28	.21	2.41	.46	3.69	.30
	Female	55	3.71	0.73	.09	.77	.03	1.50	.10	1.22	.13	1.84	.16	3.06	.24
Third	All	39	0.96	0.66	.01	1.06	.02	1.71	.02	1.12	.01	2.36	.03	3.48	.03
	Male	45	0.34	0.56	.02	1.50	.05	2.06	.04	.85	.03	3.05	.06	3.89	.05
	Female	35	1.68	0.73	.01	.72	.01	1.45	.01	1.33	.01	1.84	.03	3.18	.03

Table 2. Dental caries in the permanent dentition according to grade and gender.

				Teeth								Surfaces							
Grade	**Gender**	**Caries Free (%)**	**(se)**	**DT**	**(se)**	**MT**	**(se)**	**FT**	**(se)**	**DMFT**	**(se)**	**DS**	**(se)**	**MS**	**(se)**	**FS**	**(se)**	**DMFS**	**(se)**
Total	All	53	8.14	0.47	0.28	0.06	0.02	0.93	0.09	1.47	0.33	0.56	0.35	0.32	0.08	1.57	0.21	2.45	0.49
	Male	48	11.96	0.28	0.14	0.01	0.01	1.18	0.33	1.47	0.35	0.30	0.16	0.05	0.03	2.15	0.66	2.50	0.66
	Female	57	10.17	0.60	0.37	0.10	0.02	0.76	0.10	1.47	0.45	0.73	0.47	0.50	0.12	1.19	0.22	2.43	0.75
First	All	88	2.38	0.10	0.04	0.01	0.01	0.05	0.01	0.17	0.04	0.13	0.03	0.06	0.03	0.08	0.02	0.27	0.03
	Male	89	2.71	0.10	0.04	0.00	0.00	0.05	0.01	0.16	0.03	0.13	0.04	0.00	0.01	0.07	0.01	0.21	0.05
	Female	88	2.32	0.10	0.04	0.02	0.01	0.06	0.03	0.18	0.06	0.12	0.03	0.12	0.07	0.09	0.05	0.33	0.04
Third	All	91	1.81	0.03	0.03	0.00	0.00	0.08	0.01	0.11	0.04	0.03	0.03	0.00	0.00	0.18	0.01	0.22	0.04
	Male	90	1.70	0.03	0.03	0.00	0.00	0.09	0.01	0.12	0.04	0.03	0.03	0.00	0.00	0.17	0.01	0.21	0.04
	Female	92	1.94	0.02	0.03	0.00	0.00	0.07	0.01	0.09	0.04	0.03	0.03	0.00	0.00	0.19	0.01	0.22	0.04
Tenth	All	46	5.70	0.56	0.30	0.08	0.02	1.09	0.07	1.73	0.27	0.66	0.37	0.38	0.09	1.84	0.17	2.89	0.38
	Male	39	10.12	0.33	0.15	0.01	0.01	1.42	0.33	1.76	0.29	0.36	0.17	0.06	0.03	2.58	0.71	3.00	0.63
	Female	51	9.93	0.70	0.38	0.12	0.03	0.89	0.14	1.71	0.45	0.86	0.49	0.59	0.15	1.37	0.25	2.82	0.77

Table 3. Dental caries in the primary dentition according to grade and HMO region.

		Teeth								Surfaces					
HMO Regions	**Grade**	**Caries Free (%)**	**(se)**	**dt**	**(se)**	**ft**	**(se)**	**dft**	**(se)**	**ds**	**(se)**	**fs**	**(se)**	**dfs**	**(se)**
Total	All	41	1.50	.66	.01	1.04	.04	1.70	.03	1.13	.03	2.34	.06	3.47	.04
	First	56	1.84	.71	.08	.85	.07	1.56	.04	1.25	.16	2.12	.23	3.37	.16
	Third	39	0.96	.66	.01	1.06	.02	1.71	.02	1.12	.01	2.36	.03	3.48	.03
Blue Ridge	All	54	2.52	.72	.13	.91	.09	1.62	.18	1.38	.22	2.16	.27	3.54	.38
	First	57	3.22	.62	.12	.84	.19	1.46	.18	1.08	.20	2.02	.54	3.10	.50
	Third	52	2.64	.80	.18	.96	.08	1.75	.23	1.62	.35	2.27	.21	3.89	.38
NOVA	All	55	0.83	.67	.03	.73	.03	1.40	.02	1.21	.06	1.71	.04	2.92	.05
	First	59	1.35	.70	.04	.73	.05	1.43	.03	1.30	.08	1.56	.13	2.87	.05
	Third	52	0.96	.65	.03	.73	.05	1.37	.02	1.16	.07	1.79	.08	2.95	.09
Southwest	All	51	2.22	.61	.12	1.38	.15	1.99	.13	1.25	.23	4.21	.46	5.46	.45
	First	55	4.99	.67	.13	1.10	.17	1.78	.26	1.41	.22	3.49	.85	4.90	.85
	Third	47	2.45	.55	.16	1.65	.41	2.20	.29	1.09	.36	4.95	1.03	6.04	.79
Roanoke	All	52	4.03	.65	.11	.98	.12	1.64	.14	1.27	.18	2.08	.33	3.34	.33
	First	57	3.71	.77	.08	.73	.14	1.50	.18	1.50	.14	1.62	.37	3.12	.43
	Third	49	6.05	.59	.15	1.10	.11	1.70	.18	1.15	.25	2.30	.39	3.45	.46
Hampton Roads	All	40	0.28	.66	.01	1.06	.02	1.72	.01	1.12	.02	2.37	.04	3.49	.02
	First	55	3.28	.71	.13	.88	.10	1.59	.05	1.17	.21	2.21	.32	3.38	.17
	Third	39	0.16	.66	.00	1.07	.01	1.73	.01	1.12	.00	2.37	.02	3.49	.01
Central	All	51	5.56	.72	.18	.88	.08	1.60	.12	1.35	.38	2.50	.09	3.85	.46
	First	57	7.47	.75	.21	.90	.09	1.66	.28	1.58	.51	2.69	.39	4.27	.88
	Third	48	5.70	.70	.21	.87	.12	1.57	.14	1.24	.44	2.40	.19	3.64	.56

Table 4. Dental caries in the permanent dentition according to grade and HMO region.

		Teeth										Surfaces							
HMO Regions	**Grade**	**Caries Free (%)**	**(se)**	**DT**	**(se)**	**MT**	**(se)**	**FT**	**(se)**	**DMFT**	**(se)**	**DS**	**(se)**	**MS**	**(se)**	**FS**	**(se)**	**DMFS**	**(se)**
Total	All	53	8.14	0.47	0.28	0.06	0.02	0.93	0.09	1.47	0.33	0.56	0.35	0.32	0.08	1.57	0.21	2.45	0.49
	First	88	2.38	0.10	0.04	0.01	0.01	0.05	0.01	0.17	0.04	0.13	0.03	0.06	0.03	0.08	0.02	0.27	0.03
	Third	91	1.81	0.03	0.03	0.00	0.00	0.08	0.01	0.11	0.04	0.03	0.03	0.00	0.00	0.18	0.01	0.22	0.04
	Tenth	46	5.70	0.56	0.30	0.08	0.02	1.09	0.07	1.73	0.27	0.66	0.37	0.38	0.09	1.84	0.17	2.89	0.38
Blue Ridge	All	54	2.70	0.06	0.04	0.02	0.01	1.23	0.12	1.31	0.11	0.08	0.05	0.08	0.07	1.50	0.12	1.66	0.11
	First	94	2.15	0.05	0.03	0.00	0.00	0.03	0.01	0.08	0.04	0.07	0.04	0.00	0.00	0.04	0.02	0.11	0.06
	Third	83	1.50	0.11	0.03	0.00	0.00	0.17	0.03	0.29	0.03	0.16	0.05	0.01	0.01	0.21	0.04	0.38	0.05
	Tenth	51	2.23	0.06	0.04	0.02	0.02	1.33	0.11	1.40	0.11	0.08	0.06	0.08	0.08	1.61	0.10	1.77	0.14
NOVA	All	32	3.31	1.45	0.11	0.12	0.01	0.92	0.06	2.48	0.18	1.77	0.13	0.59	0.05	1.63	0.11	3.99	0.29
	First	82	2.36	0.20	0.03	0.00	0.00	0.08	0.01	0.28	0.04	0.21	0.02	0.00	0.00	0.12	0.02	0.34	0.04
	Third	68	3.51	0.36	0.04	0.00	0.00	0.19	0.02	0.55	0.06	0.47	0.06	0.00	0.00	0.28	0.03	0.75	0.08
	Tenth	31	3.22	1.49	0.11	0.12	0.01	0.95	0.06	2.56	0.18	1.83	0.13	0.61	0.05	1.68	0.11	4.12	0.29
Southwest	All	49	4.92	0.38	0.11	0.06	0.04	0.92	0.11	1.36	0.21	0.60	0.23	0.28	0.22	1.57	0.36	2.44	0.55
	First	89	4.54	0.12	0.08	0.00	0.00	0.03	0.01	0.15	0.07	0.13	0.08	0.00	0.00	0.04	0.01	0.17	0.07
	Third	85	2.69	0.08	0.03	0.00	0.00	0.15	0.03	0.23	0.05	0.09	0.04	0.01	0.01	0.27	0.05	0.36	0.08
	Tenth	44	4.49	0.42	0.11	0.06	0.05	1.02	0.12	1.50	0.22	0.66	0.25	0.31	0.25	1.74	0.38	2.72	0.55
Roanoke	All	58	5.17	0.32	0.07	0.03	0.02	0.67	0.19	1.02	0.20	0.39	0.07	0.11	0.11	0.98	0.24	1.49	0.34
	First	93	1.90	0.07	0.03	0.00	0.00	0.02	0.01	0.09	0.03	0.10	0.04	0.01	0.01	0.03	0.02	0.13	0.05
	Third	76	3.97	0.22	0.06	0.00	0.00	0.15	0.02	0.37	0.06	0.24	0.07	0.00	0.00	0.19	0.04	0.44	0.06
	Tenth	56	5.82	0.33	0.08	0.04	0.03	0.71	0.21	1.07	0.22	0.40	0.08	0.12	0.12	1.04	0.27	1.57	0.38
Hampton Roads	All	61	5.59	0.26	0.15	0.06	0.01	0.81	0.03	1.13	0.16	0.28	0.18	0.31	0.05	1.28	0.05	1.88	0.17
	First	90	1.64	0.07	0.03	0.02	0.01	0.04	0.01	0.13	0.03	0.09	0.03	0.10	0.03	0.05	0.02	0.25	0.02
	Third	92	0.53	0.01	0.01	0.00	0.00	0.07	0.00	0.08	0.01	0.01	0.01	0.00	0.00	0.18	0.00	0.19	0.01
	Tenth	51	4.35	0.34	0.17	0.08	0.02	1.05	0.08	1.48	0.11	0.37	0.20	0.41	0.08	1.65	0.17	2.43	0.14
Central	All	50	0.77	0.03	0.01	0.01	0.00	1.41	0.06	1.44	0.05	0.04	0.01	0.04	0.01	2.68	0.20	2.76	0.19
	First	86	2.75	0.14	0.04	0.01	0.01	0.10	0.03	0.24	0.06	0.17	0.06	0.03	0.03	0.19	0.06	0.39	0.13
	Third	76	6.54	0.32	0.14	0.00	0.00	0.10	0.03	0.41	0.12	0.33	0.14	0.00	0.00	0.16	0.05	0.49	0.10
	Tenth	49	0.27	0.02	0.01	0.01	0.00	1.44	0.04	1.47	0.03	0.03	0.01	0.04	0.01	2.75	0.15	2.82	0.15

Table 5. Dental caries in the primary dentition for varying ethnicities and HMO regions.

decayed teeth (dt)							
Ethnicity	**Blue Ridge**	**NOVA**	**Southwest**	**Roanoke**	**Hampton Roads**	**Central**	**Total**
Total	0.72 (.13)	0.67 (.03)	0.61 (.12)	0.65 (.11)	0.66 (.01)	0.72 (.18)	0.66 (.01)
White	0.65 (.15)	0.41 (.05)	0.59 (.11)	0.57 (.08)	0.65 (.00)	0.44 (.08)	0.63(.01)
Black	1.16 (.17)	1.07 (.03)	2.01 (.79)	1.08 (.30)	1.07 (.10)	1.00 (.16)	1.05 (.07)
Asian	0.37 (.43)	1.75 (.03)	.00 (.00)	0.32 (.28)	2.15 (.29)	0.10 (.12)	1.78 (.11)
Hispanic	1.79 (.66)	1.50 (.25)	0.30 (.37)	1.28 (.06)	0.71 (.35)	0.61 (.56)	1.18 (.27)
Native American	0.00 (.00)	0.00 (.00)	1.08 (.11)	0.68 (.67)	0.17 (.23)	0.00 (.00)	0.09 (.08)
Other	2.39 (1.56)	0.48 (.03)	0.23 (.24)	0.44 (.30)	0.66 (.44)	0.39 (.08)	0.60 (.24)

Table 6. Dental caries in the permanent dentition for varying ethnicities and HMO regions.

Decayed Teeth (DT)							
Ethnicity	**Blue Ridge**	**NOVA**	**Southwest**	**Roanoke**	**Hampton Roads**	**Central**	**Total**
Total	0.06 (.04)	1.45 (.11)	0.38 (.11)	0.32 (.07)	0.26 (.15)	0.03 (.01)	0.47 (.28)
White	0.05 (.03)	1.06 (.08)	0.38 (.11)	0.26 (.11)	0.18 (.10)	0.02 (.00)	0.27 (.16)
Black	0.13 (.14)	0.65 (.11)	0.85 (.46)	0.45 (.09)	0.54 (.25)	0.29 (.10)	0.54 (.20)
Asian	0.23 (.32)	1.96 (.00)	0.00 (.00)	0.00 (.00)	0.06 (.07)	0.00 (.00)	1.41 (.50)
Hispanic	0.07 (.07)	2.39 (.03)	0.00 (.00)	0.00 (.00)	0.01 (.01)	0.00 (.00)	2.25 (.16)
Native American	0.00 (.00)	5.97 (.05)	0.00 (.00)	0.00 (.00)	1.05 (.92)	0.00 (.00)	3.43 (1.77)
Other	0.14 (.17)	0.46 (.00)	0.28 (.26)	0.00 (.00)	1.32 (.32)	0.00 (.00)	0.76 (.28)

Table 7. Regression analysis of dental caries in the primary dentition and HMO regions.

decayed, filled teeth (dft)				
HMO Regions	**ß coefficient**	**(se)**	**95 % CI**	**P Value**
Blue Ridge	0.03	.22	(-0.41 - 0.46)	0.9080
NOVA	-0.20	.12	(-0.45 - 0.04)	0.1056
Southwest	0.39	.18	(0.03 – 0.74)	**0.0323***
Roanoke	0.04	.19	(-0.34 – 0.41)	0.8393
Hampton Roads	0.12	.12	(-0.12 – 0.37)	0.3220
Central	0.00	referent	referent	.
decayed teeth (dt)				
HMO Regions	**ß coefficient**	**(se)**	**95 % CI**	**P Value**
Blue Ridge	0.00	.23	(-0.45 – 0.45)	0.9960
NOVA	-0.05	.19	(-0.42 – 0.32)	0.7842
Southwest	-0.11	.22	(-0.55 – 0.34)	0.6361
Roanoke	-0.07	.22	(-0.50 – 0.37)	0.7621
Hampton Roads	-0.06	.18	(-0.43 – 0.31)	0.7583
Central	0.00	referent	referent	.

***P-Value of <0.05 was considered significant.**

Table 8. Regression analysis of dental caries in the permanent dentition and HMO regions.

Decayed, Missing, Filled Teeth (DMFT)				
HMO Regions	**ß coefficient**	**(se)**	**95 % CI**	**P Value**
Blue Ridge	-0.13	.12	(-0.38 – 0.12)	0.2880
NOVA	1.04	.19	(0.67 – 1.41)	**0.0000**
Southwest	-0.08	.22	(-0.52 – 0.36)	0.7005
Roanoke	-0.42	.20	(-0.83 – -0.01)	**0.0442**
Hampton Roads	-0.31	.16	(-0.64 – 0.02)	0.0632
Central	0.00	referent	referent	.
Decayed Teeth (DT)				
HMO Regions	**ß coefficient**	**(se)**	**95 % CI**	**P Value**
Blue Ridge	0.03	.04	(-0.05 – 0.11)	0.4339
NOVA	1.42	.11	(1.20 – 1.64)	0.0000
Southwest	0.36	.11	(0.14 - .058)	0.0020
Roanoke	0.29	.08	(0.14 – 0.44)	0.0004
Hampton Roads	0.23	.15	(-0.07 – 0.53)	0.1335
Central	0.00	referent	referent	.

***P-Value of <0.05 was considered significant.**

VITA

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