Children's School Performance: Impact of General and Oral Health

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Abstract

Objectives: *The purpose of this study was to examine: a) the sociodemographic and health factors associated with poor school performance among North Carolina children; and b) the impact of poor oral health status on school performance while controlling for other health and sociodemographic factors.* ***Methods:*** *We used data from the 2005 Child Health Assessment and Monitoring Program, a follow-back telephone survey to the Behavioral Risk Factor Surveillance System involving parents/guardians of children 0 to 17. This project includes sections on oral health and school performance. Our principal outcome variable was school performance and our major explanatory variable was children's oral health status, based upon parental report.* ***Results:*** *Our sample consisted of 2,871 school children, weighted to reflect the North Carolina census. Bivariate analysis revealed that sex, race, parental education, low socioeconomic status, poor general health, poor oral health, and the interaction of poor oral health and general health were significantly related to school performance (*$P < 0.05$*). Logistic regression analysis demonstrates the effects of poor oral health and general health on school performance. Children with both poor oral health and general health were 2.3 times more likely to report poor school performance. Children with either poor oral health or general health were only 1.4 times more likely to report poor school performance.* ***Conclusions:*** *Our results show that children who have both poor oral health and general health are more likely to have poor school performance. Our findings suggest that the improvement of children's oral health may be a vehicle to improve their educational experience.*

Key Words: school performance, poor school performance, school absence, poor oral health, poor general health, good oral health, good general health, children, caries, policy

Introduction

Oral Health is an Important Dimension of General Health. It is well established that oral health is a fundamental component of general health. As a policy talking point in the early 1980s, former Surgeon General (1981-89) C. Everett Koop recognized the relationship between oral health and overall health and coined the often-repeated quote "You're not healthy without good oral health." The former Surgeon General, David Satcher, reinforced this concept by focusing national attention on oral health by way of a Surgeon General's Conference as chronicled in *Oral Health in America: A Report of the Surgeon General* (1), in which he stated "You cannot be healthy without good oral health." This report explicates the role of oral health in overall health in terms of oral health being a mirror for general health, with the oral cavity as a portal for infectious organisms to reach the rest of the body.

Although cause has not been firmly established, recently established connections have been found between oral infections and diabetes, heart disease, stroke, and preterm low birth weight babies (1). In addition to the connection between oral and systemic health, oral health strongly influences quality of life and general well-being. In children, dental disease may lead to serious general health problems and significant pain, interference with eating, overuse of emergency rooms, and lost school time (1).

Several chronic diseases are known to affect children by causing significant adjustments in life management and varying degrees of a decreased quality of life. The National Institute of Health estimates that chronic health conditions occur in 20 to 30 percent of children and adolescents in the United States (2). Among the chronic diseases of childhood that are the most prevalent are asthma, diabetes, and obesity. How does dental disease compare with the chronic childhood diseases of asthma, diabetes, and obesity? In fact, dental caries is the most common chronic disease of childhood, occurring five to eight times more than asthma (1). According to the 1999-2002 National Health and Nutrition Examination Survey (NHANES), among children aged 2 to 11 years, 41 percent had dental caries in their primary teeth. Forty-two percent of children and adolescents aged 6 to 19 years had dental caries in their permanent teeth (3).

Dental caries does not affect all children equally – 80 percent of the

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disease is found in 25 percent of children and adolescents (4). The percentage of children with untreated decay did not decrease between 1986 and the release of *Healthy People 2000*; indeed, the percentage of children who saw a dentist before kindergarten actually decreased during this time frame (5). The need for dental care is also a parental concern. According to the National Center for Health Statistics data from 1996, when parents reported unmet health care needs for their child, 57 percent of the time the unmet need was for dental care (5). Evidence also suggests that children with dental caries have poorer oral health quality of life (6,7).

General Health and School Performance. Chronic illness can interfere with a child's ability to succeed in school. A number of studies have demonstrated a positive relationship between health and cognitive development and a correlation between poor health and lowered productivity (8). School attendance has been reported to be a variable for school success, and increased absence from school has been shown to decrease performance (8). Moreover, when a chronic illness causes an increase in missed school days, there is evidence that this can decrease school performance (8).

Fowler and colleagues examined the relationship between school performance and missed school because of chronic health conditions and found that North Carolina (NC) children with chronic health conditions missed an average of 16 school days/annually *versus* a statewide average of less than 7 days per year (9). Thirty percent of the children had repeated one grade, and 34 percent were receiving additional help with schoolwork. Fowler and colleagues also found that these children performed significantly worse on state achievement tests compared with their healthy peers (9).

Oral Health and School Performance. Children with dental disease are not healthy and may be at a disadvantage for their physiologic, social, and mental development. This is a concept that has received considerable attention from policymakers; indeed the relationship between school performance and dental disease is often mentioned in speeches and policy briefs. With a goal of looking more closely at published data, we undertook a comprehensive review of the literature on the topic and could find no contemporary information. One commonly quoted statistic is that 1.57 million school days were lost in 1980 because of dental problems (10), a conclusion drawn from a National Health Interview Survey (NHIS). These data are over 25 years old and do not disentangle school days missed for emergency *versus* nonemergency dental needs.

A commonly quoted figure in the literature is that over 51 million school hours are lost annually because of dentally related illness, a statistic emanating from the 1989 NHIS data (11). This statistic is also dated, and the study's definition of illness is not spelled out.

To summarize, most published studies have looked only at school days missed, reporting no data on school performance related to dentally related absenteeism. Accordingly, our overarching goal was to examine the impact of poor oral health status on school performance, while controlling for other health and sociodemographic factors.

Rationale for the Current Study. Our interest in this subject led us to a contemporary data set that offered potential to address the relationship of dental disease to children's school performance in NC. The data set emanated from the Child Health Assessment and Monitoring Program survey, called CHAMP. Devoted to children's overall health status, CHAMP was a statewide phone interview of households conducted in 2005 and it included sections on oral health and school performance. Our study's specific aims were to: a) examine the sociodemographic factors associated with poor school performance; b) examine the general health factors that impact school performance; and c) examine the impact of poor oral health status on school performance, while controlling for other health and sociodemographic factors.

Methods

Study Design and Data Source. CHAMP was a follow-up to the NC Behavioral Risk Factor Surveillance Survey (BRFSS), a federally supported survey by the Centers for Disease Control for adults 18 and older. Each state must complete a core BRFSS annually in such a manner that the surveys are constantly under collection at any time in any given state. It should be noted that BRFSS does not have a child health component. As a follow-up to the 2005 BRFSS in NC, the State Center for Health Statistics conceived and developed the CHAMP to explore a wide range of child health issues, including 26 sections ranging from general health to birth characteristics to sun safety to adolescent sexuality. CHAMP included separate sections on both oral health and school performance. The oral health section included seven questions, and the school performance section included three questions.

The logistics of CHAMP were as follows: a probability sample of households was relied upon and racial and ethnic minority groups oversampled to ensure adequate representation. When a household (parent) was identified by random sampling to complete the BRFSS, the parent was asked if they had children. Those identified as having children were asked to participate in CHAMP and if they agreed, they were called back in 2 weeks to complete the 10- to 15-minute phone CHAMP interview. When there was more than one child in the household, one child under the age of 18 was selected randomly as the subject of the interview. The US Census model was employed for the collection of demographic information of families and children.

Variable Definitions. The principal outcome variable was school performance as reported by the parent. This variable was derived

from a question asking the parent "during the past 12 months, how would you describe your child's performance in school" (excellent, above average, average, below average, or poor). Our major explanatory variable was child oral health status as reported by the parent. The question regarding oral health status was as follows: "How would you rate the condition of your child's teeth? Would you say their condition is excellent, very good, good, fair, or poor?" One overall general health question was included. The question regarding overall health status was as follows: "How would you rate the condition of your child's overall health? Would you say their condition is excellent, very good, good, fair, or poor?"

Other health and well-being variables were included: special health care needs (yes, no); behavioral conditions (yes, no); and mental health (yes, no). Ten control variables were included in the analysis: child's sex (male, female); race (White, minority); ethnicity (Hispanic, non-Hispanic), parental education (less than high school, high school, some college, 4-year degree or higher); insurance status (public insurance, private insurance, none); school type (private/home versus public); diagnosis of a mental health disorder (yes, no); diagnosis of behavioral health conditions (yes, no); and diagnosis of a learning disability (yes, no). Additionally, we also controlled for missed school days of greater than 2 weeks (≥2 weeks, <2 weeks).

Analytical Strategy. Descriptive statistics reporting percent frequency distributions of responses for sociodemographic characteristics, oral health status, and school performance were run using SAS software (SAS Institute, Cary, NC). The SAS software was used to help take into account the complex survey design of the CHAMP. We analyzed weighted data and took into account stratification using SAS PROC SURVEYLOGISTIC with strata and weight statements. This is equivalent to PROC RLOGIST in SUDAAN and gives identical results.

We examined oral health and general health individually and as an interaction term. We also created a new variable that measured both oral and general health status. This new overall health variable was a four-level measure: a) both poor oral and general health (1.82 percent); b) poor oral and good general health (2.66 percent); c) good oral and poor general health (8.13 percent); and d) both good oral and general health (87.4 percent).

After examination of bivariate associations of independent variables and school performance using Pearson Chi-square tests, logistic regression models were developed to test the relationship of oral health status (excellent/very good/good *versus* fair/poor) and school performance (excellent/above average *versus* average/below average/poor), while accounting for control variables. To facilitate the interpretation of the regression parameter estimates, categorical, or dichotomous, variables were created. Multivariate logistic models were used to obtain the regression parameter estimates and their variances. The backward elimination method was performed for variable selection at a significance level of $P \leq 0.2$ for keeping variables in the model.

Ethical Considerations. The data from CHAMP contain no unique identifiers and have been approved for research purposes by the Internal Review Board of the NC Center for Health Statistics. The data were made available to us by the NC Center for Health Statistics and the University of North Carolina at Chapel Hill (UNC-CH) Center for Health Promotion and Disease Prevention.

Results

The CHAMP 2005 final sample size was 3,973 respondents, a response rate of 84 percent. Because our goal was to examine school performance, we limited our study to children in kindergarten or higher, in public or private school, leaving a sample size of 2,871 school children. The data were weighted to reflect the NC state census. Descriptive statistics of the sample are presented in Table 1. The majority of the children were male (51.0 percent), White (69.7 percent), and had private health insurance (65.1 percent) Over 90 percent of the parents reported that their children had good to excellent general and dental health status. The results of the bivariate analyses examining the factors associated with poor school performance are illustrated in Table 2. These findings revealed that sex (male), race (non-White), parental education (high school or less), low socioeconomic status, and special health care needs were significantly related to parent perception of school performance ($P < 0.05$). The number of days of school missed of 2 weeks or more (<2 weeks, ≥2 weeks) was significantly correlated with parent perception of poor school performance ($P = 0.01$). Children with poor general health, poor oral health, and both poor oral and general health were significantly related to parent perception of poor school performance ($P < 0.05$).

In planning our analytical scheme, we developed and tested a model that included general health and oral health separately and as an interaction term. Our initial results revealed that children with poor general health were 1.6 times more likely to have parentally reported poor school performance than those with good general health. Additionally, those with poor oral health were 1.4 times more likely to have parentally reported poor school performance. Both poor general and oral health alone were not significant ($P = 0.06$), nor was the interaction ($P > 0.10$).

Because of our belief that oral health is a part of general health and a child cannot be healthy without good oral health, we tested four different dimensions of overall health as our main explanatory variable of interest. These included: a) both poor oral and general health; b) poor oral and good general health; c) good oral and poor general health; and d) both good oral and general health. We tested this relationship using multivariate logistic regression

Table 1
Characteristics of Study Population (*n* = 2,871)

Variable	%
Child's gender	
Male	51.0
Female	49.0
Parent's educational level	
High school or less	30.1
2 years/some college	26.0
College degree or higher	43.9
Race	
White	69.7
Black	21.0
Other	9.3
Hispanic	
Yes	5.5
No	94.5
Health insurance status	
Public/SCHIP/Medicaid	34.9
Private	65.1
Dental health status	
Excellent/very good/good	91.1
Fair/poor	8.8
General health status	
Excellent/very good/good	95.8
Fair/poor	4.2
Children with special health care needs	
Yes	18.8
No	81.2

analysis, while controlling for sex, race, parental education, Medicaid, public versus private school, presence of medical conditions requiring care, presence of mental and behavioral conditions, learning disability, and school days missed >2 weeks. These results are illustrated in Table 3. Children who were male [odds ratio (OR) = 1.86, 95 percent confidence interval (CI) = 1.34, 2.60], African-American (OR = 1.50, 95 percent CI = 1.03, 2.08), had public or no insurance (OR = 1.72, 95 percent CI = 1.17, 2.53), and whose parents had a high school education or less (OR = 3.66, 95 percent CI = 2.35, 5.69) were more likely to have parentally reported poor school performance. Additionally, the diagnosis of a mental disorder (OR = 2.68, 95 percent CI = 1.58, 4.54), diagnosis of behavioral conditions (OR = 3.98, 95 percent CI = 2.50, 6.34), and diagnosis of a learning disability (OR = 4.97, 95 percent CI = 3.10, 7.97) were found to be significantly related to poor school performance. Logistic regression of the effects of poor oral and general health on school performance revealed an OR of 2.34 (95 percent CI = 1.07, 5.67); therefore, children with both poor oral and general health were 2.3 times more likely to report poor school performance than those with both good oral and general health. Although not statistically significant, children with poor oral and good general health were 1.4 times more likely to have poor school performance reported than those with good oral and general health; likewise, those with good oral and poor general health were 1.4 times more likely to have poor school performance reported than those with good oral and general health.

Discussion

Data Validity Considerations. We believe the parentally reported school performance data are reasonable to accept at face value; if anything, parents might have a tendency to overestimate their children's school performance. It is probably not easy for parents to be candid that their children do poorly or fail in school, even if this admission comes in the context of a telephone interview.

The validity of parents' perceptions of their children's oral health status is an important factor to consider. A recent study examined parental perceptions of their children's oral health, finding a significant association between parents' classifying their child's oral health status as "fair" or "poor" and actual oral disease present (12). This study relied upon the same classification scheme as the CHAMP survey, asking parents to rate oral health status as "excellent," "very good," "good," "fair," or "poor." This study also positively correlated parents' perceptions of a child's general health as poor with poor perceptions of dental health, underscoring the relationship between general and dental health. In short, clinical dental disease, parent-defined need for dental treatment, and perceptions of poor oral health have been shown to coexist (12).

Study Findings. A child with poor general health is more likely to have poor school performance. Our findings show a significant increase in the likelihood for parentally reported poor school performance when a child has poor oral health in addition to poor general health. An OR of 2.3 for children with both poor oral and general health *versus* 1.4 for children with either poor oral or general health may underscore the impact that the additional burden of poor oral health to poor general health has in terms of poor school performance. While the difference in OR does not verify a cause-and-effect relationship between poor oral health and poor school performance, it demonstrates the possibility that improving children's oral health may improve their school performance.

We felt that the significant findings in our multivariate analysis (Table 3) were, for the most part, intuitive reflecting parameters of socioeconomic status and cognitive

Table 2
Bivariate Relationships for the Likelihood of Poor School Performance (n = 2,871)

Variable	Poor school performance		
	%	χ^2	P
Child's gender			
Male	16.7	28.97	<0.0001
Female	9.1		
Race			
White	10.9	19.62	<0.0001
Black	18.2		
Other	16.8		
Hispanic			
Yes	13.5	0.043	0.8344
No	12.9		
Parent's educational level			
High school or less	24.1	110.8	<0.0001
2 years/some college	11.5		
College degree or higher	6.4		
School days missed			
Less than 2 weeks	12.2	18.02	0.0004
2 weeks or more	21.8		
Mental health screen			
Yes	27.9	38.45	<0.0001
No	12.0		
Behavioral screen			
Yes	38.0	200.29	<0.0001
No	10.5		
Learning disability			
Yes	43.5	237.39	<0.0001
No	10.5		
Health insurance status			
Public/SCHIP/Medicaid/none	24.6	126.23	<0.0001
Private	7.8		
General health status			
Excellent/very good/good	11.9	49.27	<0.0001
Fair/poor	35.5		
Children with special health care needs			
Yes	21.4	69.50	<0.0001
No	8.8		
Dental health status			
Excellent/very good/good	11.5	33.87	<0.0001
Fair/poor	25.0		
Dental and general health status			
Both excellent/very good/good	11.2	82.42	<0.0001
Both fair/poor	45.0		

capacity/readiness, although a significant difference between males and females was not expected. This finding of a gender difference is an outcome that may deserve further study by educational experts.

In summary, our analysis adds to the knowledge base of the relationship between poor general health and school performance, but it falls short of implicating oral health as a stand-alone factor in poor school performance. It is well established that children with poor overall health have increased school absence and decreased school performance (8,9), although further study is required to establish how improving a child's health, regardless of the contributing sociodemographic factors, may influence school performance. Similarly, further study is needed to explore how improving oral health alone might better school performance.

Strengths and Limitations. The strengths of this study include the wealth of CHAMP child health information that coincides with questions regarding oral health and school performance – providing another view beyond those widely discussed 20-year-old data. The combination of poor oral health and poor general health has a much greater impact on reported school performance than either one alone. Our findings suggest that the improvement of children's oral health may be a vehicle to improve their educational experience.

CHAMP data addressing school performance and dental health are subjective measures by the parent. While it has been shown that there is good correlation between parent perception of dental health and actual dental needs present (12), the validity of parent perception of school performance is not established. Inconsistency in how well parents judge dental health and school performance, possibly depending on cultural and socioeconomic variables, is a limiting factor in this study.

A major limitation of this study is that there are no specific questions in CHAMP that address missed school days because of dental problems, so our analyses focused on school performance and oral health, controlling for as many factors as possible, thus complementing the data that exist for missed school days. Bivariate analysis of the CHAMP data set revealed that the number of days of school missed of 2 weeks or more was significantly correlated with poor school performance (P = 0.01); therefore, CHAMP has shed more light on this topic, but it remains impossible to address cause and effect, or relation to oral health, from our findings.

A recent study by Muirhead and Locker considered school performance as an indicator of existing dental needs and found that grades three and six school performance results were significant predictors of urgent dental treatment needs in York Region elementary schools (13). While this study also failed to

Table 3
Logistic Regression Model for the Likelihood of Poor School Performance (n = 2,638)

Variable	Adjusted odds ratio (95% confidence interval)
Child's gender	
Male versus female	1.86 (1.34, 2.60)
Race	
Black versus White	1.50 (1.03, 2.18)
Other versus White	1.48 (0.79, 2.77)
Parent's educational level	
High school or less versus college degree or higher	3.66 (2.35, 5.69)
Some college versus college degree or higher	1.80 (1.18, 2.75)
Hispanic	
Yes versus no	0.77 (0.38, 1.52)
Health insurance status	
Public/SCHIP/Medicaid/none versus private	1.72 (1.17, 2.53)
School type	
Public versus private/home	1.26 (0.72, 2.21)
Mental health screen	
Yes versus no	2.68 (1.58, 4.54)
Behavioral screen	
Yes versus no	3.98 (2.50, 6.34)
Learning disability	
Yes versus no	4.97 (3.10, 7.97)
School days missed	
Less than 2 weeks versus 2 weeks or more	1.35 (0.85, 2.14)
Dental and general health	
Both fair/poor dental and general health versus good/very good/excellent dental and general health	2.34 (1.07, 5.67)
Dental and general health	
Fair/poor dental and good/very good/excellent general health versus good/very good/excellent dental and general health	1.42 (0.69, 2.92)
Dental and general health	
Good/very good/excellent dental and fair/poor general health versus good/very good/excellent dental and general health	1.35 (0.85, 2.14)

establish a cause and effect relationship, it adds support to the association between dental disease and school performance.

An annual estimate for the number of school days missed because of poor oral health would be helpful, and we will recommend this as one dimension of future NC CHAMP surveys. In view of the relationship between school absence and school performance (8,9), a more definitive analysis of how poor oral health affects the school performance of NC children is also a research question that needs to be addressed.

Policy Implications. Our findings are suggestive of the impact that poor oral health has, in combination with poor general health, on lowering school performance in NC children. Our findings support that a healthy child can be expected to perform better in school and add weight to the adage that "you can't be healthy without good oral health."

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