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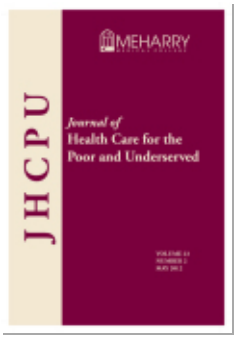

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Social Gradients in Dental Health among Low-Income Mothers and their Young Children

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Abstract: For low-income mothers of children aged 3–6 years, we estimate whether social gradients exist between mothers' income, education, and employment status and mothers' perceptions of self and child dental and general health, and whether these relationships differ by racial/ethnic group. Disproportionate stratified sampling by racial/ethnic group selected 10,909 eligible children aged 3 to 6 in Medicaid in Washington State. Mothers (n=4,373) completed a mixed-mode (web, mail, telephone) survey. Mothers' education had a strong, gradient relationship with mother ratings of self and child dental health that was not explained by other measures. Similar gradients were found for mothers' employment status and income, but some associations were no longer significant ($p>.05$) after adjusting for oral health beliefs and behaviors, dental insurance, and regular dental care. Associations did not differ significantly by racial/ethnic group.

Key words: Children, mothers, perceived oral health, perceived general health, Medicaid, race, ethnicity, income, education, employment, socioeconomic status, dental insurance, oral behaviors, oral beliefs.

The U.S. Surgeon General's report,[1] *Oral Health in America*, indicates that oral diseases are common in the U.S. population, and that striking disparities exist by income and racial/ethnic group. Low-income and minority individuals are more likely to have untreated oral diseases than others. The problem is severe particularly for low-income preschool children, who have one or more decayed or filled primary tooth by age 5 years, with African American and Hispanic children having more untreated decay.[1,2] While oral health has increased in virtually all U.S. population groups, dental caries in primary teeth has increased in children aged 2–5, with higher increases in low-income groups.[3,4]

While social gradients in perceived oral health and general health exist in representative populations of adults and children,[5–14] few studies have examined whether social gradients still exist within a low-income population, particularly a racial and ethnically diverse population of low-income mothers and their young children. The question

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is important from a life-course perspective because mothers are the primary source of the dental caries bacteria infection in their children, and oral health in childhood affects oral health in adulthood.[15–17] If social gradients in the oral health of low-income mothers exist, those gradients may be transmitted to their young children and persist into adulthood.[15,18]

Our purpose is to test whether a socioeconomic status gradient, defined by income, education, and unemployment, exists in the perceived oral and general health of a low-income, racial and ethnically diverse population of mothers and their young children. The absolute income hypothesis posits that a positive relationship exists between an individual's absolute income and oral health: each additional dollar of income is associated with an increment—albeit a diminishing one—in better oral health.[19] The diminishing returns occur partly because of less access to resources that can be used to avoid risks or minimize the consequences of decay once it occurs,[20] and because of a ceiling effect in upper-income groups, where less room for oral health improvement exists. However, when upper income groups are excluded in analyses, ceiling effects, and therefore diminishing returns, may be less likely. Because race/ethnicity effects are generally smaller than income effects on health, robust income-oral health associations may exist across racial/ethnic groups.[12,21,22] However, Latino mothers may be an exception, given evidence that recent-arrival immigrant Latinos have better health and birth outcomes than acculturated Latinos, non-Latino Whites and Blacks.[23–25]

We also test whether employment status and education are associated with perceived general and oral health. Unemployment is correlated with income and is associated usually with worse health.[26] While greater education is associated with better general health, the relationship may not be a gradient.[22] Education effects are typically smaller than income effects, mainly because income mediates the relationship between education and health, and because income captures an individual's access to health-protecting resources.[20,21,27] While reverse causation may occur with health affecting education, employment status and income, the relationship from education, employment, and income to health is usually stronger.[21] Access to dental care may attenuate the social gradient in perceived oral health through preventive and reparative mechanisms.[6,28]

Few studies of low-income populations have examined whether income, employment, and education are associated with better mother ratings of her oral health and her child's oral health, and whether these relationships differ by racial/ethnic group. Associations between income, employment, education, and mother ratings of dental health may be mediated by oral health beliefs and behaviors, private or public dental insurance, or regular dental care,[1,29,30] which may indicate opportunities for reducing oral health disparities in this population.

Methods

Population, sample, and study design. The population consisted of 108,151 children enrolled in Medicaid (the U.S. public dental insurance program for low-income people) aged 3 to 6 and their mothers in Washington State (children's household income eligibility for Medicaid in Washington State is 250% of Federal poverty level). We chose children aged 3–6 because the study's main objective was estimating whether a regular

source of dental care (RSDC) for mothers was related to their children's dental utilization, and dental utilization for children below age 3 was less than 30%, which would have decreased the likelihood of detecting an association between mothers' RSDC and their children's dental utilization.[31]

In April 2004, a disproportionate stratified random sample of 11,305 preschool children aged 3 to 6 was selected from Medicaid enrollment records in the following four racial/ethnic groups: 3,791 Black; 2,806 Hispanic; 1,902 White; and 2,806 other racial/ethnic groups. If a household had more than one child in the age range, one child was selected randomly. The cross-sectional study design consisted of a survey of children's mothers in September–December 2004. Study protocols were approved by the Washington State Institutional Review Board.

Measures. Hay et al.'s conceptual model of oral health and Grembowski et al.'s conceptual model of dental care posit that socioeconomic status and race/ethnicity are related to oral health and dental care.[32,33] We used the models to identify other factors that potentially influenced oral health, or that potentially mediated the relationships between socioeconomic status, race/ethnicity, and oral health in the study's population. Measures of oral health and the determinants of oral health were derived in terms of these relationships.

Mother rating of child and self oral health. Mothers rated the dental health of their children on a 5-point scale of poor [1], fair, good, very good, excellent [5]. Mothers also reported whether their children sometimes or frequently had any pain in his or her teeth *versus* no pain. Caregiver reports of child oral health are correlated highly with clinical findings. In a national sample of children aged 2–5, 11% of parents rated their children's oral health as fair or poor (*versus* good, very good, excellent), and of all the parents, those in low-income and minority families gave lower ratings of their children's oral health.[34] Parents' ratings of their children's oral health were correlated strongly with the number of children's carious tooth surfaces. In a sample of low-income African American families with children aged 1–5, caregivers' perceptions of their children's oral health were significantly associated with children's dental caries and perceived limitations of oral functions/activities as well as their own oral health.[35,36]

Mothers rated their self-dental health on the same 5-point scale. Mothers also were asked, "How do your teeth look to you?" with response categories of poor condition [1], fair condition, good condition, very good condition, and excellent condition [5]. Positive associations exist between self-rated oral health and clinical indicators of oral health in adults.[37–41]

Mothers also reported whether they had each of the following dental problems: tooth ache, broken filling or broken tooth, discolored teeth, sore or bleeding gums, gum boil or abscess, a loose tooth, sensitive teeth, or a bridge or partial denture that does not fit. We counted the number of distinct dental problems (maximum count is eight).

Mother rating of self and child general health. Mothers were asked, "How is this child's general medical health now?" with response categories on a 5–point scale of poor [1], fair, good, very good, excellent [5]. Mothers also were asked, "In general, how would you rate your health in the past year?" with the same 5-point response scale.

Over 20 years of evidence indicates that self-rated health is a powerful and reliable

indicator of clinical outcome and mortality.[42–44] The association is found among men and women, and among all of the main racial/ethnic groups in U.S. society.[45,46]

Mother and family characteristics. Mothers' race/ethnicity was measured by the question: "What race or ethnic background *best* describes you?" with responses of Hispanic, Latino, or Spanish; White, not Hispanic; Black or African American; American Indian; Alaska Native; Asian (such as Vietnamese, Korean, Japanese, Filipino, Chinese, Asian Indian); Pacific Islander (such as Hawaiian or Samoan); or some other race/ethnicity. Socioeconomic status was measured by the mother's highest educational degree, employment status, and family income in 2003 (categorized as less than $10,000, between $10,000—$20,000, and over $20,000). Dental insurance was measured by whether the mother had no dental insurance, Medicaid, or private dental insurance from an employer. Mother characteristics also included mother's age, single parent, current cigarette smoker, numbers of preschool and school-aged children in the household, and which mode of the survey the mother completed. Acculturation was measured by whether the mother was an immigrant (not born in the U.S.), and whether the primary language in the home was not English. Mental health symptoms in the past four weeks were assessed by averaging the mother's responses to a 6-item mental health scale, where each item's score ranged from 1 (best) to 6 (worst).[47,48]

Mother oral health behaviors. Mothers' oral health behaviors were measured as follows: brushing duration (spent a fair or a lot of time brushing *vs*. not long at all, just enough for a quick once-over, or did not brush teeth); flossing frequency and toothpick use (for each one, defined as daily or few times a week *vs*. less often or never), and use of whiteners (bought toothpaste that whitens teeth, bought tooth whitener, or whether a dentist had whitened their teeth).

Mother oral health beliefs. Mothers reported their dental fear and indicated whether they agreed or disagreed with each of the following statements: 1) you can prevent cavities if your teeth are cleaned regularly in a dental office; and 2) you can keep your teeth from getting loose if your teeth are cleaned regularly in a dental office.[49]

Mother regular dental care. Mothers reported whether they regularly go to a dentist whether or not they have a problem, occasionally go a dentist whether or not they have a problem, go to a dentist only when they have problems, or never go to a dentist.[50]

Survey of mothers. In June 2004 the Department of Social and Health Services (DSHS), which administers the Medicaid Program, mailed the parents of sampled children letters describing the study and containing instructions to notify DSHS if they did not want to participate. Three hundred ninety-six parents opted out of the study or had nondeliverable letters, leaving 10,909 participants.

The Social and Economic Science Research Center (SESRC) at Washington State University performed a mixed-mode, web-mail-telephone survey of mothers using methods developed by Dillman.[51] Mothers who did not complete the English or Spanish Web questionnaire were sent an English or Spanish mail questionnaire with a $2 bill incentive in the first mailing, with mail follow-ups to nonrespondents. Mothers who did not respond to the Web or mail questionnaires were invited to complete a telephone interview in English, Spanish, Russian or Vietnamese, with interviews ending on December 31, 2004.[52]

Data analysis. Descriptive statistics were calculated, and Pearson chi-squared test and ANOVA were performed to determine whether personal characteristics were significantly different for Blacks, Hispanics, and Whites. Spearman correlations estimated the associations between mother and child dental health and general health.

Linear regression models were estimated to test whether mothers' socioeconomic status was associated with mothers' ratings of their own and their children's dental and general health. Though the Likert-scale outcomes were not strictly continuous in nature, it has been shown that in large samples linear regression produced valid estimates. However, self-rated health may be defined as an ordinal measure analyzed with ordered logistic regression, or recoded as a binary measure (such as 1 = poor or fair; 0 = good, very good, excellent) and analyzed with logistic regression. We also estimated the self-rated health measures with logistic and ordered logistic regression, and the results were very similar to the linear regression models. Therefore, we chose linear regression for readability and ease of interpretation of results, as well as use in prior studies of self-rated oral health and studies of mortality and self-rated health.[34,53–58]

For each measure of oral health, models were estimated in three steps. In Model 1, we initially entered mothers' socioeconomic status (income, education and employment status), age, marital status, race/ethnicity, the number of preschool and school-aged children in the household, immigration status, primary language, and a survey mode indicator. In Model 2, we entered mothers' oral health behaviors and beliefs, dental insurance coverage, and mental health symptoms, and in Model 3 we entered whether the mother received regular dental care. Interaction tests were performed to determine whether the associations between socioeconomic status and perceived oral health differed by the mothers' racial/ethnic group using the Wald test. For binary (0,1) reports of the presence or absence of child dental pain, logistic regression models were estimated. Models were estimated using *R version 2.2.1* ©2005 statistical software.

Results

In total, 4,762 parents completed either the Web (n=306), mail (n=3,329) or telephone (n=1,127) instruments. Of the remaining 6,147 parents (10,909−4,762 = 6,147), 695 parents refused to participate, 86% of those when contacted by telephone after the Web and mail surveys. Another 4,387 households had non-deliverable addresses, non-working telephone numbers, or ineligible individuals; and 1,065 parents were unreachable (no response to Web or mail questionnaire and telephone calls had no answer, busy signal, answering machine, parent not available), unable to interview (due to hearing difficulty, language barrier or disability), or deceased. The response rate was 44% (4,762/10,909), and excluding the 4,387 households with ineligible individuals or inaccurate contact information, the contact rate was 73% (4,762/6,522).[59]

Eligible respondents were mothers who were Black (n=818), Hispanic (n=1,310), or White (n=1,382). We excluded from the analyses 562 mothers who defined their race/ethnicity as in other racial/ethnic groups, 301 who either declined to specify their racial/ethnic group (140) or who specified more than one (161). We also excluded 389 respondents who were not the mothers of a sampled child.

Health and characteristics of mothers and children. Table 1 compares the perceived

dental and general health, personal characteristics of mothers and children by racial/ethnic group. Statistically significant differences exist for almost all of the personal characteristics.

In general, Hispanic mothers rate the dental and general health of their children lower than Black and White mothers. The dental and general health of mothers is similar across racial/ethnic groups for most measures, although Hispanic mothers report a

Table 1.

DENTAL HEALTH, GENERAL HEALTH AND PERSONAL CHARACTERISTICS OF BLACK, HISPANIC AND WHITE MOTHERS AND THEIR CHILDREN WITH MEDICAID DENTAL INSURANCE IN WASHINGTON STATE IN 2004

	Black Mothers (n=818)	Hispanic Mothers (n=1,310)	White Mothers (n=1,382)	p-value*
Mother Dental and General Health				
Average self-rated dental health (1–5, 1 = poor and 5 = excellent)	2.9±1.3	2.6±1.2	2.8±1.2	.58
Average self-rated condition of teeth (1–5, 1 = poor and 5 = excellent)	2.8±1.1	2.4±1	2.8±1.1	.34
Average number of dental problems[a]	2.0±1.7	1.8±1.6	2.1±1.7	.02
Average self-rated general health (1–5, 1 = poor and 5 = excellent)	3.4±1.1	3.1±1.1	3.4±1.1	.22
Child Dental and General Health				
Average rating of child dental health (1–5, 1 = poor and 5 = excellent)	3.7±1.1	3.3±1.1	3.7±1.1	.02
Child sometimes or frequently had dental pain	15%	15%	13%	.26
Average rating of child general health (1–5, 1 = poor and 5 = excellent)	4.4±0.8	4.1±1	4.4±0.8	.003
Annual Household Income ($)				<.001
<10,000	56%	44%	37%	
10,000–20,000	25%	31%	27%	
>20,000	19%	24%	36%	
Education				<.001
Did not finish high school	12%	49%	11%	
High School diploma or GED	34%	34%	32%	
Some college or 2-year associate degree	49%	15%	48%	
4-year college degree or higher	5%	3%	9%	
Unemployed	18%	15%	9%	<.001
Mother's age (mean + SD)	30.7±6	30.7±6	31.2±6.3	.07

(Continued on p. 576)

Table 1. *(continued)*

	Black Mothers (n=818)	Hispanic Mothers (n=1,310)	White Mothers (n=1,382)	p-value*
Number of preschool-age children in household (mean±SD)	0.8±0.7	1.1±0.9	0.8±0.8	<.001
Number of school-age children in household (mean±SD)	1.7±1.3	1.7±1.3	1.6±1.2	.04
Single Parent	68%	22%	37%	<.001
Immigrant	9%	76%	7%	<.001
Primary household language not English	3%	64%	3%	<.001
Survey Mode				<.001
Web	6%	3%	10%	
Mail	73%	63%	72%	
Telephone	21%	34%	18%	
Mother smokes	34%	7%	36%	<.001
Mental health score				<.001
1 (Best)	16%	19%	10%	
2	38%	41%	44%	
3	27%	28%	30%	
4	13%	8%	13%	
5–6 (Worst)	5%	3%	4%	
Floss a few times a week or more	49%	61%	53%	<.001
Brushes a lot or fair amount of time	86%	78%	90%	<.001
Use toothpicks a few times a week or more	31%	42%	20%	<.001
Uses teeth whitener	20%	16%	29%	<.001
Believes dental cleanings prevent cavities	80%	87%	83%	<.001
Believes dental cleanings prevent loose teeth	57%	73%	62%	<.001
Dental Insurance				<.001
None	24%	71%	47%	
Medicaid	54%	14%	31%	
Private	22%	15%	22%	
Mother afraid or frightened of going to dentist	17%	21%	17%	.01
Dental visit frequency				<.001
Regularly, with or without problem	21%	16%	21%	
Occasionally with or without problem	27%	15%	21%	
Only when I have a problem	42%	54%	46%	
Never go to a dentist	10%	15%	13%	

*Null hypothesis is no difference between racial/ethnic groups (Pearson Chi-square test for categorical variables, ANOVA for categorical and continuous variables).
[a]Mothers could report a maximum of eight dental problems in the survey.

slightly smaller number of dental problems, on average. About 45% of mothers rated their dental health as fair or poor, and 25% rated their general health fair or poor, while 18% rated their children's dental health fair or poor.

Table 2 presents the bivariate associations between mother and child dental health and mother and child general health. All of the associations are significant ($p<.001$) and range between 0.21 and 0.39. The largest association (0.39) is for the mothers' ratings of her dental and general health. The other associations between mother and child dental health and general health range between 0.21–0.36

Mothers' self-rated dental health. Table 3 indicates the relationships between mothers' socioeconomic status (income, education and employment status) and mothers' self-reported dental health. Controlling for mother characteristics in Model 1, income, education and being employed are related strongly to the mothers' self-ratings of dental health. The relationships are gradients, where regression coefficients increase in size with each step up the income and education ladders. Compared to mothers with annual household incomes below $10,000, mothers with incomes between $10,000–$20,000 have 0.12 greater self-rated dental health, while mothers with incomes greater than $20,000 have 0.36 greater self-rated dental health. Another interpretation of the first coefficient is that, on average, 12% of the mothers with incomes $10,000–$20,000 are one point higher on the 1-to-5 dental health scale than mothers with incomes below $10,000. A similar pattern exists for the education ladder from less than high school to a college degree or higher. Being employed also is associated strongly with better dental health than being unemployed.

In Model 2, however, the statistical significance and magnitude of the coefficients decline somewhat after the mothers' oral health beliefs and behaviors, mental health symptoms and dental insurance are entered into the model. After entering whether the mother had regular dental visits in Model 3, income is no longer significant, and only the highest education level remains significant. Employment status is no longer significant at conventional levels, and its coefficient is about half the size as in Model 1. These findings indicate that regular dental care may partly mediate the relationship

Table 2.

SPEARMAN CORRELATIONS INDICATING ASSOCIATIONS BETWEEN THE MOTHERS' REPORTS OF MOTHER AND CHILD DENTAL HEALTH AND GENERAL HEALTH

	Mother Dental Health	Mother General Health	Child Dental Health
Mother Dental Health	1.00		
Mother General Health	0.39	1.0	
Child Dental Health	0.28	0.26	1.0
Child General Health	0.21	0.32	0.36

between income and self-rated dental health. The associations do not differ by racial/ethnic group.

For mothers' ratings of the condition of their teeth, income, education and employment status are related strongly to condition of teeth in Model 1, and the relationships are gradients. In Models 2 and 3 the statistical associations and social gradients remain after oral health beliefs, behaviors, dental insurance, and regular dental care enter the models. The interaction of Black racial/ethnic group with education was significant in Model 3 (Wald test p=.037): Black mothers who had a 4-year college degree or more

Table 3.

ASSOCIATIONS BETWEEN MOTHERS' ANNUAL HOUSEHOLD INCOME, EDUCATION AND EMPLOYMENT STATUS AND MOTHERS' SELF-RATED DENTAL HEALTH: LINEAR REGRESSION COEFFICIENTS[a]

	Control Variables		
	Model 1 Individual Characteristics	**Model 2 Model 1 + Risk Factors**	**Model 3 Models 1 + 2 + Dental Care**
Self-Rated Dental Health[b,c]			
Income ($)			
<10,000	—	—	—
10,000–20,000	.12**	.01	.02
>20,000	.36****	.18***	.11*
Education			
Less than high school		—	
High school diploma or GED	.14**	.05	.01
Some college	.31****	.15**	.10
College degree or more	.66****	.37****	.26**
Employed[d]	.20***	.14**	.11*
Self-Rated Condition of Teeth[c,e]			
Income ($)			
<10,000	—	—	—
10,000–20,000	.13***	.08	.08*
>20,000	.36****	.25****	.19***
Education			
Less than high school			
High school diploma or GED	.17***	.13	.10
Some college	.42****	.36****	.28***
College degree or more	.78****	.79****	.68****
Employed[d]	.22****	.16***	.14**

(Continued on p. 579)

Table 3. *(continued)*

	Control Variables		
	Model 1 Individual Characteristics	**Model 2 Model 1 + Risk Factors**	**Model 3 Models 1 + 2 + Dental Care**
Self-Reported Number of Dental Problems			
Income ($)			
<10,000	—	—	—
10,000–20,000	−.18**	−.05	−.06
>20,000	−.48****	−.27***	−.20**
Education			
Less than high school	—		
High school diploma or GED	−.22**	−.12	−.07
Some college	−.50****	−.31***	−.23**
College degree or more	−.81****	−.48****	−.35**
Employed[d]	−.25***	−.15	−.14

*p<.10
**p<.05
***p<.01
****p<.001

[a]Model 1: Controlling for race/ethnicity, age, single head of household, number of preschool children, number of school-aged or older children, immigrant status, household primary language not English, survey mode.

Model 2: Model 1 control variables plus smoking status, mental health status, flossing frequency, length of brushing, toothpick use, tooth whitener use, belief cleaning prevents cavities, belief cleaning prevents loose teeth, mother fear of dentist, type of dental insurance coverage.

Model 3: Models 1 and 2 control variables plus frequency of dental care.

[b]Interactions of racial/ethnic group with income, education and employment status were not significant in all models.

[c]The mother ratings of dental health and condition of teeth are on a 1–5 scale, where 1 = poor and 5 = excellent.

[d]Employed, full-time homemaker, in-school, military, or disabled for work versus unemployed or laid off.

[e]Interactions of racial/ethnic group with income, education and employment status were significant only for education (Wald test $p=.037$). The interaction between Black and having a 4-year college degree or more was statistically significant in Model 3 (coefficient: −0.69; $p=.005$), indicating the positive effects of high education (0.68) are virtually eliminated in this group.

rated the condition of their teeth lower (coefficient: −0.69; p=.005), indicating the positive effects of high education (0.68) were virtually eliminated in this group.

For number of dental problems, greater income and education and being employed are related strongly to fewer dental problems in Model 1, and the relationships are gradients. Controlling for oral health and dental care measures in Models 2 and 3 does not eliminate the associations for income and education, but employment status is no longer significant. These associations do not differ by racial/ethnic group.

Mother's ratings of child dental health. Table 4 presents associations between mothers' socioeconomic status and mother-rated child dental health. In all models, mothers' education has a highly significant, positive association with mother ratings of child dental health, and the relationships are gradients. In contrast, only the highest income category is significant, and employment status is not significant. These associations do not differ by racial/ethnic group.

For mother-rated child dental pain, higher mothers' education is associated with lower odds of having child dental pain, and the relationships are gradients. In Models 2 and 3, however, the statistical significance of the associations declines. Income and employment status are generally not associated with mother rated child dental pain in all models. These associations do not differ by racial/ethnic group.

Mothers' ratings of general health. Similar to dental health, income, education, and employment are generally related strongly to mothers' ratings of self and child general health (see Table 5). Controlling for mediating risk factors and dental utilization diminish these relationships but do not eliminate them, and the relationship between mothers' education and child general health remains strong in all models.

Discussion

Social gradients in perceived oral health and general health exist in representative populations of adults and children. Our findings confirm that social gradients exist even in a low-income population of mothers of diverse races and ethnicities and their young children. We found strong associations between education and mother-rated self and child dental and general health, and the relationships are gradients, where coefficients increased in size with each step up the education ladder, even after controlling for potential mediators in the education—dental health pathway.

Studies of general health suggest that education affects health mainly by increasing an individual's sense of control.[27,60–62] Another potential mechanism is cognitive ability; Sabbah et al.[63] report that the association between education and clinical oral health was attenuated after controlling for cognitive ability. We did not measure these concepts and therefore, cannot test this potential relationship.

Income groups (less than $10,000, $10,000–$20,000, more than $20,000) generally had a gradient relationship with low-income mother' ratings of self dental and general health in models without mediating concepts. Oral health beliefs, behaviors, dental insurance and regular dental care are conceptually in the causal pathway between income and dental health, and adjusting statistically for them erodes the social gradient between income and mothers' ratings of dental and general health.

Being employed (*versus* unemployed) also is related generally to better mother ratings of self dental and general health. Adjusting for oral health beliefs, behaviors, dental insurance and regular dental care reduces the magnitude and significance of the employment status coefficients. Mothers' employment status is unrelated to her ratings of child dental and general health. The employment, income and education results generally do not differ for Black, Hispanic, and White mothers and their young children.

Consistent with prior studies, the social gradients emerge mainly because of social stratification in society. That is, all societies, rich or poor, structure the life experiences,

Table 4.

ASSOCIATIONS BETWEEN MOTHERS' ANNUAL HOUSEHOLD INCOME, EDUCATION AND EMPLOYMENT STATUS AND MOTHERS' RATINGS OF CHILD DENTAL HEALTH[a]

	Control Variables		
	Model 1 Individual Characteristics	**Model 2 Model 1 + Risk Factors**	**Model 3 Models 1 + 2 + Dental Care**
Mother-Rated Child Dental Health (Linear Regression Coefficients)[b,c]			
Income ($)			
<10,000	—	—	—
10,000–20,000	.09*	.07	.09*
>20,000	.19****	.15**	.14**
Education			
Less than high school	—	—	—
High school diploma or GED	.27****	.23****	.21****
Some college	.40****	.32****	.29****
College degree or more	.57****	.45****	.41****
Employed[d]	.07	.04	.04
Mother-Rated Child Dental Pain (Logistic Regression Odds Ratios)[b]			
Income ($)			
<10,000	—	—	—
10,000–20,000	.79*	.87	.88
>20,000	.81	.91	.95
Education			
Less than high school	—	—	—
High school diploma or GED	.70***	.74**	.73**
Some college	.69***	.74*	.74*
College degree or more	.45***	.45**	.45**
Employed[d]	1.02	1.03	.99

*p<.10
**p<.05
***p<.01
****p<.001

[a]Model 1: Controlling for race/ethnicity, age, single head of household, number of preschool children, number of school-aged or older children, immigrant status, household primary language not English, survey mode.

Model 2: Model 1 control variables plus smoking status, mental health status, flossing frequency, length of brushing, toothpick use, tooth whitener use, belief cleaning prevents cavities, belief cleaning prevents loose teeth, mother fear of dentist, type of dental insurance coverage.

Model 3: Models 1 and 2 control variables plus frequency of dental care.

[b]Interactions of racial/ethnic group with income, education and employment status were not significant in all models.

[c]The mother ratings of child dental health are on a 1–5 scale, where 1 = poor and 5 = excellent.

[d]Employed, full-time homemaker, in-school, military, or disabled for work versus unemployed or laid off.

Table 5.

ASSOCIATIONS BETWEEN MOTHERS' ANNUAL HOUSEHOLD INCOME, EDUCATION AND EMPLOYMENT STATUS AND MOTHERS' RATINGS OF SELF GENERAL HEALTH AND CHILD GENERAL HEALTH: LINEAR REGRESSION COEFFICIENTS[a]

	Control Variables		
	Model 1 Individual Characteristics	**Model 2 Model 1 + Risk Factors**	**Model 3 Models 1 + 2 + Dental Care**
Self-Rated General Health[b,c]			
Income ($)			
<10,000	—	—	—
10,000–20,000	.16***	.06	.05
>20,000	.36****	.19****	.17***
Education			
Less than high school	—		
High school diploma or GED	.15***	.07	.07
Some college	.26****	.12**	.10*
College degree or more	.63****	.40****	.36****
Employed[d]	.15***	.07	.05
Mother-Rated Child General Health[c,e]			
Income ($)			
<10,000	—	—	—
10,000–20,000	.03	.01	.00
>20,000	.11**	.06	.05

(Continued on p. 583)

behaviors, and the advantages and disadvantages of its members, which tend to cluster by social group, accumulate over the life course, and are transmitted from one generation to the next.[30,64–67] The stratification of individuals by social position produces the gradients, where each step up the social ladder results in improved dental and general health, more healthy behaviors, and better child development. The social, or root, causes of poor dental and general health indicate that simply changing the oral behaviors of mothers and their young children will not solve the problem.[68,69] Ideally, policy must flatten the gradient upwards by spreading the conditions for optimum oral health throughout society and particularly in lower socioeconomic groups.[64]

For example, policy that improves the education of mothers may reduce gradients in oral health in low-income mothers and their young children. We found robust relationships between maternal education and maternal and child dental and general health. If the relationships are causal, efforts to increase the education of low-income mothers may lead to improvements in their oral health, which in turn may break the transmission

Table 5. *(continued)*

	Control Variables		
	Model 1 Individual Characteristics	**Model 2 Model 1 + Risk Factors**	**Model 3 Models 1 + 2 + Dental Care**
Education			
Less than high school	—		
High school diploma or GED	.13***	.12***	.12***
Some college	.20****	.17****	.18****
College degree or more	.30****	.25***	.25***
Employed[d]	.04	.02	.02

*p<.10
**p<.05
***p<.01
****p<.001

[a]Model 1: Controlling for race/ethnicity, age, single head of household, number of preschool children, number of school-aged or older children, immigrant status, household primary language not English, survey mode.

Model 2: Model 1 control variables plus smoking status, mental health status, flossing frequency, length of brushing, toothpick use, tooth whitener use, belief cleaning prevents cavities, belief cleaning prevents loose teeth, mother fear of dentist, type of dental insurance coverage.

Model 3: Models 1 and 2 control variables plus frequency of dental care.

[b]Interactions of racial/ethnic group with income, education and employment status were not significant in all models.

[c]The mother ratings of general health are on a 1–5 scale, where 1=poor and 5=excellent.

[d]Employed, full-time homemaker, in-school, military, or disabled for work versus unemployed or laid off.

[e]Interactions of racial/ethnic group with income, education and employment status were significant only for education (Wald test $p=.037$). The interaction between Black and having a 4-year college degree or more was statistically significant in Model 3 (coefficient: −0.69; $p=.005$), indicating the positive effects of high education (0.68) are virtually eliminated in this group.

of education-health gradients to their young children. Education improvements may also lead to greater incomes and less unemployment, which also may reduce gradients. Education interventions might have greater benefits for Hispanic mothers, given their lower years of formal education, relative to Black and White mothers. The benefits of maternal education for child survival in developing countries are well known and also may apply to low-income mothers in disadvantaged places in the U.S.[70]

We found that oral health behaviors and regular dental care explained part of the relationships between income, employment status, and mother perceptions of self and child dental health. Substantial proportions of low-income mothers in our sample did not have public or private dental insurance, and expanding dental coverage may contribute to regular dental care and reduce income disparities in oral health in both mothers and their young children.[31,71] Similarly, community-based health education programs that increase oral self-care among low-income mothers may also reduce income disparities.

We found that mothers' dental health was much worse than children's dental health. Over 45% of mothers in the three racial/ethnic groups rated the condition of their teeth as fair or poor across racial/ethnic groups, while 18% of mothers rated their children's dental health as fair or poor, which is worse than the 11% found in a national survey of children aged 2–5.[34] These patterns suggest that if low-income, young children have good-to-excellent oral health, their oral health may be at risk to erode over the life course and ultimately resemble the 45% levels of fair or poor oral health in their mothers. Public health interventions are warranted to prevent higher levels of child oral health from declining as they age into adulthood.

We also found that mothers' self-rated dental health was much worse than their general health. About 25% of mothers in the three racial/ethnic groups rated their general health as fair or poor—far lower than the percentage for dental health, reinforcing the importance of public interventions to improve the oral health of low-income mothers.

Limitations and conclusions. Our findings are limited to low-income mothers of preschool children who are enrolled in Medicaid dental insurance in Washington State, and findings may not be generalizable to other places. Mothers who responded to the survey may be different than mothers who did not respond, which may affect results. Findings are based on cross-sectional survey data, which do not indicate causal relationships.

While perceived and clinical measures of oral health are correlated, results may differ in studies with clinical measures of child and mother oral health. In a representative sample of U.S. adults, education and income were associated with measures of clinical and perceived oral health after controlling for dental insurance, frequency of dental visits, diet and extent of calculus, a proxy for oral hygiene behavior.[72] Whether these findings also apply to low-income mothers in the sample is unknown.

We conclude that among low-income mothers with children aged 3–6 covered by Medicaid, mothers' education has a strong, gradient relationship with mother ratings of self and child dental health that is not explained by dental beliefs, behaviors, insurance, or regular dental care. Similar findings exist for mothers' income and employment status, but relationships are inconsistent across measures of dental health and erode when controlling for mediating factors. These relationships generally are consistent for Black, Hispanic, and White mothers.

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