2024

The impact of race/ ethnicity on the oral health food insecurity association among U.S. adults

BOSTON UNIVERSITY

HENRY M. GOLDMAN SCHOOL OF DENTAL MEDICINE

THESIS

THE IMPACT OF RACE/ ETHNICITY ON THE ORAL HEALTH FOOD INSECURITY ASSOCIATION AMONG U.S. ADULTS

by

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BDS Bahria University, Islamabad, 2017

Submitted in partial fulfillment of the requirements for the degree of Master of Science in Dentistry (MSD) In the Department of Dental Public Health

2024

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DEDICATION

This degree is dedicated to my mother, who lost her battle with cancer in 2023; she was the focus of my life and, unfortunately, was not able to see me graduate.

ACKNOWLEDGMENTS

I want to thank the Department of Public Health faculty, especially Dr. Tavares, who supported me and provided guidance through multiple aspects of the program. I would also like to thank Dr. Kaye for her efforts, who was patient with me and helped me through the difficulties of understanding the Statistical Analysis System, along with Dr. Robert McDonough. Finally, Professor Scott gave me thoughtful input and continuous encouragement and helped me shape this paper.

THE IMPACT OF RACE/ ETHNICITY ON THE ORAL HEALTH FOOD INSECURITY ASSOCIATION AMONG U.S. ADULTS

FATIMA ASGHAR CHAUDHRY

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Objective: Food insecurity is a significant health concern that limits access to nutritional foods, with some racial and ethnic groups experiencing more food insecurity. Aim: To examine the impact of race/ethnicity on the relationship between food insecurity and oral health outcomes.

Methods: This cross-sectional study utilized the 2011- 2012 and 2013- 2014 NHANES cycles. The sample included 7,274 adults (20-65 years) with complete data for food security, oral health outcomes, and race/ethnicity. The primary outcomes were active caries (yes/no) and periodontal disease (none/mild vs moderate/severe). The primary independent variable was adult food security (full/marginal, low/very low); the modifier was self-reported race/ethnicity. Descriptive statistics were stratified by race/ethnicity and food insecurity status. Logistic regression models investigated race/ethnicity modification effects on the food security-oral health relationship. Analyses using SAS V9.4 accounted for NHANES complex sampling design.

Results: Food insecurity was lowest for non-Hispanic Whites (13.1%) and "Other" races (13.9%). Hispanics (27.7%) and non-Hispanic Blacks (24.3%) had the highest prevalence. Food insecurity effects on active caries were elevated across all races/ethnicities; however, no statistically significant interaction was detected between the groups in multivariate models (OR:(95%CI) Hispanic=1.7:(1.2-2.4), non-Hispanic white=2.0:(1.5-2.6), non-Hispanic Blacks=1.4:(1.0-1.8), Other races=1.1:(0.6-2.0)); food security*race/ethnicity interaction p-

value=0.22. While race/ethnicity ORs for the food security-periodontal disease relationship differed, the differences were statistically significant (Hispanic=1.2:(0.9-1.5), White=1.6:(1.2-2.1), non-Hispanic Blacks=1.2:(0.95-1.6), Other races=3.1:(1.3-7.4); food security*race/ethnicity interaction p-value=0.025).

Conclusion: While there were significant differences in race/ethnicity and food security, we did not detect these differences in food insecurity's impact on oral health when looking at caries interaction. However, there were significant differences in race/ethnicity in terms of periodontal disease.

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i. Background

Food insecurity is “the condition of not having access to sufficient food, or food of an adequate quality, to meet one's basic needs.” (Oxford et al., 2023). According to the United States Department of Agriculture, in 2021, 33.8 million people lived in food-insecure households (USDA ERS, 2023). Individuals with food insecurity have problems providing enough food to feed their household, let alone accessing healthy, nutritious food (CDC, 2022). This staggering number leads to many related issues besides poor oral health and general health, such as injury (falls have been linked to vitamin D deficiency and frailty caused primarily by low nutritional intake and food insecurity) (Mosen et al., 2019), infectious disease, and anxiety, premature deaths due to unintentional injuries and even suicide. Food insecurity also negatively impacts employment opportunities, education, and other socioeconomic factors (Wiener et al., 2018). Racial differences exist in access to food. Food insecurity is significantly higher in the Hispanic and African American populations in the U.S. In 2022, nearly 20% of African Americans and 17% of Hispanics in the US experience food insecurity compared to 7% among non-Hispanic Whites in the same year (Feeding America, 2023b).

Oral diseases also demonstrate racial differences. Dental caries affects many in the U.S. National studies have shown that 65% of children under 18 and 95% of adults younger than 65 are affected by tooth decay (CDC, 2019). Untreated tooth decay in 20–64-year-old adults is highest in non-Hispanic Blacks (42%), followed by Hispanics (36%), while 22% of non-Hispanic Whites experience untreated decay. Periodontitis is another prevalent dental disease in the US, with almost half of US adults (46%) having periodontitis, with the highest prevalence among Hispanics (63.5%), followed by non-Hispanic Blacks (59.1%), and lowest among non-Hispanic Whites (40.8%) (Eke et al., 2015).

While numerous reports explore the relationship between food insecurity and oral health among children, research is limited for adults. One study explored the effects of food security on U.S. adults and reported that after controlling for confounders, adults experiencing food insecurity had 1.2 times higher odds of having untreated dental caries than those who are food secure (Bahanan et al., 2021). A study done assessing periodontitis and its relationship to food insecurity in adults both in the U.S and Korea also found that higher levels of food insecurity lead to elevated odds of periodontitis among middle-aged U.S. adults (40-59 years) than food-secure middle-aged U.S. adults (although the odds of periodontitis 1.4 times higher level in the U.S middle aged adults (35%) as compared to Korean (27%)). The results of tooth decay among older adults when comparing U.S. and Koreans were similar to middle-aged adults as well (Lee et al., 2022). This result is logical since nutrition plays a vital role in the prevention of periodontitis and also in maintaining periodontal health (vitamins A, C, E, glutathione, and melatonin). Hence, a balanced diet is required for good oral health (Mehta, 2018).

There are many reasons why racial differences in oral diseases occur, and food insecurity may be one potential relationship. Since there are racial disparities in dental disease and access to food, this raises the potential that race may modify the food insecurity-dental disease relationship. This project analyzes two data cycles from National Health and Nutrition Examination surveys to test the hypothesis that low food security significantly influences working-age adults' oral health outcomes (such as caries and periodontal status) differently by race/ethnicity.

ii. METHODS

We conducted our study using the National Health and Nutrition Examination Survey (NHANES) 2011-2012 and 2013-2014 cycles. The National Center for Health Statistics and the Centers for Disease Control (CDC) conducts the NHANES survey research program, which is vital in collecting information about the nation's health. The information collected by NHANES is mainly through interviews, physical examinations, clinical measurements, and laboratory tests.

STUDY DESIGN AND VARIABLES:

The study design is cross-sectional, with a total population size of 7,274 individuals after the inclusion criteria were applied. The target population was working-age adults aged 20 to 65 years. For caries analyses, the inclusion criteria were being 20 to 65 years old and having complete information for analyzed variables, including a caries assessment, resulting in a sample size of 7274 adults. Since NHANES does not collect periodontal measures on participants younger than 30 years, the inclusion criteria for the periodontal analysis were being between 30 and 65 years old, who underwent a periodontal examination, and with complete information on the exposure, outcomes, or covariates resulting in 5582 adults aged 30 and above.

The primary outcome is oral health, which is analyzed as two outcomes: either active decay (DT) (present/absent) or periodontal disease (none/mild vs moderate/severe). Calibrated examiners performed caries and periodontal examination procedures with the exclusion of third molars. Periodontal status was defined as none/mild, including those with no attachment loss or mild loss (>=2 interproximal sites with LOA >=3 mm, AND >=2 interproximal sites with PD >=4 mm (not on the same tooth) or one site with PD >=5 mm). Moderate/severe periodontal status included moderate loss (>= two interproximal sites with LOA >=4 mm (not on same

tooth), OR >=2 interproximal sites with PD>=5 mm (not on the same tooth), and severe loss (>= two interproximal sites with LOA >=6 mm (not on the same tooth) AND >=1 interproximal site with PD >=5 mm) (Eke, 2012). Active or untreated decay (including white spots and frank lesions) was categorized as present or absent (*Oral et al.*, 2013).

The primary independent variable was household food security. NHANES datasets include a food security questionnaire to determine household food security. Ten questions were asked to determine adult food security: whether they ran out of food, that it did not last, could not afford balanced meals, if they cut to size or skipped meals and how often, if they ate less than they should if they were hungry but did not eat lost weight, but no money for food, if they did not eat for a day, and how often. For this paper, the adult food security category for the last 12 months was calculated at a household level. Households that self-identified as full or marginal food security were categorized as secure (2 or fewer affirmative responses). In contrast, those reporting low or very low food security were categorized as food insecure (3 or more affirmative responses).

We explored whether race/ethnicity modifies the food insecurity-oral health relationship. Race/ethnicity was based on responses to the NHANES Demographic questionnaire. It was recategorized as Hispanic (combined Mexican American and Hispanic), non-Hispanic White, non-Hispanic Black, and 'other' race/ethnicity, which included multiracial.

The following potential covariates were also explored: age (divided into four categories: 20-29, 30-39, 40-49, and 50-65) and gender (male or female). Marital status was analyzed as married/ with a partner (married or living with a partner) or unmarried/partnered (widowed, divorced, separated, never married). Education was dichotomized into at least some college (attended some form of education higher than high school) or less than college (did not attend

any higher education beyond high school). The family income to poverty ratio divides the family (or individual) income by the poverty guidelines specific to the family size to the survey year, which ranges from 0 (no income) to 5.0 (highest income) and is analyzed as a continuous variable in this study. Employment was dichotomized as employed (including those with a job or business) or unemployed (looking for a job or not working at a job or a business). Insurance was categorized as those who reported health insurance coverage (yes, no). Average sugar intake was determined from two 24-hour dietary recalls for total sugars consumed. Smoking status was analyzed as current cigarette smokers (report currently smoking), former smokers (report smoking at least 100 cigarettes in a lifetime but not smoking currently), and nonsmokers (report smoking less than 100 cigarettes in a lifetime). Four races were compared: Hispanics, non-Hispanic whites, non-Hispanic Blacks, and Others.

Descriptive analysis included weighted frequencies and means stratified by race/ethnicity and food security/insecurity status. Multivariate logistic regression was performed to estimate the associations between food security and oral conditions (periodontal disease (none/mild vs moderate/severe) and active caries (yes/no)) stratified by race/ethnicity. Covariates in the model were selected based on the research literature and their significant association in crude analysis. A race/ethnicity*food insecurity interaction term was added to detect if there was a significant racial difference in the association between food insecurity and race/ethnicity in the oral health relationship. All analyses were performed using SAS version 9.4 survey procedures, accounting for NHANES' complex study design.

iii. RESULTS:

Table 1 shows the descriptive results of our analysis. The highest prevalence of food insecurity was found among Hispanics (27.6%) and non-Hispanic Blacks (24.3%), while the 'Other' race (14%) and Non-Hispanic Whites (13%) had less food insecurity. Food Insecurity was highest among Hispanics aged 30-39 years, closely followed by 20–29-year-old 'Other,' whereas 30–39-year-old non-Hispanic Blacks and 50–65-year-old Hispanics experienced the least. Food insecurity prevalence was higher among non-Hispanic Black females and 'Other' race females than their male counterparts. Food insecure Hispanics and Non-Hispanic Blacks were less likely to have a college education, with the most significant impact among Hispanics. A higher prevalence of food insecurity was detected among unemployed Hispanics and Other races, those with lower incomes, and all insured individuals. A higher proportion of food-insecure individuals reported being non-partnered or unmarried, except non-Hispanic Blacks.

Food-insecure individuals of all races/ethnicities were more likely than food-secure to be current smokers, with food-insecure non-Hispanic whites having the highest prevalence of current smoking. In contrast, food-insecure Hispanics had the lowest percentage of current smokers. The mean sugar intake was higher among food-insecure non-Hispanic whites, followed by 'Other' races and non-Hispanic Blacks. Food-insecure individuals were more likely to have active decay or moderate/severe periodontal disease, which was most prominent among food-insecure African Americans.

Table 1: Description of the study population stratified by race/ethnicity and food security status (NHANES 2011-2014 weighted percentages)

	HISPANICS		Non- Hispanic Whites		Non- Hispanic Blacks		OTHERS	
	Food Secure 72.3%	Food Insecure 27.6%	Food Secure 87.0%	Food Insecure 13.0%	Food Secure 75.6%	Food Insecure 24.3%	Food Secure 86.0%	Food Insecure 14.0%
Age								
20-29	28.0%	29.2%	18.6%	25.7%	22.9%	29.0%	25.2%	30.5%
(30-39yrs)	26.3%	31.8%	19.0%	22.0%	21.3%	23.0%	24.0%	22.8%
(40-49yrs)	24.6%	19.8%	21.7%	23.5%	22.6%	19.0%	24.5%	24.1%
(50-65yrs)	20.9%	19.0%	40.5%	28.6%	32.9%	28.8%	26.1%	22.4%
Gender								
Male	51.6%	51.8%	49.9%	51.8%	46.2%	44.3%	48.2%	46.4%
Female	48.3%	48.1%	50.0%	48.1%	53.7%	55.6%	51.7%	53.5%
Education								
Some college	45.4%	28.7%	74.0%	50.6%	60.6%	43.0%	77.7%	56.4%
Less than college	54.5%	71.2%	25.9%	49.3%	39.3%	56.9%	22.2%	43.5%
Employed								
Yes	72.2%	64.1%	74.2%	59.2%	68.3%	49.6%	71.8%	57.7%
No	27.7%	35.8%	25.7%	40.7%	31.6%	50.3%	28.1%	42.2%
Partnered								
Yes	67.4%	60.1%	67.6%	51.3%	43.3%	31.9%	65.8%	56.8%
No	32.5%	39.8%	32.3%	48.6%	56.6%	68.0%	34.1%	43.1%
Income Ratio								
Mean Family Income to Poverty Ratio± S.E	2.3±0.08	1.2±0.05	3.5±0.10	1.6± 0.07	2.5±0.13	1.3±0.08	3.2± 0.08	1.6±0.18

Insurance								
Yes	59.3%	42.4%	87.1%	67.3%	76.0%	60.2%	80.6%	62.1%
No	40.6%	57.5%	12.8%	32.6%	23.9%	39.7%	19.3%	37.8%
Smoker								
Current Smoker	13.9%	18.2%	19.4%	49.0%	22.6%	33.3%	16.2%	40.9%
Former Smoker	20.3%	18.6%	23.8%	18.1%	12.4%	10.4%	14.5%	14.0%
Never Smoked	65.6%	63.0%	56.6%	32.8%	64.8%	56.1%	69.1%	44.9%
Sugar Intake(g)								
2 days (mean± S.E)	116±2.0	117±3.6	112±1.8	134±3.9	116±2.4	124±6.3	93.7±2.3	132±8.2
Active Caries (DT)								
Yes	32.1%	49.5%	20.9%	47.4%	40.5%	54.7%	23.6%	39.5%
No	67.8%	50.4%	79.0%	52.5%	59.4%	45.2%	76.3%	60.4%
Periodontal Status								
No/Mild	54.2%	46.4%	74.2%	52.2%	51.3%	42.6%	64.8%	33.8%
Moderate/severe	45.7%	53.5%	25.7%	47.7%	48.6%	57.3%	35.0%	66.1%

Table 2. MULTIVARIATE LOGISTIC REGRESSION MODEL PREDICTING ACTIVE CARIES (yes/no) STRATIFIED BY RACE/ETHNICITY.												
	Hispanics			Whites			Blacks			Others		
Effect	Odds Ratio	95%Confidence Limits		Odds Ratio	95%Confidence Limits		Odds Ratio	95%Confidence Limits		Odds Ratio	95%Confidence Limits	
Male (ref=Female)	1.20	0.87	1.66	1.24	0.91	1.68	1.10	0.90	1.35	0.60	0.39	0.94
Age (ref=50-65)												
20-29	1.01	0.63	1.63	1.14	0.87	1.49	0.97	0.70	1.36	1.09	0.45	2.64
30-39	0.85	0.60	1.21	1.34	0.91	1.93	1.23	0.85	1.79	1.44	0.89	2.35
40-49	0.99	0.76	1.29	1.08	0.84	1.40	1.31	1.06	1.63	0.94	0.46	1.92
Uninsured (ref=Insured)	2.06	1.63	2.61	2.42	1.88	3.16	1.56	1.25	1.95	2.36	1.39	4.02
Not partnered (ref=partnered)	1.04	0.78	1.29	1.22	0.94	1.59	1.86	1.54	2.25	1.46	0.90	2.37
Mean Family Income to Poverty Ratio	0.82	0.74	0.91	0.80	0.74	0.86	0.82	0.77	0.88	0.82	0.69	0.96
No college (ref=some College or higher	1.51	1.16	1.96	2.21	1.60	3.06	1.81	1.36	2.37	1.70	1.07	2.71
Current Smoker (ref= never smoked)	1.10	0.68	1.77	2.52	1.90	3.20	1.73	1.36	2.20	1.72	1.02	2.91
Former Smoker (ref=never smoked)	1.28	0.86	1.92	1.14	0.82	1.60	1.03	0.77	1.36	2.30	1.31	4.00
Mean sugar (per 10 gm/day)	1.00	0.98	1.02	1.02	1.00	1.03	0.99	0.98	1.01	1.03	1.00	1.07
Food-Insecure (ref=Food Secure)	1.72	1.23	2.41	2.00	1.51	2.64	1.38	1.04	1.84	1.13	0.64	1.98

P-value for food security*race/Ethnicity interaction term =0.22

In Table 2, multivariate logistic regression models were performed for active decay and periodontal disease after stratifying for race. In terms of gender, only males of the 'Other' race showed a significant association with active caries. Non-Hispanic Blacks who were never married or aged 40-49 had higher odds of active caries. The odds of untreated caries were elevated across all races/ethnicities for uninsured individuals with less than a college education and lower income. Additional unique relationships were detected for individual races/ethnicities, with non-Hispanic Whites or Blacks demonstrating elevated odds if they were current smokers or among 'Other' race individuals who were current/former smokers. An increased risk was found between sugar and active caries among Whites and the 'Other' race; however, not for Hispanics and non-Hispanic Blacks. Food insecurity was strongly associated with increased odds of caries among Hispanics, non-Hispanic Whites, and Blacks, but not for the 'Other' race. However, after the interaction terms were applied, no statistically significant difference was found between the ethnic groups for food insecurity, demonstrating similar elevated odds across all ethnicities ($p=0.22$)

Table 3. MULTIVARIATE LOGISTIC REGRESSION MODEL PREDICTING PERIODONTAL DISEASE (moderate/severe vs mild/none) STRATIFIED BY RACE/ETHNICITY.

	Hispanics			Whites			African American			Among Others		
Effect	Odds Ratio	95% Confidence Limits		Odds Ratio	95% Confidence Limits		Odds Ratio	95% Confidence Limits		Odds Ratio	95% Confidence Limits	
Male (ref=Female)	2.20	1.67	2.83	2.09	1.68	2.60	2.13	1.55	2.92	1.29	0.84	2.00
Age(ref=50-65)												
30-39	0.30	0.18	0.49	0.21	0.13	0.34	0.27	0.19	0.39	0.22	0.13	0.36
40-49	0.65	0.48	0.89	0.47	0.35	0.61	0.57	0.37	0.86	0.44	0.27	0.70
Uninsured (ref=insured)	2.55	2.10	3.09	1.88	1.41	2.51	1.51	1.04	2.21	1.23	0.71	2.13
Not partnered (ref= partnered)	0.98	0.76	1.28	1.58	1.14	2.19	1.26	0.98	1.62	0.74	0.51	1.09
Mean Family Income to Poverty Ratio	0.80	0.70	0.92	0.86	0.79	0.93	0.82	0.73	0.91	0.81	0.70	0.93
No College (ref=Some college or higher	2.44	1.77	3.35	2.14	1.71	2.69	2.00	1.52	2.78	2.30	1.43	3.71
Current Smoker (ref=never smoked)	1.86	1.20	2.87	5.10	3.89	6.70	2.08	1.40	3.09	3.12	1.51	6.46
Former Smoker	1.08	0.80	1.45	2.00	1.55	2.59	1.58	1.11	2.25	1.11	0.66	1.86
Food Insecure (ref= Food Secure) *	1.15	0.87	1.51	1.57	1.18	2.09	1.23	0.95	1.60	3.12	1.31	7.39

*p-value for food security*race/ethnicity interaction= 0.025

Table 3 shows that Periodontal (moderate/severe) disease was significantly associated with increasing age, current smoking, less than a college education, and lower income in all race/ethnic groups. Non-Hispanic White, non-Hispanic Black, and Hispanic Men had increased the odds of periodontal disease compared to females. All age groups showed a significant increase in association with periodontal disease as age increased. Being uninsured increases the odds of periodontal disease among all races except the 'Other' race. All races demonstrated statistically significant increased odds of periodontal disease among current smokers, with the highest odds found for non-Hispanic whites and 'Other' races. Non-Hispanic Blacks and non-Hispanic whites who were former smokers also had higher odds of periodontal disease. Current/former smokers and periodontal disease, followed by 'Other.' Whites who never married had higher odds of being at risk for periodontal disease. Food insecurity is significantly associated with increased odds of periodontal disease among Whites and "Other" race. In contrast, food security status did not elicit a statistically significant relationship for Hispanics and non-Hispanic Blacks. After applying the interaction term, the food security relationship indicated statistically significant differences in race/ethnicity in the association between food insecurity and periodontal disease (P=0.025).

iv. Discussion:

We explored the prevalence of food insecurity among different races/ethnicities and whether it may have varied effects on the prevalence of caries and periodontal disease in various races. We wondered whether Hispanics and non-Hispanic Blacks would have higher rates of both caries and periodontal disease based on their food security status; as discussed earlier, these races have significantly higher food insecurity experiences. However, while our periodontal disease analysis did detect a statistically significant difference between the races, it was with food-insecure non-Hispanic Whites and the 'Other' race who had elevated odds of periodontal disease compared to those who were food-secure. However, our study results did not support the hypothesis for untreated caries as the different races were found to have similar elevated odds of untreated dental caries if they were food insecure. Another issue faced by minorities such as Hispanics and Blacks is stereotypes present in American societies regarding certain ethnicities. Although less research is present on this matter, national data has shown that Whites view Blacks, Hispanics, as well as Asians negatively compared to their white counterparts (Bulatao & Anderson, 2019).

While no studies have explored racial differences in food security and oral health in adults, most of the previous literature focuses on Hispanics and non-Hispanic Blacks rather than surveying the food insecurity impact among different races. For example, two studies explored the effects of food insecurity on oral health, specifically focusing on Hispanic children (Varela et al., 2022) (explored children aged 0-3 years of age); and Potochnick et al., 2019 (children aged 8-16 years of age). Both studies reports had consistent findings indicating that food insecurity

has negatively impacted Hispanic children in the U.S., especially younger children, leading to adverse health outcomes, lack of nutrition, obesity, and anxiety, to name a few.

Based on our results, we can understand there are greater odds of periodontal disease among the food insecure vs food secure non-Hispanic whites and Others. A previous study that investigated neighborhood effects on periodontal disease prevalence indicated that low-income Whites living in disadvantaged neighborhoods had higher odds of severe periodontitis as compared to those living in high-income areas (Borrell et al., 2006).

A potential issue is that minorities, such as Hispanics and Blacks, face stereotypes in American society. In a provider-patient setting, these beliefs can impact the decision in provider perception;. However, less research is present on this matter, national data has shown that Whites view Blacks, Hispanics, as well as Asians negatively compared to their white counterparts. Non-Hispanic Blacks and Hispanics may experience so many additional barriers that any differences in food security status may have less of an impact on their oral health, with both food secure and food insecure experiencing higher odds of dental disease (Bulatao & Anderson, 2019).

Prior literature has focused on the lack of health insurance and social determinants of health and its implications (Velasco-Mondragon et al., 2017), which indicated that not having health insurance leads to an increased risk of health-related issues and many other socioeconomic factors, as the article indicated Hispanics who are primarily uninsured are living below the poverty level but not low enough in states such as Texas and Florida thus making them ineligible for Medicaid. Lack of insurance leads to fewer health screenings and follow-ups.

v. **Strength/Weakness:**

This study was a cross-sectional study design that used NHANES as its data source, utilizing two cycles to get a larger population for comparison. Using NHANES for research is beneficial since the data is weighted, accounts for over and under-sampling and non-responses, and adjusts for post-stratification to give nationally representative estimates of prevalence and odds ratios. NHANES collects a large amount of data, allowing for control of numerous potential confounders. Another strength is that the dental examinations were conducted by calibrated examiners, who provided direct measurements of caries and periodontal disease for analysis rather than relying on self-reports of dental disease.

However, this study has some limitations. As a cross-sectional study, it cannot provide the causal effects of the association because it is measured at one point in time. Another limitation is that some variables, such as food security and insurance status, are self-reported, which can create recall or reporting bias; those with oral disease may underreport to give a more socially acceptable answer than being truthful. An additional issue is the temporal relationship between the food security questionnaire, which only asks about the past 12 months, and the dental variables, which take longer to develop, so the current food insecurity status may not reflect the individual's status when the disease was initiated.

Food insecurity has many health implications, including increased risk for obesity, heart disease, diabetes, and cancer. Nonetheless, general health is not the only kind of health affected. Mental health is significantly impacted as well, leading to problems such as depression, anxiety,

aggression as well as behavioral problems (National Institute on Minority Health and Health Disparities, 2023). There should be further research as well as an exploration of potential interventions to address the problems associated with food insecurity and mental health, especially in young adults. Mental health issues may lead to neglect of oral hygiene (apart from many other behavioral and social issues), which can, in turn, cause tooth decay, periodontal disease, tooth infections, and other unmet dental needs.

vi. Public health Implications

Some steps may be taken due to policy changes that can reduce food insecurity and benefit anyone in need.

1. Address core issues such as unemployment by creating more (full-time) jobs that provide health benefits; thus, there will be less hunger and food insecurity.
2. Increasing the minimum wage.
3. Promoting education in all communities creates more employment opportunities.
4. Expanding medical and dental coverage so more people can benefit from better health.
5. Support should be given through nutritional assistance programs and the benefits should be increased through national programs such as SNAP.
6. Establishing more programs such as Comprando Rico y Sano, a national program that reduces hunger and food insecurity by introducing healthy shopping and eating habits among the Latino population (*UnidosUS, 2020).*
7. Expanding the local farm's involvement in the food public assistance programs.
8. Increasingly affordable housing may allow more money to be spent on food, thus decreasing food insecurity. This might occur through removing tariffs on Canadian wood

to make building homes cheaper, removing the Private Mortgage Insurance for new home loans, or freezing state/city taxes for the first 5-10 years of home ownership. It may also make new homes and food more affordable.

9. The dental community could get involved with their local communities by volunteering even one day a month in shelters and places of worship. This would lead to a better sense of community and an awareness among their peers to give back, leading to better oral health care awareness, especially among financially affected people. It may also lead to less prevalence of diseases such as periodontitis, as seen in non-Hispanic whites.
10. Finally, more opportunities should be provided to minority communities, such as higher acceptance rates and quota seats in dental/ medical schools. This can ensure diversity in the healthcare industry and reduce any preconceived perceptions that can lead to unconscious racial biases when treating minority patients.

vii. Conclusion

In conclusion, our study reveals complex dynamics between food insecurity, race, and oral health. While food insecurity is notably higher among Hispanics and non-Hispanic Blacks, its impact on untreated dental caries does not differ significantly across races. However, food insecurity is associated with higher odds of periodontal disease among non-Hispanic Whites and individuals classified as 'Other.' This suggests that the effects of food insecurity on oral health may vary by race and the type of dental condition. Additionally, the prevalence of stereotypes and systemic barriers faced by minorities could exacerbate health disparities, complicating the relationship between food insecurity and oral health outcomes. Despite the strengths of using NHANES data, such as its representativeness and comprehensive measurements, the cross-

sectional design limits causal inferences, and self-reported data may introduce biases. Future research should address these gaps, mainly focusing on mental health implications and exploring interventions to mitigate food insecurity's adverse effects on general and oral health.

viii. Bibliography

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