Community Dent Oral Epidemiol 2007; 35: 439–448

COMMUNITY DENTISTRY AND ORAL EPIDEMIOLOGY

Psychosocial factors and early childhood caries among low-income African–American children in Detroit

Tracy L. Finlayson[1], Kristine Siefert[2], Amid I. Ismail[3] and Woosung Sohn[3]

[1]Agency for Healthcare Research and Quality (AHRQ), Scholar, School of Public Health, University of California, Berkeley, CA, [2]School of Social Work, NIMH Research Center on Poverty, Risk, and Mental Health, University of Michigan, Ann Arbor, MI, [3]School of Dentistry, University of Michigan, Ann Arbor, MI, USA

Finlayson TL, Siefert K, Ismail AI, Sohn W. Psychosocial factors and early childhood caries among low-income African–American children in Detroit. Community Dent Oral Epidemiol 2007; 35: 439–448. © 2007 The Authors. Journal compilation © 2007 Blackwell Munksgaard

Abstract – *Objectives:* This study sought to advance knowledge of the social determinants of oral health, by examining how several specific maternal health beliefs, behaviors, and psychosocial factors relate to young children's early childhood caries (ECC) status in a lower-income African–American population. *Methods:* Data were collected by the Detroit Dental Health Project (NIDCR grant), a population-based study of 1021 African–American families with at least one child under 6 years of age and living in 39 low-income Census tracts in Detroit, Michigan. Analyses were limited to 719 children aged 1–5 years and their biological mothers, and conducted in SUDAAN to account for the complex sampling design. Survey data included health belief scales on mothers' self-efficacy, feelings of fatalism, knowledge about appropriate bottle use and children's oral hygiene needs, brushing habits, psychosocial measures of depressive symptoms (CES-D), parenting stress, and availability of instrumental social support. The child's age, dental insurance status, dental visit history, and 1-week brushing frequency were also included in the model. Children's ECC status, based on a dental examination, was the main outcome. The dental team used the International Caries Detection and Assessment System (ICDAS) criteria for caries detection. Each child was classified as either caries-free or having ECC or severe ECC (S-ECC) based on the case definition of ECC proposed by an expert panel for research purposes with preschool-aged children. *Results:* The dental team followed a specific examination protocol and established reliable and consistent ratings of ECC based on the ICDAS criteria. The inter-rater reliability kappa was 0.83 overall, and the intra-rater reliability kappa was 0.74 overall. One-third of the children had ECC, and 20% had severe ECC. Age of the child and lower parenting stress scores were each positively associated with ECC, while higher education and income were protective. Maternal oral health fatalism and knowledge of children's hygiene needs were associated with ECC among preschool-aged children. ECC was higher among younger children who had past restorative care. *Conclusions:* These findings call attention to the high prevalence of ECC in this population and the need to consider psychosocial as well as traditional risk factors in developing interventions to reduce oral health disparities.

Key words: African–American; Early Childhood Caries (ECC); International Caries Detection and Assessment System (ICDAS); parenting stress; preschool aged children; psychological factors

Tracy L. Finlayson, Berkeley School of Public Health, 140 E. Warren Hall MC 7360, Berkeley, CA 94720-7360, USA
Tel: +1 510-642-5652
Fax: +1 510-643-4281
e-mail: tracyf@berkeley.edu

Submitted 1 February 2006;
accepted 12 July 2006

Dental caries was recently identified as the single most common chronic childhood disease (1). Although dental caries prevalence and severity in children has dramatically decreased over the last three decades, significant levels of disease persist and are concentrated among socioeconomically disadvantaged groups (2–4). The incidence, prevalence, and severity of dental caries in the

doi: 10.1111/j.1600-0528.2006.00352.x

USA is highest among low-income populations and those racial/ethnic minority groups overrepresented among the lower socioeconomic strata (5–7).

Oral health disparities are most pronounced among preschool-aged children. Early childhood caries (ECC) is associated with significant adverse physical, functional, and behavioral consequences that can greatly impair quality of life (8). The effects of ECC can be long term, increasing risk for dental problems later in life (9–14), and interfering with basic social functioning (4, 5), as well as optimal growth and development (15, 16).

As a result of examination difficulties and variation in ECC clinical diagnostic criteria, the prevalence of ECC in the USA is not entirely clear (17). Current estimates in developed Western societies range between 1% and 12% (18). However, among low-income and many minority groups, ECC is at endemic levels and these children experience significantly higher levels of dental caries and poorer oral health than their counterparts (19–21). According to data from the Third National Health and Nutrition Examination Survey from 1988 to 1994 (NHANES III), ECC occurs in about twice as many minority children, two and a half times as many children of less educated parents (those who did not finish high school), and three times as many poor children relative to other preschool-aged children (22).

Although low-income minority children are at high risk for ECC, not all such children develop this costly-to-treat and disabling disease. The reasons for this are unknown. Studies have focused on access to care issues and biological risk factors for caries in young children, but recently, the research focus has shifted toward understanding the psychosocial and behavioral determinants of ECC (23). There is growing recognition of the need to understand how social, cultural, environmental, and psychological forces in the family affect oral health outcomes in early childhood. Research has shown that broader psychosocial factors can influence engaging in and maintaining health-promoting behaviors, and risk factors that have been found to adversely affect parents' ability to engage in preventive health practices include poverty, chronic stress, and depression (24–27).

Studies are beginning to explore and document the relationships between caregiver psychosocial factors and children's ECC status (11, 28–37). In studies of Head Start children, Reisine and Litt (34) investigated brushing habits, sugar intake in the diet, social class, stressful life events, dental health locus of control, dental self-efficacy, tooth decay, and bacteria in saliva. In this cross-sectional biopsychosocial model, caregivers' low self-efficacy was found to be associated with higher caries rates in their children. Bacterial count and mothers' locus of control, income, dental knowledge, and stress levels were also significantly associated with caries; stress had an inverse relationship with ECC. One year later, efficacy was an important predictor of sugar intake in the final structural equations model, which in turn predicted bacterial levels and dental caries (31). In another study 1 year later, caries experience, bacteria level, and brushing at baseline predicted later caries risk in a discriminant function analysis (11).

Other studies have investigated the effect of caregivers' stress measured by various versions of the Parenting Stress Index (PSI) (38) on children's oral health status. LaValle et al. (29) studied parenting stress in primarily low-income caregivers of 5–12-year olds, and found that lower caregiver age, education, and Child Domain PSI subscale scores (measuring child characteristics like demandingness, mood, and adaptability) were associated with children's poorer oral health. Quinonez et al. (33) used the PSI Short Form total score to measure parenting stress in a sample of mostly lower income minority caregivers, and found that the score was significantly positively related to ECC among 18–36-month olds in the bivariate case only, but not in the final multivariable prediction model including demographic and other biological factors. Recently, Tang et al. (35) also had similar findings of a significant bivariate correlation between the PSI Short Form and ECC in 4- to 5-year-old Australians, but the effect did not appear in the regression models.

The objective of the present study was to better understand the correlates of intra-group oral health disparities in a large community-based sample of very poor young African–American children. Because there is no conclusive evidence that traditional efforts to improve oral hygiene behaviors reduce dental caries (6), it is important to identify risk and protective factors that can provide an empirical basis for effective interventions. Using a conceptual framework derived from social cognitive theory (SCT) (39–42) and findings from research on psychosocial influences on preventive health behaviors (24–27), we sought to identify how maternal self-efficacy, oral health-related beliefs and knowledge, maternal depression, parenting stress, and social support relate to ECC among low-income African–American children aged 1–5 years.

Methods

Study design and sample

Data for this study are from the Detroit Dental Health Project (DDHP), one of five Centers funded by the National Institutes of Health (NIDCR grant U-54 DE 14261) to conduct research to reduce oral health disparities in the USA (43). The DDHP research program investigates the social, familial, biological, and neighborhood determinants of oral health status among low-income African–American families in Detroit, Michigan. The population-based sample of African–American families was selected using a multistage area probability sample design. The DDHP research team selected the 39 lowest income Census tracts in the city of Detroit based on 2000 Census data. Families were eligible if they had at least one child <6 years of age at baseline and had incomes below 250% of the federal poverty line. The total study cohort included 1021 children and their primary caregivers. Of the 12 265 randomly selected housing units, 9781 were successfully contacted and an adult living in the unit responded to the project staff (77.3% contact rate). Of the 9781 contacted housing units, 1386 (14.2%) had an eligible African–American child <6 years of age. Of the 1386 families with eligible children, 1021 completed the study (73.7%).

Trained staff conducted face-to-face interviews with caregivers at the DDHP Examination Center in Detroit during 2002–2003; caregivers were surveyed about oral health beliefs and behavior and a wide range of psychosocial factors using a series of structured questionnaires. All children and caregivers underwent a clinical dental examination. The present study analyzed data from mothers and their children aged 1–5 years.

Study variables

Our dependent variable was a measure of children's oral health based on a clinical evaluation. A team of six dentists performed detailed visual examinations of each clean and dry tooth surface using the International Caries Detection and Assessment System (ICDAS) criteria for caries detection (44). The ICDAS is not a new system; rather it represents a consolidation of 29 criteria systems that have been used in previous studies (45–48) into one system (49) that can be used to provide more in-depth analysis of the stages of the carious process. It allows for evaluation of the early non-cavitated stages separately from cavitated carious lesions.

The criteria system measures six stages of the carious process: (i) first visual change in enamel; (ii) distinct visual change in enamel; (iii) non-cavitated surface with underlying dark shadow from dentin; (iv) initial breakdown in enamel because of caries with no visible dentin; (v) distinct cavity with visible dentin; and (vi) extensive distinct cavity with visible dentin.

The ICDAS system was also found to have moderate to excellent reliability in the DDHP. The six examiners who collected the dental data for this study had weighted intra-examiner kappa coefficients ranging between 0.65 and 0.91. The weighted kappa coefficients for the inter-examiner reliabilities ranged between 0.68 and 0.80. Based on the dental examination, each child was classified as either caries-free or having ECC or severe ECC (S-ECC) based on the case definition of ECC proposed by an expert panel for research purposes with preschool-aged children (21). This definition has been used in prior research (50), and was adopted by the American Academy of Pediatric Dentistry Council on Clinical Affairs in May 2000 (51).

Our analysis included four sets of covariates: (i) a set of variables operationalizing SCT, (ii) maternal psychosocial factors potentially influencing health behavior, (iii) sociodemographic characteristics, and (iv) the child's dental history. The SCT variables included four brief scales designed to operationalize SCT and relate its key constructs to children's oral health: oral health-related self-efficacy (OHSE), knowledge about appropriate bottle use (KBU) and about children's oral hygiene (KCOH), and belief in oral health fatalism (OHF). A detailed description of the development of these scales is available elsewhere (52). Analyses conducted by the authors supported their reliability and validity, with Cronbach's alpha coefficient ranging from 0.76 to 0.91.

Oral health self-efficacy (OHSE) was assessed by a nine-item measure that inquired how confident caregivers were about making sure children's teeth were brushed before bedtime under situations such as being tired. Possible responses ranged from 1 (not at all confident) to 4 (very confident); answers were averaged to generate a single oral health self-efficacy score. Maternal KBU and KCOH were assessed by responses to several oral health statements on a five-point Likert scale. Four items were used to create the KBU scale; a sample item is ''there is nothing wrong with putting the baby to bed with a bottle.'' Six items were used to create the KCOH scale; a sample item is ''cavities in baby teeth don't matter since they fall out anyway.'' Responses to each set of items were averaged to construct each scale. A dummy variable for OHF was created to reflect maternal agreement with the statement that ''most children eventually develop dental cavities.'' We also included a dummy variable indicating whether the mother reported brushing her own teeth at bedtime in the past week.

We examined three psychosocial factors potentially influencing maternal preventive health behavior: symptoms of depression, parenting stress, and social support. Depressive symptoms were assessed using the Center for Epidemiological Studies Depression Scale (CES-D) (53). A dummy variable was created and coded '1' for mothers scoring above 16 or more on the CES-D, the standard cutoff for identifying individuals at risk of depression (54, 55). The Cronbach's alpha for the CES-D in our sample was 0.89.

The constraints of time and respondent burden necessitated the use of a brief measure of parenting stress appropriate for use with impoverished and overburdened families. The eight items in the DDHP measure were taken from Abidin's Parenting Stress Index (PSI), a standard measure of perceived stress in the caregiving role (38) as adapted in the New Chance Study, an evaluation of a comprehensive program for mothers in poverty and their children (56). This brief measure was used in the Women's Employment Survey (WES), a longitudinal survey of mothers in an urban Michigan county who were receiving welfare in 1997 (57–59) and a similar measure was used in a study of the socioeconomic and psychological well-being of low-income young mothers under welfare reform (60). Excellent alpha reliability coefficients were reported in both studies.

To validate the measure in our sample, an exploratory factor analysis (EFA) of the eight items was conducted. The EFA resulted in two distinct factors, and a scale about feelings related to the caregiver role was created from the six items comprising one factor. The final six items in the measure included: (i) how often do you feel that you have too little time to spend by yourself; (ii) how often do you wish you did not have so many responsibilities; (iii) how often would you say that your child gets (or children get) on your nerves; (iv) how often do you feel that your child is (children are) making too many demands on you; (v) how often do you find that being a mother is much more work than pleasure; and (vi) how often do you feel tired, worn out, or exhausted from raising a family? The response scale was 5 = almost always, 4 = often, 3 = sometimes, 2 = rarely, 1 = never. Parenting stress was measured by the average score of the six items. The alpha reliability for this scale in our sample was 0.76.

Social support focused on instrumental support and was assessed by four separate questions about whether or not mothers reported having someone they could count on to: (i) run errands, (ii) lend them money, (iii) watch their children, and (iv) lend them a car or give them a ride if needed (61–63).

Sociodemographic variables included the mothers' age (continuous variable), education level (coded as completing high school or more vs. less than high school), annual household income (categorized as <$10 000 as the reference, $10 000–19 999, and $20 000 or above), and household size (continuous variable). The child's age, 1-week brushing frequency, dental insurance status (1 = insured), and dental visit history were also examined.

Data analysis

The very few missing items (<4% for any individual item) in the survey data were imputed with Imputation and Variance Estimation software (IVEware, University of Michigan, Ann Arbor, MI, USA). Imputation was done for individual items before calculating scores for scales, allowing a more consistent sample size to be used in analyses. Cases with missing demographic data (household size, education, and income) were not imputed and were excluded from analyses. Descriptive statistics for all the variables were calculated to examine their distributions and ascertain the characteristics of the sample.

Early childhood caries is strongly correlated with age, so the outcome was modeled differently by age group (1–3 and 4–5 years) to control for child's age and reflect the distribution of dental caries. Logistic regression was used to estimate the relationships between the independent variables and the child's ECC status (caries-free or diseased; the very few cases classified as having S-ECC were not distinguished from ECC) for the 1- to 3-year-old children, and a cumulative logit model was used for the analysis of the ordered categorical dependent variable, 4–5-year olds' ECC status (caries-free, ECC, or S-ECC).

All data management steps were done in SAS version 8 (64), and all statistical analyses were conducted in SUDAAN version 8 (65) software to account for the complex sample design and produce robust variance estimations. SUDAAN uses generalized estimating equation (GEE) methodology to produce the parameter estimates and the Taylor series linearization technique to produce robust variance estimations for all of the regression models (66). All analyses were adjusted with a sample weight created to account for the unequal probability of selection, participant non-response, and a post-stratification control (all features of the complex sample design) to make the sample representative of the population of children in Detroit in terms of race, gender, and age.

Results

Characteristics of the final sample, which included 719 mother–child dyads with no missing data on any of the study variables, are summarized in Table 1 by child's age group. Mothers' ages averaged 28 years. Nearly half (46%) of the mothers reported their annual household income to be

Table 1 Background sample characteristics for African–American children ages 1–5 years and their mothers, by age group

Variable	Age 1–3 years (n = 446)	Age 4–5 years (n = 273)	Range (items)
Social cognitive theory variables			
Self-efficacy (mean, SE)	3.00 (0.04)	2.98 (0.06)	1–4 (9)
Fatalistic belief (n, %)	344 (76.76)	224 (81.56)	
Knowledge–hygiene needs (mean, SE)	1.48 (0.04)	1.50 (0.06)	1–5 (6)
Bottle use knowledge (mean, SE)	1.97 (0.05)	2.05 (0.08)	1–5 (4)
Mother brushed at bedtime (n, %)	248 (57.63)	151 (55.74)	
Psychosocial characteristics			
Depressive symptoms/CES-D ≥ 16 (n, %)	162 (35.10)	96 (34.33)	
Parenting Stress Scale (mean, SE)	2.98 (0.06)	3.07 (0.05)	1–5 (6)
Instrumental support available (n, %)			
Errands	349 (80.86)	203 (73.75)	
Money	366 (83.20)	209 (75.36)	
Childcare	406 (90.35)	238 (87.98)	
Transportation	375 (85.54)	216 (77.93)	
Background characteristics			
Mothers' age (mean, SE)	26.37 (0.32)	29.65 (0.54)	16–49
Education (n, %)			
Less than High School (reference)	215 (49.03)	132 (48.36)	
High School or more	231 (50.97)	141 (51.64)	
Household income (n, %)			
Less than $10 000 (reference)	195 (45.75)	132 (46.61)	
$10 000 to $19 999	127 (28.26)	69 (26.25)	
$20 000 or above	124 (25.99)	72 (27.14)	
Household size (mean, SE)	4.06 (0.09)	4.29 (0.16)	2–14
Child's dental history (n, %)			
Child's age (n, %)			
1 year old	143 (19.42)		
2 years old	155 (18.48)		
3 years old	148 (19.06)		
4 years old		138 (21.84)	
5 years old		135 (21.20)	
Dental insurance (n, %)	389 (89.05)	239 (87.88)	
No past dental visit (reference)	350 (78.39)	88 (31.77)	
Child has past dental visit (n, %)		185 (68.23)	
Reason for child's past dental visit			
Preventive visit/checkup	65 (8.56)		
Restorative care/problem	18 (2.15)		
Child's brushing frequency (mean, SE)	8.42 (0.36)	9.75 (0.32)	0–40

Weighted percentages and standard errors (SE).

<$10 000 to support an average household size of four. Almost half (49%) had not finished high school. Mothers reported relatively high levels of self-efficacy (3 on a four-point scale) and were knowledgeable about appropriate bottle use and children's oral hygiene needs. However, more than three quarters of the sample endorsed a fatalistic oral health belief. Maternal symptoms of depression were highly prevalent; about one-third (35%) of the sample scored 16 or more on the CES-D. Parenting stress scale scores were fairly normally distributed, and most mothers reported that they 'sometimes' experienced feelings of stress. Most reported having all four types of instrumental social support available. Eighty-nine percent of children had some type of dental insurance coverage, typically Medicaid, and a majority (78%) had not been to a dentist yet. Children's teeth were brushed 8.42 times per week on average, slightly more often than once daily.

The regression model odds ratio (OR) estimates for both age groups are presented in Table 2. Other analyses (not shown) revealed no multicollinearity, and the effects of all variables together in the full model are shown. In Table 2, OR >1 indicate that the independent variable is positively associated with ECC (increases the risk of ECC), while OR <1 indicate an inverse relationship with ECC (decreases the risk of ECC). Among the 1- to 3-year-old children (Table 2, left column), one-third were classified as having ECC. None of the social cognitive variables were significant, but parenting stress, income, and the child's age and dental visit history were relevant for whether a child had ECC. Parenting stress was a significant predictor of ECC, and surprisingly, was inversely associated with

Table 2 Estimated odds ratios (OR) and 95% confidence intervals (CI) from regression models for children's Early Childhood Caries (ECC) status

	Age 1–3 years (n = 446)		Age 4–5 years (n = 273)	
	OR	95% CI	OR	95% CI
Social Cognitive Theory variables				
Self-efficacy	0.87	0.54–1.39	1.10	0.74–1.63
Fatalistic belief	0.99	0.49–2.01	2.67**	1.20–5.98
Knowledge–hygiene needs	0.96	0.64–1.45	0.66**	0.44–0.97
Bottle use knowledge	0.83	0.64–1.06	0.98	0.69–1.40
Mom brushed (1 = yes)	1.07	0.57–2.00	1.41	0.90–2.20
Psychosocial factors				
Depressed (CES-D ≥ 16)	1.04	0.45–2.41	1.40	0.78–2.53
Parenting Stress Score	0.62**	0.39–0.98	0.72*	0.50–1.03
Errands help (1 = yes)	1.54	0.54–4.38	0.99	0.42–2.30
Money help (1 = yes)	0.87	0.32–2.35	0.96	0.43–2.11
Childcare help (1 = yes)	0.71	0.16–3.24	2.29	0.62–8.50
Transportation help (1 = yes)	0.89	0.41–1.93	1.35	0.55–3.33
Background characteristics				
Less than High School	1.00	–	1.00	–
High School or more	1.09	0.58–2.04	0.51**	0.28–0.95
Less than $10 000	1.00	–	1.00	–
$10 000–19 999	0.67	0.34–1.31	0.86	0.44–1.69
$20 000+	0.51*	0.26–1.01	0.67	0.36–1.23
Household size	0.94	0.78–1.14	1.07	0.90–1.27
Mother's age	1.01	0.96–1.06	1.05*	0.99–1.12
Child's dental history				
Child's age	2.99****	1.99–4.50	2.08*	0.98–4.45
Dental insurance	0.89	0.39–1.99	0.44*	0.16–1.15
Brushing rate	1.04	0.98–1.10	0.98	0.92–1.05
No past dental visit	1.00	–	1.00	–
Past dental visit		–	1.28	0.62–2.62
Checkup	1.86	0.74–4.69		
Problems	11.50***	2.66–49.73		

*$P < 0.10$; **$P < 0.05$; ***$P < 0.01$; ****$P < 0.001$.

The case definition of ECC proposed by an expert panel was used in these analyses [Drury et al (21)]. For the 1- to 3-year-old children, a logistic regression model (outcome defined as sound vs. ECC) was used; 288 children did not have cavities and 158 children had ECC. For the 4- to 5-year-old children, a cumulative logit model (outcome defined as sound vs. ECC or severe ECC) was used; 107 children had severe ECC, 121 had ECC, and 45 children did not have cavities.

children's ECC status, such that for each unit increase on the stress scale, the odds of the child having ECC reduced by about one-third (OR = 0.62, 95% CI 0.39–0.98; $P < 0.05$). Even within this low-income population, higher income appeared to be protective, a trend that approached significance (OR = 0.51, 95% CI 0.26–1.01; $P < 0.10$). Children's age was strongly positively associated with disease levels, as expected (OR = 2.99, 95% CI 1.99–4.50; $P < 0.001$), and those children who had a restorative dental visit were also much more likely to have ECC relative to their counterparts who had never been to a dentist at all (OR = 11.50, 95% CI 2.66–49.73; $P < 0.001$). In sum, the significant findings in the 1- to 3-year-old ECC model included parenting stress as inversely associated with ECC and two factors – the child's age and past restorative dental visit – as each being positively associated with ECC.

Among the 4–5-year olds (Table 2; right column), 107 (39%) had S-ECC, 121 (44%) had ECC, and 45 (17%) were caries-free. Mothers' knowledge about children's oral hygiene (KCOH) was an important factor, significantly reducing both the odds of ECC or S-ECC (OR = 0.66, 95% CI 0.44–0.97; $P < 0.05$). Endorsing a fatalistic belief (OHF) significantly increased children's odds of disease by 2.67 (95% CI 1.20–5.98, $P < 0.05$).

A surprising trend that emerged among 4- to 5-year-old children was that parenting stress, which was expected to operate as a risk factor, was instead protective. Children of mothers who reported experiencing more stress in the parenting role were less likely to have caries, such that for each unit increase on the stress scale, the odds of the child having ECC or S-ECC reduced by about one quarter (OR = 0.72, 95% CI 0.50–1.03, $P < 0.10$).

Higher educational attainment was protective as well, and children of mothers with more than a high school education or a GED were significantly less likely to have ECC or S-ECC (OR = 0.51, 95% CI 0.28–0.95; $P < 0.05$). Children with dental insurance coverage appeared to enjoy better oral health outcomes than their uninsured counterparts, a trend that approached significance (OR = 0.44, 95% CI 0.16–1.15; $P < 0.10$). Both the age of the child and that of the mother also approached significance. Consistent with the well-established correlation between age and dental disease, 5-year olds were twice as likely (OR = 2.08, 95% CI 0.98–4.45, $P < 0.10$) as 4-year olds to have caries. Additionally, children of older mothers were also slightly more likely to have disease (OR = 1.05, 95% CI 0.99–1.12, $P < 0.10$). Oral health self-efficacy, maternal toothbrushing behavior, depressive symptoms, social support, and dental visit history were not significantly associated with children's caries status. In sum, the significant findings in the 4- to 5-year-old ECC model included maternal knowledge of children's oral health, maternal education, and the child having dental insurance as each being inversely associated with ECC, while maternal endorsement of fatalism was positively associated with ECC.

Discussion

The high prevalence of ECC among the children in this population-based sample is of great concern. Overall, one-third of the children had ECC, and another 20% had S-ECC, with the proportion of children with disease increasing with age. To place these numbers in perspective, the prevalence of ECC in NHANES III data for all 2–4-year olds is 18%, and for African–Americans is 24% (5). In a large study of Head Start children, the estimated prevalence of ECC among lower income African–American 3–5-year olds was 20.5% (67).

Two of the SCT variables, oral-health fatalism (OHF) and knowledge of children's oral hygiene needs (KCOH), were associated with ECC. Endorsing a fatalistic belief nearly tripled children's odds of disease and higher KCOH scores were protective against ECC in the model for 4- to 5-year-old children. While cognitions are potentially modifiable and these relationships have potential implications for designing interventions, fatalistic perceptions may be difficult to modify and it is not clear if increased knowledge led to better outcomes or vice versa. Contrary to our expectations, considering the support for SCT across many other studies of health outcomes (42), maternal oral health self-efficacy, knowledge about appropriate bottle use, and mothers' own toothbrushing behavior were not associated with ECC. However, our findings are consistent with those of systematic literature reviews that have found improved oral health knowledge does not lead to long-lasting changes in behaviors (68–70). Studies examining parental knowledge and ECC outcomes in particular have found that greater knowledge of ECC risk factors does not always preclude parents from engaging in risky behaviors (71–73). Nevertheless, given the limitations of our measures, as well as our use of cross-sectional data, these social cognitive constructs warrant further exploration as potential determinants of children's oral health.

Interestingly, higher levels of parenting stress were significantly associated with better dental outcomes. Additionally, all of the individual items of the parenting stress scale were inversely related with ECC, and the correlations for two of the six items (having little time to oneself and feeling tired from raising a family) were significant. While these findings may simply reflect the limitations of our measure of parenting stress, it could also be that perceived distress in the parenting role reflects greater conscientiousness on the part of the parent, better developed coping skills in the face of adversity, or some other adaptive quality.

Litt et al. (31) measured stress in terms of life events and examined its association with ECC in a Head Start populations; the direction of the findings in their study is consistent with our finding of an inverse relationship between higher levels of stress and ECC. Furthermore, Weinstein et al. (73), reported that Mexican–American migrant farmworker caregivers of babies without baby bottle tooth decay had higher scores on PSI items related to feeling trapped by parenting responsibilities and not enjoying life. However, our findings conflict with those of Tang et al. (35) and Quinonez et al. (33); they found that higher total scores on the PSI Short Form significantly correlated with ECC in bivariate analyses, although it did not contribute independently in multivariate analyses. Similarly, LaValle et al. (29) found a significant positive association between a subscale of the PSI (Child Domain) and ECC. Clearly, the effect of caregivers' stress levels on their children's ECC status is an area that warrants further investigation. It is unfortunate that we were unable to administer the full (120-item) or short (36-item) form of the PSI, and future research should pursue this finding using the full PSI or another 'gold standard' measure.

As anticipated, higher education and income appeared protective against disease. Higher annual income (\$20 000 or more compared to <\$10,000 a year) was protective against ECC for the 1–3-year olds in our sample, although this trend may not have reached standard significance levels because of the homogeneity of the income levels. Higher education was significantly inversely related to ECC among the 4–5-year olds. Moreover, as expected, 1- to 3-year-old children with past dental visits for restorative care were at a much higher risk of ECC, although the number of children with this type of visit was small and this finding should be considered with caution. Ten of the 18 children who sought treatment were 3-year olds.

Our findings provide support for including broader psychosocial variables in addition to traditional socioeconomic variables in multidimensional models of young children's oral health outcomes in future disparities research. One of the *Healthy People 2010* Oral Health Objectives (no. 21-1a) is to reduce the proportion of young children aged 2–4 years with dental caries in their primary teeth to 11% (74). The process by which social stratification translates to poor oral health beginning in earliest childhood, especially for groups at higher risk for disease, is not well understood. Although the constraints of cross-sectional data and the limitations of our measures must be acknowledged, our findings suggest the need for future research to move beyond traditional risk factors and more closely examine the impact of the social environment on oral health beliefs, behavior, and outcomes. In addition, we studied a relatively homogenous sample of poor families, in which low socioeconomic and minority status are universal. The fact that higher income and education were protective even within this sample suggests that in order to eliminate oral health disparities, the social forces that differentially allocate health resources and risk exposure across various groups in society must be addressed (75).

Acknowledgments

The authors gratefully acknowledge the efforts of all the investigators, staff, and participants of the Detroit Dental Health Project (aka the Detroit Center for Research on Oral Health Disparities). Support for this study was provided by the National Institute for Dental and Craniofacial Research (NIDCR grant no. U-54 DE 14261), a Minority Research Supplement under the NIDCR parent grant to the first author, the Delta Dental Fund of Michigan, The University of Michigan Office of the Vice President for Research, and the National Institute of Mental Health (NIMH grant no. 5 T32 MH16806).

References

1. Newacheck PW, Hughes DC, Hung YY, Wong S, Stoddard JJ. The unmet health needs of America's children. Pediatrics 2000;105:989–97.
2. Allukian M. The neglected epidemic and the Surgeon General's Report: a call to action for better oral health. Am J Public Health 2000;90:843–5.

3. United States General Accounting Office. Oral health: dental disease is a chronic problem among low-income populations. Washington, DC: GAO; 2000.
4. National Maternal and Child Oral Health Resource Center. Preventing tooth decay and saving teeth with dental sealants. Washington, DC: NMCOHRC, Georgetown University; 2003.
5. U.S. Department of Health and Human Services. Oral health in America: a report of the Surgeon General – executive summary. Rockville, MD: National Institutes of Health U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research; 2000.
6. Bader JD, Rozier RG, Lohr KN, Frame PS. Physicians' roles in preventing dental caries in preschool children. Am J Prev Med 2004;26:315–25.
7. Hughes DC, Duderstadt KG, Soobader MP, Newacheck PW. Disparities in children's use of oral health services. Public Health Rep 2005;120:455–62.
8. Edelstein BL. Disparities in oral health and access to care: findings of national surveys. Ambulatory Pediatr 2002;2(2 Suppl):141–7.
9. Greenwell A, Johnsen D, DiSantis T, Gerstenmaier J, Limbert N. Longitudinal evaluation of caries patterns from the primary to the mixed dentition. Pediatr Dent 1990;12:278–82.
10. Kaste LM, Marianos D, Chang R, Phipps KR. The assessment of nursing caries and its relationship to high caries in the permanent dentition. J Public Health Dent 1992;52:64–8.
11. Reisine S, Litt M, Tinanoff N. A biopsychosocial model to predict caries in preschool children. Pediatr Dent 1994;16:413–8.
12. O'Sullivan DM, Tinanoff N. The association of early dental caries patterns with caries incidence in preschool children. J Public Health Dent 1996;56:81–3.
13. Mattila ML, Paunio P, Rautava P, Ojanlatva A, Sillanpaa M. Changes in dental health and dental health habits from 3 to 5 years of age. J Public Health Dent 1998;58:270–4.
14. Peretz, B, Ram D, Azo E, Efrat Y. Preschool caries as an indicator of future caries: a longitudinal study. Pediatr Dent 2003;25:114–8.
15. Acs G, Lodolini G, Kaminsky S, Cisneros GJ. Effect of nursing caries on body weight in a pediatric population. Pediatr Dent 1992;14:302–5.
16. Ayhan H, Suskan E, Yildirim S. The effect of nursing or rampant caries on body weight in a pediatric population. J Clin Pediatr Dent 1996;20:209–12.
17. Ismail AI, Sohn W. A systematic review of clinical diagnostic criteria of early childhood caries. J Public Health Dent 1999;59:171–91.
18. Milnes AR. Description and epidemiology of nursing caries. J Public Health Dent 1996;56:38–50.
19. Ismail AI. Prevention of early childhood caries. Community Dent Oral Epidemiol 1998;26(Suppl 1):49–61.
20. Tinanoff N. Introduction to the Early Childhood Caries Conference: initial description and current understanding. Community Dent Oral Epidemiol 1998;26:5–7.
21. Drury TF, Horowitz AM, Ismail AI, Maertens MP, Rozier RG, Selwitz RH. Diagnosing and reporting early childhood caries for research purposes. J Public Health Dent 1999;59:192–7.
22. Vargas CM, Crall JJ, Schneider DA. Sociodemographic distribution of pediatric dental caries: NHANES III, 1988–1994. J Am Dent Assoc 1998;129:1229–38.
23. Reisine S, Douglass JM. Psychosocial and behavioral issues in early childhood caries. Community Dent Oral Epidemiol 1998;26(Suppl 1):32–44.
24. Chung EK, McCollum KF, Elo IT, Lee HJ, Culhane JF. Maternal depressive symptoms and infant health practices among low-income women. Pediatrics 2004;113:e523–39.
25. McLennan J, Kotelchuck M, Hyunsan C. Prevalence, persistence, and correlates of depressive symptoms in a national sample of mothers of toddlers. J Am Acad Child Adolesc Psychiatry 2001;40:1316–23.
26. Brown DR. Depression among blacks: an epidemiologic perspective. In: Ruiz DS, editor. Handbook of mental health and mental disorder among Black Americans. New York: Greenwood Press; 1990. p. 71–93.
27. Dunston PJ. Stress, coping, and social support: their effects on black women. In: Ruiz DS, editor. Handbook of mental health and mental disorder among Black Americans. New York: Greenwood Press; 1990. p. 133–49.
28. Harrison R. Oral health promotion for high-risk children: case studies from British Columbia. J Can Dent Assoc 2003;69:292–6.
29. LaValle PS, Glaros A, Bohaty B, McCunniff M. The effect of parental stress on the oral health of children. J Clin Psychol Med Settings 2000;7:197–201.
30. Litt MD, Nye C, Shafer D. Coping with oral surgery by self-efficacy enhancement and perceptions of control. J Dent Res 1993;12:1237–43.
31. Litt MD, Reisine ST, Tinanoff N. Multidimensional causal model of dental caries development in low-income preschool children. Public Health Rep 1995;110:607–17.
32. Pine CM, Adair PM, Petersen PE, Douglass C, Burnside G, Nicoll AD et al. Developing explanatory models of health inequalities in childhood dental caries. Community Dent Health 2004;21(Suppl.):86–95.
33. Quinonez RB, Keels MA, Vann WF, McIver FT, Heller K, Whitt JK. Early Childhood Caries: Analysis of psychosocial and biological factors in a high-risk population. Caries Res 2001;35:376–83.
34. Reisine S, Litt M. Social and psychological theories and their use for dental practice. Int Dent J 1993;43(Suppl.1):279–87.
35. Tang C, Quinonez RB, Hallett KB, Lee JY, Whitt JK. Examining the association between parenting stress and the development of early childhood caries. Community Dent Oral Epidemiol 2005;33:454–60.
36. Verrips GH, Kalsbeck H, Eijkman MAJ. Ethnicity and maternal education as risk indicators for dental caries, and the role of dental behavior. Community Dent Oral Epidemiol 1993;21:209–14.
37. Wendt, LK, Svedin CG, Hallonsten AL, Larsson IB. Infants and toddlers with caries. Mental health, family interaction, and life events in infants and toddlers with caries. Swed Dent J 1995;19:17–27.
38. Abidin R. Parenting Stress Index, 3rd edn. Odessa, TX: Psychological Assessment Resources, Inc., 1995.
39. Bandura A. Social foundations of thought and action. New York: Prentice-Hall, 1986.
40. Bandura A. Human agency in social cognitive theory. Am Psychol 1989;44:1175–84.

41. DeVellis BM, DeVellis RF. Self-efficacy and health. In: Baum A, Revenson TA, Singer JE, editors. Handbook of health psychology. Mahwah, NJ: Lawrence Erlbaum Associates Inc; 2001. p. 235–47.
42. Green LW, Kreuter MW. Health program planning: an educational and ecological approach. Boston, MA: McGraw-Hill; 2005.
43. Milgrom P, Garcia RI, Ismail A, Katz RV, Weintraub JA. Improving America's access to health care: The National Institute of Dental and Craniofacial Research addresses oral health disparities. J Am Dent Assoc 2004;135:1389–96.
44. Pitts NB, Stamm J. International Consensus Workshop on Caries Clinical Trials (ICW-CCT) final consensus statements: agreeing where the evidence leads. J Dent Res 2004;83:125–8.
45. Pitts NB, Fyffe HE. The effect of varying diagnostic thresholds upon clinical caries data for a low prevalence group. J Dent Res 1988;67:592–96.
46. Ismail AI, Brodeur J-M, Gagnon P, Payette M, Picard D, Hamalian T et al. Prevalence of non-cavitated and cavitated carious lesions in a random sample of 7–9-year-old schoolchildren in Montreal, Quebec. Community Dent Oral Epidemiol 1992;20:250–5.
47. Ekstrand KR, Ricketts DN, Kidd EA. Reproducibility and accuracy of three methods for assessment of demineralization depth of the occlusal surface: an in vitro examination. Caries Res 1997;31:224–31.
48. Fyffe HE, Deery C, Nugent ZJ, Nuttall NM, Pitts NB. Effect of diagnostic threshold on the validity and reliability of epidemiological caries diagnosis using the Dundee Selectable Threshold Method for caries diagnosis (DSTM). Community Dent Oral Epidemiol 2000;28:42–51.
49. Ismail AI. Diagnostic levels in dental public health planning. Caries Res 2004;38:199–203.
50. Hardison JD, Cecil JC, White JA, Manz M, Mullins MR, Ferretti GA. The 2001 Kentucky Childrens Oral Health Survey: Findings for children ages 24 to 59 months and their caregivers. Pediatr Dent 2003;25:365–72.
51. American Academy of Pediatric Dentistry. Early childhood caries: unique challenges and treatment options. Pediatr Dent 2000;22:21.
52. Finlayson TL, Siefert K, Ismail AI, Delva J, Sohn W. Reliability and validity of brief measures of oral health-related knowledge, fatalism, and self-efficacy in mothers of African American children. Pediatr Dent 2005;27:422–8.
53. Radloff LS. The CES-D Scale: A self-report depression scale for research in the general population. Appl Psychol Measur 1977;1:385–401.
54. Jackson, AP, Brooks-Gunn J, Huang CC, Glassman M. Single mothers in low-wage jobs: Financial strain, parenting, and preschoolers' outcomes. Child Dev 2000;71:1409–23.
55. Radloff LS, Locke BZ. The community mental health assessment survey and the CES-D scale. In: Weissman WW, Myers JD, Ross CE, editors. Community surveys of psychiatric disorders. New Brunswick, NJ: Rutgers University Press; 1986. p. 177–89.
56. Morrison D, Zaslow M, Dion R. Parenting behavior in a sample of young mothers. In: Zaslow M, Eldred C, editors. Completing the portrayal of parenting behavior with interview based measures. New York: Manpower Demonstration Research Corporation; 1998. p. 170–212.
57. Dunifon R, Kalil A, Bajracharya A. Maternal working conditions and child well-being in welfare-leaving families. Dev Psychol 2005;41:851–9.
58. Dunifon R, Kalil A, Bajracharya A. Maternal working conditions and child well-being in welfare-leaving families. Dev Psychol 2005;41:851–9.
59. Danziger S, Oltmans E, Browning G. Childcare subsidies and the transition from welfare to work. Fam Relations 2004;53:219–28.
60. Kalil A, Danziger S. How teen mothers are faring under welfare reform. J Soc Issues 2000;56:775–98.
61. House JS. Social support and the quality and quantity of life. In: Andrews FM, editor. Research on the quality of life. Ann Arbor, MI: Institute of Social Research at the University of Michigan; 1986. p. 253–69.
62. McLoyd VC, Jayaratne TE, Ceballo R, Borquez J. Unemployment and work interruption among African American single mothers: effects on parenting and adolescent socioemotional functioning. Child Dev 1994;65:562–89.
63. Siefert K, Bowman PJ, Heflin CM, Danziger S, Williams DR. Social and environmental predictors of maternal depression in current and recent welfare recipients. Am J Orthopsychiatry 2000;70:510–22.
64. SAS Institute, Inc. SAS statistical package, version 8. Cary, NC: SAS Institute, Inc; 2000.
65. SUDAAN. Software for the statistical analysis of correlated data. Version 8.0. Research Triangle Park, NC: Research Triangle Institute; 2001.
66. Research Triangle Institute. SUDAAN's user's manual, release 8.0. Research Triangle Park, NC: Research Triangle Institute; 2001.
67. Barnes GP, Parker WA, Lyon TC, Drum MA, Coleman GC. Ethnicity, location, age and fluoridation factors in baby bottle tooth decay and caries prevalence of Head Start children. Public Health Rep 1992;107:167–73.
68. Kay EJ, Locker D. A systematic review of the effectiveness of health promotion aimed at improving oral health. Community Dent Health 1997;15:132–44.
69. Brown LF. Research in dental health education and health promotion: A review of the literature. Health Educ Q 1994;21:83–102.
70. Kay EJ, Locker D. Is dental health education effective? A systematic review of current evidence. Community Dent Oral Epidemiol 1996;24:231–5.
71. Febres C, Echeverri EA, Keene HJ. Parental awareness, habits, and social factors and their relationship to baby bottle tooth decay. Pediatr Dent 1997;19:22–7.
72. O'Sullivan DM, Tinanoff N. Social and biological factors contributing to caries of the maxillary anterior teeth. Pediatr Dent 1993;15:41–4.
73. Weinstein P, Domoto P, Wohlers K, Koday M. Mexican-American parents with children at risk for baby bottle tooth decay: pilot study at a migrant farm-workers clinic. J Dent Child 1992;59:376–83.
74. U.S. Department of Health and Human Services. Healthy People 2010. Understanding and improving health. Objectives for improving health. 2 vols. Washington, DC: U.S. Government Printing Office; 2000.
75. Link BG, Phelan J. Social conditions as fundamental causes of disease. J Health Soc Behav 1995;35:80–94.