Dental Caries: Racial and Ethnic Disparities Among North Carolina Kindergarten Students

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Objectives. We examined racial/ethnic disparities in dental caries among kindergarten students in North Carolina and the cross-level effects between students' race/ethnicity and school poverty status.

Methods. We adjusted the analysis of oral health surveillance information (2009–2010) for individual-, school-, and county-level variables. We included a cross-level interaction of student's race/ethnicity (White, Black, Hispanic) and school National School Lunch Program (NSLP) participation (< 75% vs ≥ 75% of students), which we used as a compositional school-level variable measuring poverty among families of enrolled students.

Results. Among 70 089 students in 1067 schools in 95 counties, the prevalence of dental caries was 30.4% for White, 39.0% for Black, and 51.7% for Hispanic students. The adjusted difference in caries experience between Black and White students was significantly greater in schools with NSLP participation of less than 75%.

Conclusions. Racial/ethnic oral health disparities exist among kindergarten students in North Carolina as a whole and regardless of school's poverty status. Furthermore, disparities between White and Black students are larger in nonpoor schools than in poor schools. Further studies are needed to explore causal pathways that might lead to these disparities. (*Am J Public Health.* 2015;105: 2503–2509. doi:10.2105/AJPH.2015.302884)

Disparities in access to dental health services and oral health status exist among population subgroups in the United States.[1–4] Among the most pronounced and persistent disparities in pediatric oral health are those defined by race and ethnicity.[2,3,5–8] According to the 2011–2012 National Health and Nutrition Examination Survey, 45.7% of Hispanic children aged 2 to 8 years had experienced dental caries in their primary dentitions, compared with 43.6% of non-Hispanic Black children and 30.5% of non-Hispanic White children.[5]

Although disparities in oral health are well described and have been recognized as important, the causes of racial/ethnic disparities have not been fully explained in previous research. Individual-level studies generally identify residual differences in racial/ethnic groups after control for socioeconomic status (SES) and other confounders.[4,6–9] One promising direction in understanding and resolving these disparities, particularly at the conceptual level, is the consideration of risk factors occurring at multiple levels, such as the individual child, family, community, or society as a whole.[10–13] This approach might help explain reported residual racial/ethnic disparities, and such knowledge could lead to the design of interventions that target risk factors at the appropriate levels.

Several studies have used multilevel analysis to explore the role of community-level factors in child oral health.[14–17] However, to our knowledge, only 1 study has considered determinants of racial/ethnic disparities in oral health in a pediatric population in the United States. Fisher-Owens et al.[3] used information from 2 levels (children and states) to test a conceptual model with 4 levels (child, family, neighborhood, and state). They found that state-level factors had almost no impact on racial/ethnic disparities in a global measure of self-reported oral health status. This negative finding likely resulted because their definition of community (i.e., the state) was too large a geographic area to be causally related to the outcome.

Other multilevel studies of children have also found that determinants beyond the individual level tend to be weakly associated with oral health.[15,16] Yet given the small number of multilevel dental studies of racial/ethnic disparities in children, their potential limitations in defining the higher levels, and the repeated finding of residual racial/ethnic disparities in oral health after controlling for a large number of individual factors, an exploration of higher-level determinants might lead to a better understanding of the mechanism through which racial/ethnic disparities affect oral health.

Further justification for a multilevel study of oral health disparities is provided by research on other health conditions demonstrating that determinants of disease at one level can be modified by determinants at other levels.[18–20] Only 1 study has explored cross-level interactions for predictors of child oral health. Martins et al.[16] examined the interaction between children's household income and type of school attended (public or private) on dental caries experience in primary teeth; they found no statistically significant cross-level effect. To our knowledge, no study has explored the effect of a cross-level interaction involving individual race/ethnicity and pediatric oral health outcomes in a US population.

In this study, we examine racial/ethnic differences in dental caries experience among kindergarten students in North Carolina using a multilevel analysis with 2 levels, examining individual students within schools. Our particular interest is in the variation in dental caries experience by race/ethnicity at the individual level and its cross-level interaction with a compositional school-level variable measuring poverty among families of enrolled students.

METHODS

This cross-sectional study relied on secondary data derived from multiple sources to conduct a multilevel analysis of racial and ethnic

differences in dental caries experience among kindergarten students in North Carolina.

Data Sources

Our primary data source was the North Carolina Oral Health Surveillance System, which has provided individual-level information on kindergarten students' caries experience since 1996.[21] Surveillance, which is designed to provide information on all kindergarten students in all public schools each year, has averaged about 82% coverage of the average of 106 000 students in daily attendance per year. Clinical assessments of the mouth are made by dental public health hygienists, who are trained by (1) didactic sessions in which their knowledge of protocol is evaluated by written tests followed by (2) clinical calibration sessions with a gold-standard public health dentist, in which elementary students of the targeted age are used. This training reportedly provides data of good reliability and validity for the surveillance system.[22] A number of studies have used the information resulting from this surveillance system to evaluate the effects of economic trends, public insurance policy changes, dentist visits, medical visits, and fluoride regimens on oral health outcomes.[23–29]

We used data from the 2009–2010 school year. In that year, surveillance staff secured an electronic file from the North Carolina Department of Public Instruction (NCDPI) pupil management system that contained a class roster of all students in each kindergarten class for all schools under their jurisdiction. Dental public health hygienists conducted the clinical assessments and entered counts of decayed, missing, and filled primary teeth (dmft) for each student into the NCDPI electronic files. They did not count missing incisors and canines of primary teeth in the index because of the difficulty in determining the reason for tooth loss (natural exfoliation or dental caries) in children of this age. These files also provided demographic information for each student (gender, race and ethnicity, and date of birth) and unique school codes, allowing us to link surveillance information with secondary data sources containing supplemental information about the school and county. All data sources are described in Appendix 1 (available as a supplement to the online version of this article at http://www.ajph.org).

Analytical Variables

Our response variable was the dmft index score for each screened kindergarten student in the study year, dichotomized for this study as no caries (dmft = 0) versus some caries (dmft ≥ 1).

The primary explanatory variable of interest was race/ethnicity. NCDPI collects this information for each student according to US Department of Education guidelines[30] and codes it into one of the following categories, relying primarily on information reported by parents or guardians: Hispanic of any race; American Indian or Alaska Native; Asian; Black; Native Hawaiian or Other Pacific Islander; White; or "Two or More" for individuals who are non-Hispanic. For this study, we included only children identified as non-Hispanic Black, non-Hispanic White, or Hispanic because of the small sample sizes of other groups. The NCDPI also provided a continuous measure of the proportion of students in each school who were participating in the National School Lunch Program (NSLP; dichotomized as < 75% vs ≥ 75%).

Selection of additional explanatory variables was guided by the conceptual model proposed by Fisher-Owens et al.[10] and their operationalization of variables in the model.[17] This model outlines a multilevel approach to understanding a child's oral health. We used variables measured at 3 levels: the individual, school, and county. We describe all variables considered and their levels in Appendix 1.

Because of the large number of explanatory variables identified for study and the potential for some of them to be highly correlated, we sought to reduce their number. First, we fit single-variable Poisson regression models with robust standard errors to predict caries and excluded from further consideration predictor variables for which $P > .1$. We then examined the pairwise correlation of the remaining predictor variables and eliminated one of the variables from each pair with a correlation coefficient greater than 0.70. (The results are included in Appendix 1.)

Analytic Approach

We calculated descriptive statistics for all variables by race/ethnicity, using the χ^2 test to compare proportions and analysis of variance to compare means. We also present descriptive statistics for the dmft index scores and for relevant school and county covariates aggregated by school or county.

We used 2-level robust Poisson regression models to estimate caries experience,[31,32] because 3-level models would not converge, and we observed limited variation in caries across counties. First, we estimated a 2-level random intercepts model of students (level 1) within schools (level 2; model 1: null model). We used a likelihood ratio test to test the null hypothesis that between-school variance was zero. To assess whether race/ethnicity contributed to any of the school-level variance in caries, we added the 3-group race/ethnicity variable to the null model (model 2). We added additional student-, school-, and county-level variables to understand the association between race/ethnicity and caries when we adjusted for other factors (model 3).

The final model included a cross-level interaction term with the student race/ethnicity variable and NSLP participation (model 4). We estimated Wald test statistics to determine the joint significance of the interaction term. Using the fixed effects (i.e., parameter estimates) from regression model 4,[31] we estimated covariate-adjusted overall mean probabilities of caries for an average student for combinations of child's race/ethnicity (White, Black, Hispanic) and NSLP participation (≥ 75% and < 75%). We assessed differences in predicted probabilities across groups with the Wald test and 95% confidence intervals to explore the effect of student's race/ethnicity on oral health within schools with low versus high NSLP participation.

We performed all analyses in Stata version SE 13 (StataCorp LP, College Station, TX). We calculated the intraclass correlation coefficient, a measure of the correlation between the responses of students attending the same school, using the method described by Stryhn et al.[33] For all models, we report exponentiated parameters as prevalence ratios with corresponding 95% confidence intervals. We performed all tests in Stata SE 13 using a .05 significance level.

RESULTS

The surveillance data set contained information on 82 286 kindergarten students in

1074 schools in 95 of the state's 100 counties. We excluded 4853 students (5.9% of the sample) with missing information on dmft and 66 students (< 1% of the sample) with missing information on gender. Limiting the analysis to Black, White, and Hispanic students resulted in the exclusion of 7267 students (8.8% of the sample). We also excluded 11 students in 7 schools that had fewer than 5 kindergarten students. The final analytical sample totaled 70 089 kindergarten students in 1067 schools in 95 counties. Schools had an average of 66 kindergarten students. Counties had an average of 738 kindergarten students enrolled in an average of 11.2 schools.

Descriptive statistics for the analytic sample are presented in Table 1. Students in our sample averaged 1.48 dmft per student (SD = 2.67); 36% had experienced caries (23.5% had 1–4 dmft; 12.6% had > 4 dmft). The percentage of students with 1 or more dmft differed by child's race/ethnicity at a statistically significant level, with a smaller percentage of White students having caries compared with Black or Hispanic students. The mean percentage of students with any caries varied across schools (mean = 37.5%; SD = 13.4%).

In the overall sample, 32.5% of students attended schools in which NSLP participation was 75% or higher, a figure that varied by child's racial/ethnic group. A larger percentage of Black students (56.1%) and Hispanic students (53.0%) attended schools in which NSLP participation was 75% or higher than did White students (16.1%). Students in each of the 3 racial/ethnic groups attended schools with a higher proportion of students of their own race/ethnicity than of other groups. Black children included in the study attended schools that were 65.5% minority (Black = 51.2%; Hispanic = 14.3%). White children attended schools that were 29.8% minority (Black = 20.1%; Hispanic = 9.7%).

Results for all multilevel Poisson models examining students' caries experience are presented in Table 2. In the intercept-only (i.e., null) model, the likelihood ratio test showed significant school-level variation in caries ($\chi^2 = 1071$; $df = 1$; $P < .001$). Adding individual race/ethnicity reduced the school-level variance from 0.09 in the null model to 0.07 in model 2, suggesting that this variable explains some of the difference in caries among schools. After adjustment for additional explanatory variables (model 3), Black and Hispanic students had significantly greater prevalence of caries than White students (Blacks: prevalence ratio [PR] = 1.23; 95% confidence interval [CI] = 1.19, 1.27; Hispanics: PR = 1.57; 95% CI = 1.52, 1.62).

The interaction between child's race/ethnicity and school participation in the NSLP was significant in predicting caries (model 4; Wald test statistic = 25.9; $df = 2$; $P < .001$). Figure 1

TABLE 1—Descriptive Characteristics of Analytical Sample of Kindergarten Children, Measured at Student, School, and County Levels: North Carolina, 2009–2010

Characteristic	Mean (SD) or %					
	All Students (n = 70 089)	Black (n = 18 253)	Hispanic (n = 11 202)	White (n = 40 635)	Schools (n = 1067)	Counties (n = 95)
Student-level measures						
No. of dmft	1.48 (2.67)**	1.57 (2.69)	2.40 (3.24)	1.18 (2.42)	1.56 (0.77)	1.69 (0.56)
% with caries experience (dmft > 0)	36.02**	39.02	51.66	30.36	37.52 (13.43)	39.5 (8.34)
% male	51.39*	50.44	51.04	51.90	51.49 (7.32)	51.70 (2.92)
School-level measures						
% of students participating in the NSLP	61.58 (24.82)**	74.44 (23.12)	73.42 (21.75)	52.53 (22.32)	64.80 (23.84)	
% of students in schools with ≥ 75% participation in the NSLP	32.45**	56.11	53.04	16.14	36.65	
% of students in school who were White	53.19 (28.09)**	30.88 (23.80)	37.97 (26.29)	67.40 (20.65)	52.96 (29.17)	
% of students in school who were Hispanic	13.52 (13.12)**	14.29 (13.10)	26.02 (16.94)	9.73 (9.09)	12.86 (12.57)	
% of students in school who were Black	30.23 (23.03)**	51.24 (23.23)	32.66 (19.48)	20.12 (16.30)	30.74 (24.74)	
County-level measures						
No. of dentists per 10 000 population	4.02 (1.94)**	4.24 (1.92)	4.22 (1.99)	3.87 (1.92)		3.00 (1.76)
% of children in living in poverty	22.58 (6.20)**	24.06 (7.25)	22.38 (6.17)	21.97 (5.55)		25.41 (7.66)
% of births that were low birth weight	9.23 (1.12)**	9.76 (1.34)	9.16 (1.05)	9.73 (1.3)		9.41 (1.76)
% growth rate	11.84 (10.60)**	10.66 (9.56)	12.37 (10.26)	12.24 (11.08)		9.58 (9.80)
% of counties with populations > 250 000	63.37**	57.80	68.01	64.59		35.79
% of counties with ≥ 75% individuals with fluoridated drinking water	86.71**	88.70	88.26	85.40		67.37

Note. dmft = decayed, missing, or filled primary teeth; NSLP = National School Lunch Program. We measured differences by race/ethnicity at the student level, using χ^2 tests to compare proportions and analysis of variance to compare means.
*$P < .01$; **$P < .001$.

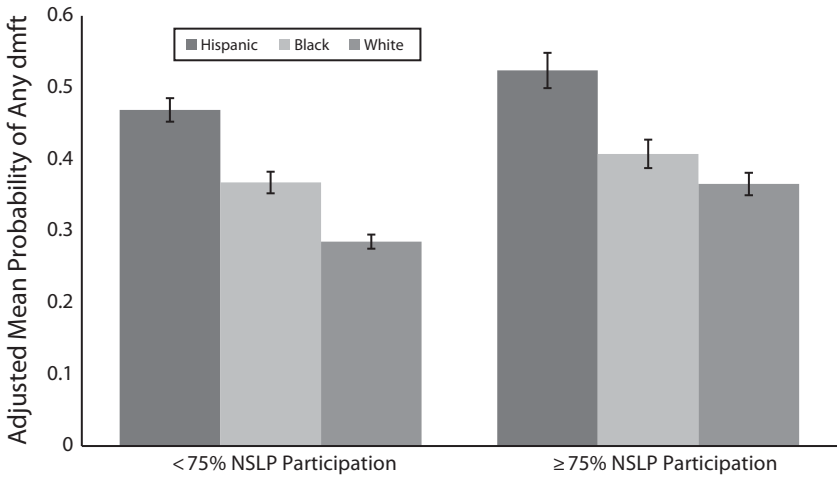
TABLE 2—Prevalence Ratios From 2-Level Robust Poisson Models Examining Caries Experience Among Kindergarten Students (n = 70 089): North Carolina, 2009–2010

Characteristic	Prevalence Ratios (95% Confidence Intervals)			
	Model 1	Model 2	Model 3	Model 4
Student-level variables				
Race/ethnicity				
White (Ref)		1.00	1.00	1.00
Black		1.26*** (1.22, 1.30)	1.23*** (1.19, 1.27)	1.29*** (1.23, 1.35)
Hispanic		1.63*** (1.58, 1.68)	1.57*** (1.52, 1.62)	1.64*** (1.58, 1.71)
Gender				
Female (Ref)			1.00	1.00
Male			1.11*** (1.08, 1.13)	1.11*** (1.08, 1.13)
School-level variables				
School participation in NSLP				
< 75% (Ref)			1.00	1.00
≥ 75%			1.18*** (1.12, 1.24)	1.28*** (1.21, 1.36)
Proportion of students who were Black			0.91 (0.81, 1.02)	0.92 (0.82, 1.03)
Proportion of students who were Hispanic			1.30** (1.09, 1.55)	1.31** (1.10, 1.56)
County-level variables				
Proportion of births that were low birth weight			0.42 (0.06, 3.18)	0.41 (0.05, 3.05)
No. of dentists per 10 000 population			0.97*** (0.96, 0.99)	0.97*** (0.96, 0.99)
Population growth rate			0.46*** (0.37, 0.58)	0.46*** (0.37, 0.58)
Proportion of children living in poverty			1.60 (1.00, 2.54)	1.62* (1.02, 2.59)
County population				
≤ 250 000 (Ref)			1.00	1.00
> 250 000			1.04 (0.99, 1.09)	1.04 (0.99, 1.10)
Population on fluoridated water system				
< 75% (Ref)			1.00	1.00
≥ 75%			0.92** (0.87, 0.97)	0.91** (0.87, 0.97)
Cross-level interactions				
Black child × school with ≥ 75% participation in NSLP				0.86*** (0.81, 0.92)
Hispanic child × school with ≥ 75% participation in NSLP				0.87*** (0.82, 0.93)
Intercept	0.35*** (0.35, 0.36)	0.30*** (0.30, 0.31)	0.32*** (0.30, 0.34)	0.31*** (0.29, 0.33)
Random effect				
School level variance (SE)	0.09 (0.01)	0.07 (0.01)	0.05 (0.01)	0.05 (0.01)
Intraclass correlation coefficient	0.013	0.008	0.004	0.004

Note. NSLP = National School Lunch Program. Caries means any number of decayed, missing, or filled primary teeth greater than zero. Models are as follows: model 1: null model; model 2: race/ethnicity; model 3: all individual-, school-, and county-level variables; model 4: all individual-, school-, and county-level variables and cross-level interaction term for student race/ethnicity and NSLP participation.
*P < .05; **P < .01; ***P < .001.

provides covariate-adjusted mean predicted probabilities of caries for this cross-level interaction between race/ethnicity and NSLP participation. Among all racial/ethnic groups, the adjusted probability of any dmft was significantly greater for students in schools in which NSLP participation was 75% or higher than in those in which it was less than 75% (difference among White students = 8.1 percentage points; P < .001; difference among Black students = 4.0 percentage points; P = .004; difference among Hispanic students = 5.5 percentage points; P = .001).

The difference between White and Black students in predicted probabilities of having any dmft was 4.1 percentage points greater in schools with lower NSLP participation (< 75%) than in schools with higher NSLP participation (≥ 75%; P < .001). Although not significant, the corresponding difference between White and Hispanic students was 2.6 percentage points greater in schools with lower NSLP participation than in those with higher participation (P < .07).



Note. dmft = decayed, missing, and filled primary teeth. Wald test indicated significant differences ($P < .001$) in predicted probability between Black and Hispanic students compared with White students for each NSLP status.

FIGURE 1—Adjusted mean probability of caries experience among kindergarten students, by race/ethnicity and school-level participation in the National School Lunch Program (NSLP): North Carolina, 2009–2010.

DISCUSSION

This study provides several insights into racial/ethnic disparities in dental caries among 5-year-old kindergarten students in North Carolina. We found large differences in dental caries among different race and ethnic groups. More than half (51.7%) of Hispanic children and 39% of Black children had been affected by caries by the time they enrolled in school, compared with 30.4% of White children. After we controlled for other variables in our multilevel regression models, Hispanic and Black children were, respectively, 1.57 and 1.23 times more likely to have experienced dental caries than White children.

We also found a cross-level effect for child-level race/ethnicity and school-level poverty status as measured by NSLP participation. Caries experience for each racial/ethnic group was affected by school-level poverty status at a statistically significant level. Caries among Black and Hispanic children was higher than among White children, regardless of the poverty status of the school. Furthermore, this difference in caries effect by child-level race/ethnicity and school-level poverty magnified the disparity between Black and White students in schools with lower NSLP participation. Although statistically significant, the absolute difference in caries experience between Black and White students in nonpoor schools was small (4.2 percentage points), but still worthy of consideration in program planning because of the population sizes involved.

The NSLP status variable used in this study was a compositional variable constructed from students in all grades attending the school. We believe that this variable, along with school-level race/ethnicity, can be considered as surrogate measures of neighborhood composition. In an analysis of a subset of schools (detailed in Appendix 2, available as a supplement to the online version of this article at http://www.ajph.org), we found that the proportion of each of the 3 different racial/ethnic groups in schools was strongly correlated with the proportion of that racial/ethnic group in the school attendance boundary (correlation coefficient = 0.90 for Black students, 0.91 for Whites, 0.92 for Hispanics), as was the proportion of students participating in the NSLP program (correlation coefficient = 0.66 for Blacks, –0.72 for Whites, 0.54 for Hispanics). The strength of these associations suggests that school compositional variables can be used to represent neighborhood characteristics, thus providing data for smaller geographic areas in multilevel studies of school-children. Further research is need to determine whether these school boundary census data can be used to study compositional and perhaps even contextual effects on oral health in multilevel models constructed from information on school-children.

An individual's SES is commonly reported to be an important confounder of racial/ethnic disparities in child oral health.[3,4,6,7] We found that our presumed community-level measure of SES (i.e., school NSLP status) also affects disparities, especially between White and Black students. Family and community levels of SES can affect a child's oral health both directly and indirectly.[10] For example, a low-SES family is more likely to eat unhealthy foods, choose unhealthy behaviors, and have low health literacy than other SES groups, all of which can affect oral health status. Families living in low-SES communities are less likely to have access to healthy foods and a quality dental care system, in part, for example, because fewer dentists might be located in their neighborhoods and transportation resources might be lacking.[10,34,35]

As in previous studies, we found residual racial/ethnic disparities at the individual level after adjusting for the effect of confounders at all levels. A large number of malleable individual- and community-level factors that we did not measure in this study might help to further explain oral health differences among racial groups.[36,37] Studies suggest that causal models of racial and ethnic disparities in oral health must include multiple variables at multiple levels.[38,39]

School-based preventive dentistry programs usually target high-risk schools, identified by NSLP participation rates.[40] In this study, we observed racial/ethnic disparities in caries regardless of school NSLP participation, but a significantly greater disparity between Black and White students was observed in schools with lower NSLP participation. Public health strategies to reduce oral health disparities need to consider approaches that can reach high-risk students in low-risk schools who usually do not benefit from most school-based oral health intervention because their schools are not targeted. The most efficient approach will likely require community-based methods with common school-level strategies. We found (model 3) that number of dentists and access to community water fluoridation affect the oral health status of children. Community water fluoridation will reach all children in the community regardless of their SES. Continuing to ensure that all community drinking water is

fluoridated and consumed is important, not only for improving oral health of the entire community but also for potentially helping to resolve disparities.[41,42] Strategies to ensure access to preventive dental care and to promote its use among very young, high-risk children living in low-risk communities might also help reduce disparities.

Increasing racial and economic segregation in public schools has been identified as a national concern.[43,44] We found that the majority of Black and White students attended schools with a high proportion of their own race and that Black students were more likely to attend low-income schools. The effects of this trend on oral health need further study. In our investigation, we mostly measured the lifetime effects of exposure to risk factors for poor oral health that occurred before the children started public school at 5 years of age. In addition to the compositional effects included in this study, the contextual effects of schools on children and their oral health after years of school enrollment need to be studied.

Limitations

A primary limitation of this study is that school surveillance data provided us with only 2 individual-level explanatory variables (race/ethnicity and gender). The effects of SES at the school level may be from residual confounding at the individual level. Other studies report that individual-level variables tend to be more influential on a child's oral health status than variables from higher levels of aggregation.[15,16] This weakness limited our ability to explore more precise mechanisms of racial/ethnic disparities at the community level. An additional weakness of our study is its cross-sectional design. The associations observed between explanatory variables and oral health outcomes might not be causal. Finally, operationalization of the conceptual model on which we based our study, and thus variables we chose to include and explore in this study, might omit some important determinants of oral health status for children in North Carolina.[3]

Strengths

Most studies of racial/ethnic disparities in child oral health status have used parent-reported perceptions as outcomes rather than clinically determined status.[3,4,6–9] Studies comparing a child's parent-perceived need with actual clinically determined need find that these associations are of only moderate strength and can be affected by the child's age.[45–47] Because we used clinical data, we add an additional perspective on oral health outcomes to the literature.

The oral health surveillance system included a majority of students in public schools during their first year of school enrollment, in a state with a large and rapidly growing population. The analytical sample thus represents a large and diverse group of 5-year-old children, and reflects the growing minority population in the state and country. Because students were in their first year of school, their oral health status largely reflects preschool family and neighborhood influences rather than school experiences. We confirmed in a separate analysis a strong correlation between the race/ethnicity of students attending schools and census information on the race/ethnicity of children within the school boundaries used for enrollment. We also observed strong correlations between race/ethnicity within school boundaries and the proportion of students participating in the NSLP. Our study might offer an advantage over other studies that used data aggregated over a larger geographic area than we used because school-level variables are highly correlated with neighborhood characteristics of school attendance boundaries.

Conclusions

We found large racial/ethnic oral health disparities among kindergarten students in North Carolina. Caries experience is worse among Black and Hispanic students than White students. We also found that racial/ethnic disparities in oral health exist regardless of school poverty status, and that the gap between Black and White students was even greater in nonpoor schools than in poor schools. The cross-sectional design of the study did not permit detailed exploration of causal pathways that might lead to these disparities. However, the results of this study can help design public health interventions for further testing and guide work toward helping to reduce racial/ethnic oral health disparities. ■

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Contributors

G. Matsuo designed the study, collected the secondary data, drafted the article, and oversaw revisions. R. G. Rozier contributed to the conceptualization and design of the study and oversaw all aspects of study implementation. A. M. Kranz designed and conducted the statistical analysis and developed formats for data presentation. All authors were involved in interpretation of the data, contributed to drafting and revising the article content, and approved the final article.

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Human Participant Protection

This study was determined by the North Carolina Division of Public Health Institutional Review Board for the Health and Safety of Human Subjects to be exempt from full board review.

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