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Relationship between caregiver's and child's caries prevalence among disadvantaged African Americans

S. Reisine[1], M. Tellez[2], J. Willem[3], W. Sohn[4] and A. Ismail[4]

[1]Department of Oral Health and Diagnostic Science, Division of Behavioral Sciences, University of Connecticut School of Dental Medicine, Farmington, CT, USA, [2]School of Dentistry – Research Unit UNICA-B, Universidad El Bosque, Bogota, Colombia, [3]School of Dentistry, University of Michigan, Ann Arbor, MI, USA, [4]Department of Cariology, Restorative Sciences and Endodontics, Ann Arbor, MI, USA

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Abstract – *Objective:* To assess the relationship between African-American caregivers' and children's caries levels adjusting for sociodemographic factors. *Methods:* A representative sample of 1021 children (0–5 years) and their caregivers were recruited using a stratified two-stage area probability sample of households in Detroit. The response rate was 73.7%. Caries was measured using the International Caries Detection and Assessment System. Caries was defined as D1S/d1s (noncavitated) or D2S/d2s (cavitated lesions) for both caregivers and children. Sociodemographic data included caregivers' employment status, sex, age, income and education. Negative binomial regression techniques were used for the multivariable analyses because of the highly skewed distribution of caries among the children. *Results:* 48% of the children were male, 39% had employed caregivers, 46% had caregivers with less than a high school education and 44% had family incomes less than $10 000. A total of 47% of the children had at least one noncavitated lesion and 31% had a cavitated lesion. Younger children (ages 0–3 years) had lower caries rates with 24% having one or more noncavitated lesion,18% having a cavitated lesion and 31% with any lesion compared with 78%, 51% and 81%, respectively, among the 4- to 5-year olds. Because of these differences in prevalence in the age groups, subsequent analyses were conducted separately for the two age groups. Multivariable analyses found that the number of cavitated surfaces among the caregivers was significantly related to the number of cavitated and noncavitated lesions among their children for both age groups. The prevalence of children's caries increased with increasing caregivers' caries score when demographic characteristics of caregivers were controlled. Younger children with family incomes of less than $10 000 had a significantly increased risk of higher caries prevalence compared with children in families with incomes greater than or equal to $20 000. *Conclusions:* Caregivers' caries levels were modestly correlated with children's caries. However, higher caries prevalence among caregivers significantly increased the risk of caries prevalence among their children. Thus, efforts aimed at improving caregiver's oral health could result in reducing caries risk among their children, regardless of whether the mechanism was biologically or behaviorally based. Efforts also should be aimed directly at reducing caries risk among children by increasing fluoride exposure among children and improving access to preventive dental care. Finally, even the poorest of the poor experienced additional health disadvantages associated with income suggesting even small increases in family income raising families could have a significant effect on reducing caries risk among young children.

Key words: African-American; caries; health disparities; oral health

Dr Susan Reisine, 263 Farmington Ave, Farmington, CT 06030-3910, USA
Tel: +1 860 679 3823
Fax: +1 860 679 1342
e-mail: reisine@nso1.uchc.edu

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Many studies have examined the association between caregivers' characteristics and their children's risk of dental caries. These include caregivers' perceptions about ability to care for children's teeth, caregivers' oral health behaviors and demographic factors (1–20). Caregivers' oral flora and transmission of bacteria to their children have also been the subject of several studies on caries risk as children who are colonized at an early age with mutans streptococci have an increased risk of caries (21–25). Transmission usually occurs from mother to child during feeding and nurturing. Although high mutans levels are associated with untreated caries and we would expect high caries levels among caregivers to be associated with increased caries risk among children, few studies have actually assessed the clinical oral health status of caregivers and its relationship to their children's caries levels.

Ringelberg (26) conducted an early study of caries experience of three generations with a sample of 427 participants in Maryland. The sample consisted of 90 index participants from a previous study on familial aggregation of dental caries (27–29), 79 spouses, 211 children and 47 grandparents. Caries experience in permanent tooth surfaces was estimated using the number of Decayed, Missing, and Filled Surfaces (DMFS) index (26). He found that parents' caries status, particularly mothers' status, was significantly related to the caries status of children. The parents' childhood status was unrelated as was the grandparents' caries status. Grytten et al. (30) investigated mother's behaviors and clinical oral health status and their association with subsequent caries among young children in a sample of 231 parent–child pairs in Norway. Data on use of fluoride, sugar intake and brushing for children was collected at 6, 18 and 36 months of age. The number of DMFS was assessed at 36 months. Mothers completed interviews on their education and dental visits at the children's birth and mothers' posterior bitewing radiographs provided data on missing teeth. The number of missing teeth in the mothers was the only significant variable related to the subsequent development of caries in their children when other factors were adjusted for. Bedos et al. (31) recently investigated the relationship between mothers' edentulousness and their children's caries levels among 6303 mother–child pairs. Children were 5–9 years old in Quebec, Canada. They found that children of edentulous mothers were significantly more likely to have caries in primary and permanent teeth.

These few studies suggest that the clinical oral health status of parents and caregivers are a significant factor in increased risk of caries among their children. However, these studies have taken place outside of the USA where cultural norms about child-rearing differ from those in the USA and both Norway and Canada have very different dental healthcare delivery systems for children that could influence these relationships. Furthermore, aside from these studies, relatively little is known about the relationship between caregiver and child's clinical oral health status, especially among young African-American children.

This analysis is part of a larger study, conducted by the Detroit Center for Research on Oral Health Disparities, of a cohort of low-income African-American caregivers and their children to identify risk factors for dental caries and to plan interventions to reduce disparities. Previous reports from the research project also have demonstrated significant relationships between caregivers' beliefs and attitudes and the prevalence of their children's caries levels (32). Researchers at the Detroit Center have found, that being older, employed, having positive emotional support, lower sugar intake, accessible dental care, good oral hygiene and good perceived oral health was associated with fewer decayed surfaces among caregivers (33–35). The purpose of this analysis was to describe caries prevalence defined as cavitated and noncavitated surfaces among caregivers and to assess the relationship between caregivers' and children's caries levels adjusting for sociodemographic factors. We hypothesized that the risk of caries among children would increase with increasing caries among caregivers.

Methods

Sample

This study was part of the Detroit Center for Research on Oral Health Disparities, known as the Detroit Dental Health Project, funded by the National Institute of Dental and Craniofacial Research (NIDCR). A two-stage area probability sample was used to select a representative sample of low-income African-American children in the city of Detroit. Our target sample size was 1000 children. The sample size was estimated based on precision requirements for four different projects collecting data from target children and their caregivers and anticipated attrition in the sample cohort over the 4-year study period.

The 2000 Census public use data were used to identify Census tracts with the largest proportions of households with low-income African-American children. Census tracts were selected based on the percent of households below 200% of the poverty level, the percent of households with African Americans, and the percent of households with children under 6 years of age.

A two-stage area probability sample of households and target children was selected from 39 Census tracts. First, a total of 1526 blocks in the tracts were downloaded from Census files in order by tract and block number. Census 2000 counts of households by block were cumulated and a probability proportionate to size selection used to select blocks for listing. A total of 118 blocks were selected. For field data collection efficiency reasons, blocks with fewer than 100 households were linked to other blocks to form units of a minimum size of 100 households. The linking process resulted in 594 blocks linked to form 118 sample segments.

The second stage required a list of households in each segment. A team of community residents were trained to list all addresses in each segment. A total of 14 391 housing units were listed, and 12 655 of the housing units were subsampled from the 118 sample segments using a systematic probability proportionate to size selection method. Trained interviewers visited each sampled housing unit to screen its residents for eligibility. A total of 10 695 sample housing units were occupied (84.5% occupancy rate); 9781 were contacted and screened (91.5% contact rate); and 1386 (14.2%) had an eligible African-American child under 6 years of age. When there was more than one eligible child in a household, only one child was randomly selected to be 'index child' using predetermined random number. The primary caregiver was defined as the person who has permanent decision-making authority about what the index child eats, how to take care of the index child's mouth and teeth and when the index child visits the doctor or dentist, excluding those in a 'babysitting' capacity for the index child.

Of the 1386 families with eligible children, 1021 completed the baseline study. The combined screening and interviewing response rate was 73.7%.

Procedure

Participants came to a central location in Detroit in the African-American community where they completed interviewer-administered questionnaires and had an oral health examination. Data were collected on sociodemographic characteristics, food frequency and several oral health parameters, including caries, missing teeth, oral hygiene, periodontal measures and edentulism. Participants were at the Detroit Center for approximately 4 h to complete all portions of the study.

Measures

Dental caries

Dental caries was defined by the International Caries Detection and Assessment System (ICDAS) (36). The impetus for developing ICDAS was based on the 2002 International Consensus Workshop on Caries Clinical Trials recommendation for the need to detect dental caries at the noncavitated stages. Thus, the IDCAS system is a two-step process. First, the dental examiners determined whether a clean and dry tooth surface is sound, sealed, restored, crowned or missing. Then the examiners classified the carious status of each tooth surface using a seven-point ordinal scale ranging from sound to extensive cavitation. It was designed to detect six stages of the carious process, ranging from the early clinically visible changes in enamel caused by carious demineralization to extensive cavitation. For the purposes of this study, surfaces for children and caregivers were defined as sound (no evidence of caries), noncavitated lesions or fully cavitated lesions. Three measures were analyzed: total number of lesions, number of noncavitated lesions and number of cavitated lesions for both children and caregivers. Total number of both cavitated and noncavitated lesions were designated as dts for children and DTS for caregivers. Number of noncavitated lesions and cavitated lesions were analyzed separately, as well, for children and caregivers and were defined as d1s and d2s, respectively, for children and D1S and D2S for caregivers.

There were six examiners but two examiners conducted 77% of all examinations. Examiners had an agreement rate of greater than 80% and an inter-rater kappa of 0.83; and intra-rater kappa of 0.74. More details regarding reliability of dental examiners have been reported separately (37).

Demographic characteristics

Demographic characteristics include age and sex of the child and caregiver, family income and caregiver's education and employment status. Age and sex were ascertained during the screening and selection of the index child. Years of education

completed also were collected during the screening. Education was grouped into three categories for the analysis as less than high school, high school and greater than or equal to some college.

Data on family income and employment status were obtained during the interviewer administered questionnaire. The questionnaire was extensively evaluated for cultural acceptance, understanding and feasibility before being administered in the field. Focus groups with people from the community as well as community leaders were conducted and the questionnaires were pilot-tested with individuals from the community. For family income, caregivers were asked to select one of nine categories that 'best represents your family's total income over the past 12 months'. The income categories ranged from 'less than $10 000' to '$80 000 and higher'. Income was grouped into three categories for the analysis: less than $10 000, $10 000–19 999 and $20 000 and higher because of the skewed distribution of the responses. Employment status was assessed by one item with five response categories: employed full-time outside the home; employed part-time outside the home; working full-time in your home and generating income; working part-time in your home and generating income; working at home to take care of the family. If caregivers selected any one of the first four responses, they were classified as employed. No reliability data on the demographic characteristics were collected.

Analysis

Data were analyzed using SAS (Version 9) and IVEware, a SAS-callable software application that accounts for complex sample design features such as stratification, clustering and weighting (38). Weights were developed to adjust for the differential nonresponse and unequal probabilities of selection. The analysis began with the description of the sample, including the age distribution and caries status of children, the caries status of caregivers and demographic characteristics of the sample. This was followed by an analysis of the bivariate relationships between demographic characteristics and child's caries status and then the bivariate correlations between caregiver's and child's caries status. As the variables represented counts of surfaces with significant dispersion (the variance of the count was larger than the mean), the negative binomial regression model was estimated (39, 40) (using IVEware) to correlate the caries experiences of the children with their caregivers accounting for socioeconomic factors. The coefficients of the negative binomial regression models were used to estimate the prevalence ratio (PR) which is defined as the estimated increase in rates or proportion of individuals with carious lesions in the exposed group relative to the unexposed group.

Results

Demographic characteristics

Table 1 presents the demographic characteristics of the sample and caries prevalence for children and caregivers. This table provides data on the combined sample and separately for children ages 0–3 and 4–5 years. Only children and caregivers with at least one tooth were included in the analysis with a total of 921 caregiver–child pairs. About half the children were male, about one-third of the caregivers were employed, about half had completed high school or more and participants had very low family incomes, as was the intention of the sampling strategy. Ninety-five percent of the caregivers were female and the average age was 29 years. There were no significant differences between the younger and older children on sex or caregiver characteristics.

Caries prevalence

Table 1 also presents a description of the caries status for children and their caregivers. The prevalence of caries was high in this sample of children with about half the children having a lesion on one or more tooth surface, and 31% having a cavitated lesion. Thirty-one percent of the younger children had either a cavitated or noncavitated lesion; 26% had one or more noncavitated surfaces and 18% had one or more cavitated surfaces. In contrast to the younger children, caries was almost universally present among the older children with 81% of the 4- to 5-year olds having had either a cavitated or noncavitated lesion; 78% had at least one noncavitated lesion and 51% had one or more cavitated lesions. Because the prevalence of caries was markedly higher among the 4- to 5-year olds, further analyses were conducted separately for these two age groups.

The prevalence of caries among the caregivers was equally high. Almost all of the caregivers had noncavitated lesions (99%) and the vast majority, 86%, had at least one cavitated lesion.

Table 1. Demographic characteristics and caries status of caregivers and children 0–3 and 4–5 years old

	Total (n = 921)	0- to 3-year olds (n = 583)	4- to 5-year olds (n = 338)
Child sex (%)			
Male	48	49	46
Caregiver employment (%)			
Employed	39	38	40
Caregiver sex (%)			
Female	95	94	97
Mean caregiver age (years)	29	28	31
Caregiver education			
<High school	46	46	48
High school	31	33	28
≥Some college	22	21	24
Family income (%)			
<$10 000	44	43	47
$10 000–19 999	27	29	24
≥$20 000	28	28	29
Caries status – child (%)			
Noncavitated (d1s)	47	26	78
Cavitated (d2s)	31	18	51
Any surfaces (dt)	51	31	81
Caries status – caregiver (%)			
Noncavitated (D1s)	99	99	99
Cavitated (D2s)	86	85	86
Any surfaces (DTS)	99	99	99

Demographic characteristics and caries prevalence

Table 2 presents the bivariate analysis of the demographic characteristics and mean caries levels for the children. Children ages 0–3 years had about two surfaces overall with either a cavitated or noncavitated lesion (dts), with an average of one surface with a noncavitated lesion (d1s) and about one surface with a cavitated lesion (d2s). The only significant factor in this sample was family income – children in families with lower incomes had higher prevalence of surfaces for total surfaces and for cavitated lesions. Children in the highest income group had about half the total number of surfaces and half the cavitated surfaces compared with the other two income groups. However, family income was not related to noncavitated lesions.

Table 2. Demographic characteristics and mean dts, d1s and d2s (±SE), children ages 0–3 and 4–5 years

	Children ages 0–3 years			Children ages 4–5 years		
	Mean dts ± SE	Mean d1s ± SE	Mean d2s ± SE	Mean dts ± SE	Mean d1s ± SE	Mean d2s ± SE
Child sex						
Male	2.4 ± 0.3	1.3 ± 0.2	1.2 ± 0.3	8.5 ± 1.3	3.6 ± 0.3	4.9 ± 1.0
Female	2.1 ± 0.4	1.0 ± 0.1	1.2 ± 0.3	7.7 ± 0.6	4.6 ± 0.3	3.1 ± 0.4
CG employment						
Employed	2.0 ± 0.3	1.0 ± 0.2	1.1 ± 0.2	6.3 ± 0.7[a]	3.4 ± 0.3[b]	2.9 ± 0.6[b]
Not employed	2.5 ± 0.4	1.3 ± 0.1	1.2 ± 0.3	9.2 ± 0.8	4.5 ± 0.3	4.7 ± 0.7
CG education						
<High school	2.3 ± 0.5	1.2 ± 0.2	1.1 ± 0.3	9.0 ± 0.9	4.0 ± 0.3	5.0 ± 0.8[a]
High school	2.4 ± 0.3	1.2 ± 0.2	1.2 ± 0.3	6.3 ± 0.8	4.0 ± 0.5	2.3 ± 0.4[a]
≥Some college	2.0 ± 0.4	1.0 ± 0.2	1.1 ± 0.3	8.5 ± 2.4	4.3 ± 0.8	4.2 ± 1.7
Family income						
<$10 000	2.7 ± 0.5[b]	1.3 ± 0.2	1.3 ± 0.4	9.0 ± 0.7	4.3 ± 0.2	4.7 ± 0.7
$10 000–19 999	2.5 ± 0.3[b]	1.1 ± 0.1	1.5 ± 0.3[a]	7.9 ± 0.8	4.1 ± 0.3	3.8 ± 0.7
≥$20 000	1.4 ± 0.2[b]	1.0 ± 0.1	0.6 ± 0.2[a]	6.9 ± 1.4	3.7 ± 0.6	3.2 ± 1.0

[a]Values are significantly different from each other at a level of $P < 0.01$.
[b]Values are significantly different from each other at a level of $P < 0.05$.

Table 2 also presents the bivariate analysis of the demographic characteristics and mean caries levels for children ages 4–6 years. Children in this age group had many more carious surfaces than the younger children. On average, they had about eight surfaces with either a cavitated or noncavitated lesion with four noncavitated surfaces and about four surfaces with cavitated lesions. Employment, education and family income were significantly related to caries prevalence. Children in families with an employed caregiver and higher incomes had a lower prevalence of caries for both the cavitated and noncavitated lesions. Additionally, children with caregivers who had at least a high school diploma had a lower prevalence of cavitated lesions. Children in households with employed caregivers had about half the number of carious surfaces compared with children in families where the caregiver was not employed.

Bivariate correlations between caregiver's and child's caries

Bivariate Pearson's correlations between the number of carious surfaces in the caregivers (D1S and D2S) and the number of carious surfaces (d1s and d2s) in the children in each age group were calculated (data not shown). The relationship between the prevalence of the caregiver's and child's carious surfaces was positive but the only significant coefficient was the relationship between the number of cavitated surfaces of the caregivers of the 0- to 3-year olds and their cavitated ($r = 0.13$; $P < 0.01$) and noncavitated lesions ($r = 0.11$; $P < 0.01$). For the 4- to 5-year olds, the only significant coefficient was the relationship between the number of cavitated surfaces of the caregivers and their child's cavitated lesions ($r = 0.24$; $P < 0.001$).

Multivariable analyses

The next two tables present the results of the multivariable models for the total number of cavitated and noncavitated surfaces (DTS and dts). Negative binomial regression techniques were used to account for the skewed distribution of decayed surfaces among the children. Table 3 shows the results of a hierarchical model of the total noncavitated and cavitated surfaces of 0- to 3-year olds (dts) with the total noncavitated and cavitated surfaces for the caregivers (DTS) entered on the first step followed by family income, caregiver's education, employment status then caregiver age and sex. At the final step, the prevalence of children's carious lesions, which was measured in dts score, increased with increasing caregiver's caries score when education, income, employment status, age and sex of caregivers were controlled (PR = 1.02; CI: 1.00–1.03; $P < 0.001$).

Additionally, family income was significantly related to increased risk of carious lesions among the 0- to 3-year olds. Those in the families with the lowest incomes had an increased risk of having more carious lesions compared with those in families in the highest income category

Table 3. Negative Binomial Regression Model with the children's total carious lesions (dts) as the dependent measure and the total number of carious lesions of the caregiver (DTS) as independent measure, adjusting for demographic characteristics (0–3 year olds)

	Model1, PR (95% CI)	Model 2, PR (95% CI)	Model 3, PR (95% CI)	Model 4, PR (95% CI)	Model 5, PR (95% CI)
DTS	1.02 (1.00–1.03)***	1.02 (1.00–1.03)**	1.02 (1.00–1.03)**	1.02 (1.00–1.03)***	1.02 (1.01–1.03)***
Family income					
<$10 000		1.82 (0.95–3.51)	1.80 (0.87–3.69)	1.71 (0.79–3.69)	1.77 (1.01–3.11)*
$10 000–19 999		1.64 (0.98–2.76)[a]	1.58 (0.95–2.61)	1.55 (0.93–2.58)	1.55 (0.97–2.49)
≥$20 000		1	1	1	1
Caregiver education					
<High school			1.00 (0.55–1.83)	0.99 (0.55–1.77)	1.00 (0.54–1.85)
High school			1.24 (0.59–2.59)	1.25 (0.60–2.61)	1.23 (0.62–2.45)
≥Some college			1	1	1
Caregiver employment					
Employed				0.88 (0.57–1.37)	0.91 (0.63–1.31)
Not employed				1	1
Caregiver age					1.04 (1.01–1.07)*
Caregiver sex					
Male					1.90 (0.85–4.22)
Female					1

PR, prevalence ratios. ***$P < 0.001$; **$P < 0.01$; *$P < 0.05$;
[a]Approaches significance ($P = 0.05039$).

(PR = 1.77; CI: 1.01–3.11; $P < 0.05$). Caregivers' age also was significantly related to caries prevalence among their children. Older caregivers had children with an increased risk of caries prevalence (PR = 1.04; CI: 1.01–1.07; $P < 0.05$).

Analysis of the noncavitated lesions among 0- to 3-year olds and their caregivers (data not shown) found that the prevalence of children's noncavitated lesions increased with increasing caregiver's caries score when education, income, employment status, age and sex of caregivers were controlled (PR = 1.03; CI: 1.00–1.05; $P < 0.01$). Family income was no longer significant in this model, but caregivers' age remained significantly related to risk of increased prevalence among their children. Older caregivers had children with an increased risk of prevalence of noncavitated lesions (PR = 1.04; CI: 1.02–1.07; $P < 0.01$). Finally, analysis of cavitated lesions (data not shown) found that none of the caregiver factors were significantly related to increased risk of caries prevalence among their children.

Table 4 presents the analysis of total number of carious lesions for children ages 4–5 years. Similar to the 0- to 3-year olds , total number of lesions in the caregiver was significantly related to the number of lesions in their children: as the caregivers' caries scores increased, the prevalence of carious lesions among the children increased (PR = 1.01; CI: 1.00–1.02; $P < 0.01$). None of the other caregiver characteristics were significantly related to increased caries prevalence among their children.

In the analysis of the number of noncavitated lesions for the 4- to 5-year olds (not shown), the caregivers caries scores remained significantly related to the prevalence of noncavitated surfaces among the children with a PR of 1.01 (CI: 1.00–1.02; $P < 0.05$) indicating that an increase in caregivers' caries score was associated with a significant increase in the prevalence of cavitated lesions in their child's caries score. Likewise for cavitated lesions, the caregivers caries scores remained significantly related to the prevalence of noncavitated surfaces among their children when adjusted for other factors (PR = 1.02; CI: 1.00–1.04; $P < 0.05$). Additionally, children with female caregivers had a higher prevalence of cavitated lesions (PR = 2.18; CI: 1.21–3.92; $P < 0.05$).

Discussion

The results showed a fairly high prevalence of dental caries among both caregivers and their children. The vast majority of 4- to 5-year olds, 78%, had a surface with noncavitated lesions and half of the children had an untreated cavitated lesion with a total of 81% of the children having had a cavitated or noncavitated lesion. Children under the age of 4 years had fewer carious surfaces, but nearly one-fifth of these very young children had at least one cavitated lesion, 26% had at least one tooth surface with a noncavitated lesion and 31% had either a cavitated or

Table 4. Negative Binomial Regression Model with the children's total carious lesions (dt) as the dependent measure and the total number of carious lesions of the caregiver (DTS) as independent measure, adjusting for demographic characteristics (4–5 year olds)

	Model1, PR (95% CI)	Model 2, PR (95% CI)	Model 3, PR (95% CI)	Model 4, PR (95% CI)	Model 5, PR (95% CI)
DTS	1.01 (1.00–1.02)***	1.01 (1.00–1.02)***	1.01 (1.00–1.02)***	1.01 (1.00–1.02)**	1.01 (1.00–1.02)*
Family income					
<$10 000		1.20 (0.74–1.95)	1.29 (0.90–1.84)	1.22 (0.84–1.76)	1.23 (0.87–1.75)
$10 000–19 999		1.02 (0.54–1.91)	1.08 (0.63–1.85)	1.04 (0.61–1.76)	1.07 (0.75–1.55)
≥$20 000		1	1	1	1
Caregiver education					
<High school			0.92 (0.52–1.61)	0.91 (0.53–1.57)	0.95 (0.54–1.66)
High school			0.65 (0.34–1.25)	0.66 (0.36–1.22)	0.67 (0.37–1.22)
≥Some college			1	1	1
Caregiver employment					
Employed				0.77 (0.53–1.11)	0.80 (0.60–1.06)
Not employed				1	1
Caregiver age					1.01 (1.00–1.03)
Caregiver sex					
Female					1.14 (0.86–1.50)
Male					1

PR, prevalence ratios. *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

noncavitated lesion. Furthermore, more than half of the 4- to 5-year-old children had a cavitated lesion. This prevalence was higher than that reported in NHANES 1999–2002 which found that 19.5% of 2- to 5-year olds, a slightly older group of children, had untreated caries. The NHANES study used the NIDCR criteria for caries detection (41) which most likely combines ICDAS Codes 2–6 into the definition of decayed. Although not identical, the children in the Detroit study have considerably higher prevalence and severity of dental caries than children in the USA who were examined in 1999–2002 NHANES. However, the Detroit study has also found that noncavitated carious lesions are more prevalent than cavitated lesions.

The prevalence of caries in this sample was similar to that found among children in Head Start programs where the prevalence of cavitated lesions ranged from 38% (42) to 55% (43). One study that assessed noncavitated lesions reported that 71% of 5-year old children in Head Start in Florida had one or more noncavitated lesions (44). These findings for Head Start children illustrate the increased risk of caries among disadvantaged children in the USA and more closely paralleled the experience of the children in the Detroit sample compared with children in the general populations.

The NHANES 1999–2002 reported similar data on the number of decayed surfaces, in that there were 1.15 (SE 0.2) decayed surfaces among the 2- to 5-year olds in the USA. The mean number of cavitated lesions among the children in the Detroit sample was considerably higher and ranged from 1.1 (SE 0.03) for the 0- to 3-year olds to 4.9 (SE 1.1) for the 4- to 5-year olds .

Children in the Detroit study were in considerable need of treatment to restore cavitated lesions. Untreated decay and referral for care was of high priority to prevent more serious complications and infections associated with untreated lesions. Of equal concern was the high level of noncavitated lesions that were at risk of progressing to fully cavitated lesions. A critical need for these children is to provide effective preventive treatment from professionals as well as caregivers to retard the progression of noncavitated lesions from becoming fully cavitated carious lesions and avoid their sequelae.

The relationships between caregiver's perceptions and oral health behaviors and their children's oral health have been well studied, even in this sample. The data on the oral health of caregivers and its relationship to their children's oral health had not been analyzed. Caregivers' caries levels were very high with virtually all participants having had at least one surface with a noncavitated lesion and more than 80% having had at least one surface with a cavitated lesion. This is twice the prevalence of untreated decay among African-American adults in the NHANES 1999–2002 study which reported that 41.3% of Black, non-Hispanics had untreated tooth decay (41). The prevalence of caries among the Detroit caregivers also greatly exceeded the experience of adults in the USA who had incomes below the poverty level. Forty-one percent of adults at or below the federal poverty level had one or more untreated carious lesion (41).

Caregivers' caries levels were modestly correlated with children's caries at the bivariate level and remained significantly related when adjusted for other factors. This finding, while not surprising, suggested that behavioral and biological factors contributed to the correlations between caregiver–child pairs, with higher caries among older children because of longer exposure to bacterial transmission, cariogenic diets, oral hygiene behaviors and lack of dental treatment. The model indicated a significant increased risk of caries for the child with increases in the number of carious surfaces in the caregiver. Although the bivariate associations and the increased PRs in the multivariable model were fairly modest, the results indicated that efforts aimed at improving caregiver's oral health could result in significant reductions in caries risk among their children, regardless of whether the mechanism was biologically or behaviorally based.

Caregivers' education and employment status were significantly related to their children's caries prevalence and severity at the bivariate level. It was noteworthy that these variables did not reach significance in the multivariable analyses when caregivers' caries status was included in the model for the 4- to 5-year olds. This finding suggested that caries risk in children was most directly related to caries prevalence in caregivers and that the effects of employment and education on caries risk for children living in poverty is through caregivers' caries status. This finding further reinforced the importance of improving caregivers' oral health as a first and necessary step in reducing caries risk among their children. This, of course, is not to say that proven strategies to improve children's oral health and prevent new carious lesions and progression of noncavitated lesions should not be prioritized. Such strategies would include increasing

exposure to fluoride either applied professionally or by caregivers, improving access to dental care for children to restore untreated lesions and changing children's diet to reduce the intake of sugar.

Finally, among the younger age group, family income was a significant factor contributing to the prevalence of carious surfaces. The findings indicate that even among economically disadvantaged groups, socioeconomic status had a significant additional effect on the risk of caries prevalence. Causes of the additional effects of low income among the most disadvantaged groups with family incomes below $10 000 should be investigated further to identify the underlying behavioral mechanisms responsible for these effects. Even the poorest of the poor experience additional health disadvantages associated with lower incomes suggesting even small increases in family income raising families above the Federal poverty level could have a significant effect on reducing caries (and other health) risk among young children.

This study has several strengths. It is a large representative sample of African-American children and their caregivers – a group that has been understudied. The results provide reliable estimates of the caries levels of highly disadvantaged children and their caregivers in the city of Detroit. A limitation is that these results may not be generalizable to other groups, although the results provide evidence of a significant relationship between caregivers' caries levels and that of their children. A further limitation of the study is the cross-sectional nature of the design. These results demonstrated associations rather than causality and should be viewed cautiously.

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