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An exploratory cross-sectional analysis of socioeconomic status, food insecurity, and fast food consumption: implications for dietary research to reduce children's oral health disparities

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Abstract

Background—Tooth decay is the most common childhood disease and disproportionately affects low-income children. The dietary risk factors associated with socioeconomic status (SES), such as food insecurity and fast food consumption, are poorly understood.

Objective—To better understand how upstream social factors are related to dietary behaviors by testing the hypothesis that food insecurity mediates the SES-fast food consumption relationship.

Design—A 36-item survey was administered to caregivers of children <18 years (n=212). The predictor variable was SES, measured by whether the child was insured by Medicaid (no/yes). Food insecurity, the potential dietary mediator, was measured using the six-item U.S. Department of Agriculture Household Food Security Survey (food secure/food insecure without hunger/food insecure with hunger). The outcome variable was whether the household reported eating at a fast food restaurant ≥2 times a week (no/yes). We used logistic structural equation and mediation models to test our hypothesis.

Results—About 63% of children were low SES. Thirty-percent of caregivers reported food insecurity (with or without hunger) and 18.6% of households consumed fast food ≥2 times per week. Lower SES was significantly associated with food insecurity (OR=3.03; 95% CI=1.51, 6.04; P=0.002), but SES was not related to fast food consumption (OR=1.94; 95% CI=0.86, 4.36;

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CONFLICT OF INTEREST DISCLOSURE

All authors declare no conflicts of interest.

P=0.11). Food insecurity was not associated with fast food consumption (OR=1.76; 95% CI=0.86, 3.62; P=0.12). The mediation analyses suggest food insecurity does not mediate the relationship between SES and fast food consumption. However, there are important potential differences in fast food consumption by SES and food insecurity status.

Conclusions—Future dietary research focusing on tooth decay prevention in vulnerable children may need to account for the differential effects of SES on food insecurity and dietary behaviors like fast food consumption. Studies are needed to further elucidate the mechanisms linking SES, dietary behaviors, and tooth decay in children.

Keywords

food insecurity; fast food consumption; dental caries; children; social determinants of health

INTRODUCTION

Tooth decay (dental caries) is the most common childhood disease in the U.S. and disproportionately affects low-income children.[1–5] Untreated tooth decay can lead to pain, infection, school absences, poor academic performance, low oral health quality of life, hospitalizations, and in rare cases death.[6–9] In addition, the potential associations between poor oral health and systemic diseases such as hypertension, cardiovascular disease, peripheral arterial disease, stroke, and obesity that manifest throughout the life course have underscored the importance of identifying strategies to prevent oral diseases.[10–14] Identifying and understanding the social and behavioral determinants of oral disease are likely to be critical in eliminating oral health disparities among socioeconomically vulnerable children.[15–16]

Food insecurity, a social determinant of health, is defined as inadequate access to food that result in food shortages, disrupted eating patterns, and hunger.[17] Many low-income children live in households that encounter food insecurity, which is associated with tooth decay and other adverse childhood conditions.[18–21] A potential mechanism linking food insecurity and tooth decay is dietary behaviors, including the quantity and frequency of carbohydrate consumption.[22–23]

Dietary sources of cariogenic (tooth decay-causing) carbohydrates include candies and sweets, fruit juices, sugar sweetened beverages, crackers, and chips, and to a lesser extent breads, rice, and pasta.[24–26] In the presence of cariogenic bacteria, the consumption of fermentable carbohydrates can lead to acid production with the potential for demineralization.[27] Cavities result when the demineralization process proceeds uncontrolled. Topical fluorides found in fluoridated toothpaste, mouthwash, and drinking water as well as fluoride gels, foams, and varnishes applied to the teeth during preventive dental or medical care visits may help reverse the demineralization process.

Numerous studies have shown that fast foods are a source of dietary carbohydrates, including added sugars and sugar sweetened beverages, and studies suggest a relationship between fast food consumption and tooth decay in children.[28–31] While low socioeconomic status (SES) may be associated with food insecurity and food insecurity, in turn, is related to

tooth decay in children, the potential link between food insecurity and fast food consumption has not yet been examined.[30,32] As a result, there is a critical gap in the scientific literature regarding potential mechanisms linking upstream social factors, dietary behaviors, and child oral health outcomes. Our study goal was to start to address this research gap by testing the hypothesis that food insecurity mediates the relationship between SES and fast food consumption.

MATERIALS AND METHODS

This was a cross-sectional observational study. We approached, recruited, and verbally consented a purposive sample of caregivers with children under age 18 years seeking dental care. Bias was minimized by including all caregivers wishing to participate. Participants were recruited from a university-based pediatric dentistry clinic in Seattle, WA from December 2011 to January 2012 (n=212). After obtaining verbal consent, which was requested by the IRB to prevent potential disclosure of study participants' identities in this minimal risk study, we administered a 36-item survey to caregivers. The English language survey included questions on parent demographics (e.g., age, sex, race, ethnicity, education, employment, marital status), child characteristics (dental insurance), and household demographics (income, food insecurity, fast food consumption). The study was approved by the University of Washington Institutional Review Board.

A preliminary conceptual model is presented based on previous work that examined socioeconomic status (SES), food insecurity, and tooth decay in children (Figure 1). In our study, a proxy for SES was whether the child was insured by Medicaid (no/yes). The proposed mediator, food insecurity, was measured using the six-item U.S. Department of Agriculture Household Food Security Survey.[33] Based on the number of affirmative responses to the six questions, we assigned each participant to one of three categories: food secure (0 or 1 affirmative responses), food insecure without hunger (2 to 4 affirmative responses), or food insecure with hunger (5 or 6 affirmative responses). To measure fast food consumption (FFC), the outcome measure, we asked participants "how many times per week do you and your family eat from a fast food restaurant?". The possible choices ranged from zero to ≥10. Based on a previous operationalization of FFC, we classified those who reported eating at a fast food restaurant ≥2 times a week as "yes" and remaining participants as "no".[34]

After generating descriptive statistics, we fit a series of logistic structural equation models (SEM) using maximum likelihood estimation.[35] These models resulted in odds ratios and 95% confidence intervals (α=0.05). We evaluated the bivariate relationships between (1) SES and food insecurity; (2) SES and FFC; and (3) food insecurity and FFC.[36] Statistically significant bivariate relationships between predictor (SES) and outcome (FFC) as well as mediator (food insecurity) and outcome (FFC) are typically necessary conditions prior to testing for mediation. However, estimated effect sizes and statistical power (β) based on the odds ratios from the logistic SEM indicated that our analyses were not adequately powered to detect large effect sizes (β=0.33 and β=0.35, respectively).[37] Thus, we conducted descriptive mediation analyses to test our hypothesis without regard to the statistical significance of the bivariate relationships.[38] In the mediation model, we bootstrapped the

standard errors and estimated the total, direct, and indirect effects. We estimated indirect effects using odds.[35,39] Consistent with our a priori conceptual model, there were no hypothesized confounders.[18] All statistical analyses were conducted using Mplus version 7 for Windows (Los Angeles, CA: Muthén & Muthén).[40]

RESULTS

There were 212 caregivers included in the analyses. The mean age of caregivers was 39.7 years (SD: 9.7) (Table 1). Nearly 77% of surveyed caregivers were female and 58.5% were White. Most caregivers had completed at least some college, 17.9% had lost a job in the past 12 months, and 56.1% were married. Sixty-three percent of the children were insured by Medicaid. Most children lived in food secure households (61.2%), 20.6% lived in food insecure households with no hunger, and 10.5% lived in food insecure households with hunger. Eighty-one percent of children lived in households that consumed fast foods ≤1 times per week and the remaining 18.6% of children consumed fast foods ≥2 times per week (range: 0 to 7 times per week; mean±SD: 0.91±1.13; data not shown).

There was a significant association between low SES and food insecurity (Odds Ratio [OR]: 3.03; 95% confidence interval [CI]: 1.51, 6.04; P=0.002), However, we did not observe a statistically significant relationship between SES and FFC (OR: 1.94; 95% CI: 0.86, 4.36; P=0.11) or between FFC and food insecurity (OR: 1.76; 95% CI: 0.86, 3.62; P=0.12).

Based on the mediation analyses, there were four main findings (data not shown). First, we found that regardless of SES status, food insecure children were three times as likely to consume fast food (OR: 3.03; 95% CI: 1.51, 6.04; P=0.005) as food secure children. Second, among food secure households, low SES children were twice as likely to consume fast food (OR: 2.09; 95% CI: 0.76, 5.74; P=0.053) as high SES children. Third, among high SES households, food insecure children were nearly three times as likely to consume fast food (OR: 2.80; 95% CI: 0.6, 10.20; P=0.203) as food secure children. Fourth, among children from food insecure households, low SES children were less likely to consume fast food than all other children (OR: 0.53; 95% CI: 0.09. 2.32; P=0.264).

The total effect was 0.09, the indirect effect was 0.03, and the direct effect was 0.07. Considering the joint relationships among SES, food insecurity, and FFC, the likelihood of consuming fast food increases 0.09 based on the direct and indirect effects of SES on FFC. We created a ratio of the indirect effect (0.03) to total effect (0.09). This represents the proportion of FFC attributable to influence of SES on food insecurity alone ignoring all other effects SES may have on FFC. In other words, food insecurity accounts for about 33% of FFC. Similarly, one minus the ratio of the direct effect (0.07) to the total effect (0.09) indicates the proportion of FFC that would occur due to SES's influence on FFC alone ignoring SES's influence on FFC through food insecurity. This indicates 16% of FFC is attributable to SES's influence on food insecurity.

DISCUSSION

We surveyed a purposive sample of caregivers of children under age 18 years and found that low SES is significantly associated with food insecurity. However, food insecurity was not

significantly related to fast food consumption, a potential risk factor for tooth decay in children. The former is consistent with previous work based on data from a nationally representative group of U.S. children.[18] The latter is a potentially new addition to the literature. Collectively, our findings provide insight into possible mechanisms linking upstream social and dietary factors and child oral health outcomes. Our findings demonstrate the need for additional research with larger sample sizes to identify the dietary and nutritional mediators that potentially link food insecurity and tooth decay in low SES children. This knowledge is critical in developing empirical conceptual models that can help to guide the development of clinical interventions and broader health policies aimed at eliminating oral health disparities within socioeconomically vulnerable child populations.

Fast food consumption leads to adverse health conditions, including obesity, hypertension, cardiovascular disease, and tooth decay.[31,41–43] When coupled with the knowledge that fast foods expose children to excess sugars, fats, and sodium, researchers, clinicians, and public health advocates have endorsed population-based interventions that seek to reduce fast food consumption in children. However, recent work has questioned this approach based on the influence the remainder of the child's diet can have on health outcomes.[44] Similarly, in regards to oral health, any potential adverse effects associated with fast foods are likely to be modified by factors such as exposure to topical fluorides and access to preventive care. In other words, a child at increased risk for tooth decay because of fast food consumption can have their risk modified through frequent tooth brushing with fluoride toothpastes and regular visits to the dentist. These findings suggest that future dietary and nutritional interventions in oral health focusing on behavior change need to focus not only on improving the quality of the diet but also on reinforcing hygiene behaviors and fluoride use.

We also found that a higher proportion of FFC was attributable to the influence of SES alone (33%) as opposed to the effects of SES on food insecurity (16%). These findings suggest that SES is an important correlate of FFC but that addressing food insecurity cannot be ignored as a target of interventions aimed at reducing FFC in children.

There were three main study limitations. First, we used self-reported measures. We adopted the six-item USDA food insecurity screener, which is effective at identifying food insecure households.[45] Single item fast food consumption measures have been shown to have high reliability but may have low validity.[46] Post-hoc sensitivity analyses testing different operationalizations of fast food consumption (e.g., ≥1 time per week, ≥3 times per week) did not change our results, though concerns about self-reported measures persist. Relatedly, we did not collect information on the specific types of fast foods consumed. Future work should continue to develop self-reported fast food consumption measures with demonstrable psychometric properties and include data collection focusing on specific types of food consumed by low-income children during fast food restaurant visits.

Second, we assumed heterogeneity in the effects of food insecurity and fast food consumption. Our data did not reveal any evidence of SES-based heterogeneity, but there is a possibility of differences across other moderators such as race. This finding is particularly relevant in light of recent studies suggesting that race-based disparities in fast food consumption as well as race-based disparities in food insecurity and tooth decay.[47–49] Future

work should continue to identify potential moderators of food insecurity to enable researchers to construct more complete conceptual models, which are critical in developing evidence-based interventions and policies aimed at preventing tooth decay and other systemic health outcomes.

Third, our study was based on a relatively small, purposive sample of caregivers recruited from one site and had a limited recruitment period (two months), which limits generalizability to other populations. We lacked statistical power to detect even relatively large effect sizes. Our findings in regards to food insecurity within low versus high SES households and income-related differences within food secure versus food insecure households has important policy implications. For example, SES appears to have an impact on fast food consumption most strongly due to the fact that fast food consumption increases dramatically among higher SES, food insecure individuals. Broad public health efforts aimed at improving SES without also increasing food security may actually increase fast food consumption, which has adverse health implications. Future studies with a larger sample (n>2000) recruited from multiple sites would help to better understand this potentially important influence on fast food consumption.

Dietary behaviors are important risk factors to address in solving children's oral health disparities, which underscores the clinical and research significance of the current exploratory study. The clinical significance of our findings is that nutritional counseling for caregivers of children occurring in dental settings should focus on reducing a child's exposure to fermentable carbohydrates (e.g., sweets, sugar sweetened beverages). Nutritional counseling will involve educating caregivers about making healthier food choices when eating away from home, including fast food restaurants. However, this strategy may be difficult for caregivers to implement in the context of misleading marketing by food companies and inadequate information on nutritional content from restaurants.[50–52] Other home-based nutritional strategies may include the incorporation of non-cariogenic sweeteners, including xylitol and other polyols, to replace sugars in foods and beverages.[53] In addition to nutritional counseling, health professionals should reinforce the importance of regular visits to the dentist, proper oral hygiene behaviors, and twice daily exposure to fluorides available through fluoridated toothpastes to help offset dietary risk factors associated with poor oral health.[54]

The research significance of our study findings is that the potential mechanisms linking food insecurity and tooth decay in children remain unclear, which hampers our ability to design evidence-based dietary interventions and policies aimed at reducing tooth decay in vulnerable children. Other untested dietary and nutritional mediators include sugar sweetened beverage consumption, specific micronutrient intake, participation in breakfast routines and meals, and access to meals prepared at home. Future work should evaluate these hypotheses to allow for further elucidation of our preliminary conceptual model (Figure 1). Prospective, longitudinal study designs would enable researchers to test the full model on a single study population.

CONCLUSION

There is a need for additional basic behavioral and social research to clarify the complex relationship between upstream social factors like socioeconomic status, food insecurity, nutrition- and hygiene-related behaviors, and child oral health outcomes. Such knowledge could be generated using nationally representative datasets, including the U.S. National Health and Nutrition Examination Survey (NHANES), which contain questions pertaining to oral health behaviors and clinical outcomes. More detailed primary data collection efforts will be needed to measure and assess the effects of other oral health-related risk factors for tooth decay. These findings could then be used to develop and test dietary and nutrition interventions aimed at improving the oral health of socioeconomically vulnerable children and eliminating pediatric oral health disparities.

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Practice Implications

What is the current knowledge on this topic?

Children from low-income households are at increased risk for food insecurity and poor oral health, but the mechanisms linking poverty and dietary behaviors like fast food consumption are unknown.

How does this research add to knowledge on this topic?

Food insecurity does not appear to significantly mediate poverty and fast food consumption. However, there are important potential differences in fast food consumption by poverty and food insecurity status.

How might this knowledge impact current dietetics practice?

Broader interventions and policies aimed at improving child oral health outcomes by addressing poverty may also need to specifically address the social determinants of health like food insecurity.

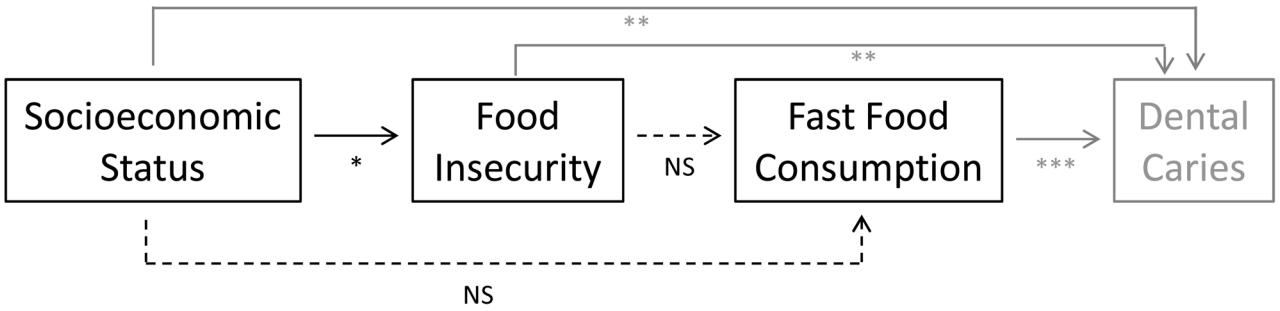

FIGURE 1. Preliminary Conceptual Model of the Relationship between Socioeconomic Status, Food Insecurity, Fast Food Consumption, and Dental Caries in Children

NS Not statistically significant (current study)

*Statistically significant (current study)

** Statistically significant (Chi et al. 2014)

*** Statistically significant (Schroth et al. 2013)

Light gray boxes and arrows indicate portions of model not tested in current study

Hatched arrows indicate non-statistically significant relationship

TABLE 1

Characteristics of Study Population of Children under Age 18 Years to Examine Socioeconomic Status, Food Insecurity, and Fast Food Consumption (N=212)

Characteristics	N (%) or Mean ± Standard Deviation
Caregiver Age	39.7 ± 9.7 years
Caregiver Sex	
Female	163 (76.9)
Male	49 (23.1)
Caregiver Race	
American Indian/Alaska Native	5 (2.4)
Black or African American	27 (12.7)
Asian	24 (11.3)
Native Hawaiian or Pacific Islander	2 (<1.0)
White	124 (58.5)
Other	27 (12.7)
No response	2 (1.4)
Caregiver Ethnicity	
Hispanic	28 (13.2)
Non-Hispanic	182 (85.8)
No response	2 (<1.0)
Caregiver Education	
Less than high school	11 (5.2)
High school or GED	41 (19.3)
Some college	98 (46.2)
Completed 4-year college or more	60 (28.3)
Caregiver Employment	
Ever lost a job in the past 12 months	38 (17.9)
Caregiver Marital Status	
Married	119 (56.1)
Widowed	4 (1.9)
Divorced	25 (11.8)
Separated	13 (6.1)
Never married	35 (16.5)
Living with a partner	14 (6.6)
No response	2 (<1.0)
Child Dental Insurance	
Medicaid	134 (63.2)
Private	50 (23.6)

Characteristics	N (%) or Mean ± Standard Deviation
Self-pay	6 (2.8)
Other	19 (9.0)
No response	3 (1.4)
Annual Household Income	
<$20,000	53 (25.0)
$20,000 to $30,000	41 (19.3)
$30,000 to $40,000	28 (13.2)
$40,000 to $50,000	22 (10.4)
$50,000 to $60,000	14 (6.6)
>$60,000	44 (20.8)
No response	10 (4.7)
Food Insecurity Status	
Food Secure	144 (68.9)
Food Insecure without Hunger	43 (20.6)
Food Insecure with Hunger	22 (10.5)
Fast Food Consumption Frequency	
Zero or One Time Per Week	171 (81.4)
Two or More Times Per Week	39 (18.6)