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ORIGINAL ARTICLE

Food deserts and dental care utilization in the United States

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Abstract

Objectives: Although food deserts are known to impact health and healthcare utilization, no research has investigated the relationship between food deserts and dental care utilization. This study aimed to fill this gap by assessing the relationship between living in a food desert and self-reported dental care utilization in the past year.

Methods: Data are from the National Longitudinal Study of Adolescent to Adult Health ($N = 10{,}495$). The association between food deserts and dental care utilization was assessed using covariate-adjusted multiple logistic regression.

Results: Living in a food desert was associated with higher odds of not utilizing dental care in the past year. This association was concentrated among high-poverty areas (≥20% poverty rate).

Conclusions: The current study is the first to assess the relationship between living in a food desert and dental care utilization. The findings demonstrate that individuals living in low-income urban food deserts may be at increased risk for not utilizing dental care.

KEYWORDS
dental care utilization, diet, food deserts, poverty

INTRODUCTION

The incidence of dental care utilization in the United States is socially patterned, with substantially lower rates of dental care visits among persons of lower socioeconomic status [1, 2]. While regular dental care utilization is important in detecting oral health problems earlier when they are easier to treat [3], only 45.7% of persons less than 100% of the federal poverty level (FPL) reported visiting a dentist in 2020, compared to 76.0% of persons greater than 400% of the FPL [2]. These disparities in dental care utilization are particularly problematic as untreated oral health problems can lead to pain and other chronic diseases [4]. In contrast, routine dental care is associated with better oral health [5].

Prior research has detailed the importance of proper nutrition for oral health. Deficiencies of vitamins (i.e., vitamins A, C, E, calcium) and micronutrients (i.e., iron, folate) have been associated with periodontal disease and poorer oral health [6, 7]. Diets high in sugars can also promote demineralization of teeth and caries [8, 9]. Furthermore, those who experience food scarcity or unreliable access to healthful foods may experience chronic stress, inhibiting tissue healing and contributing to oral health problems [10]. Certain nutritional hardships, such as food insecurity (i.e., having limited access to adequate food) [11], are associated with dental caries and unmet dental care needs in children [12–15] and adults [16–18].

Notably, previous research has overlooked the role of the food retail environment as a factor for patterns of dental care utilization. Features of the built environment (i.e., the environment in which people live and work) are essential for health and healthcare utilization [19, 20]. Central to this is research on geographic access to healthy food retailers [21, 22]. A growing body of

research investigates how food deserts (i.e., geographic areas without access to healthy food retailers) [21] are associated with health and health behaviors, including cardiovascular disease [23, 24], kidney disease [25], cancer mortality [26], obesity [27], and sleep [28]. Even so, the connection between living in a food desert and using dental care services has been overlooked.

It is plausible that individuals residing in food deserts face distinct challenges in accessing dental care services. For instance, the Social Ecological Model accentuates the multifaceted nature of health behaviors and emphasizes the influence of broader environmental factors on individual choices [29]. Within food deserts, economic constraints and geographic isolation can create a web of interconnected barriers that hinder regular engagement with healthcare services, including dental care. Financial limitations imposed by food prices, limited transportation options, and increased time needed to access healthy food options can divert resources away from medical expenditures, indirectly influencing reduced dental care utilization [30, 31]. Food deserts may also lack other health resources, such as dental care clinics, which can limit access to dental care.

Despite these abovementioned possibilities, no prior research has assessed the relationship between food desert residence and dental care utilization. This study offers the first research on whether living in a food desert was associated with self-reported dental care utilization in the past year.

DATA

Data are from the National Longitudinal Study of Adolescent to Adult Health (Add Health). The Add Health study is an ongoing, nationally representative study of adolescents in middle or high school in the United States during the 1994–1995 academic year. The initial sample was obtained from a stratified random sample of approximately 20,000 students from 132 public, private, or parochial schools. Respondents have been followed at multiple time points. The current study uses data from Wave I (1994–1995; ages 11–19) and Wave IV (2008; ages 24–34). We select these two-time points because data from Wave I include relevant information on early life socioeconomic characteristics and prior dental care utilization patterns. Wave IV is the only data collection point that includes measures on both the key dependent and independent variables. Thus, we assess the relationship between food desert residence and dental care utilization when respondents are between the ages of 24–34 years old while accounting for earlier life characteristics. Additional information on the Add Health study can be found in Harris [32].

We restricted the sample to individuals who resided in urban areas because the variable measuring food deserts is valid only for urban census tracts [27, 28, 33]. The final analytic sample includes 10,495 respondents who participated in the Wave IV survey, resided in an urban census tract at Wave IV and had information on the variables included in the analysis. Details of the sample selection procedure are provided in Appendix A.

Dependent variable

Self-reported dental care utilization

Self-reported dental care utilization was measured by asking respondents, "In the past 12 months, have you had a dental examination by a dentist or dental hygienist?" The variable was reverse coded such that a value of 1 indicates a respondent did not have an oral health examination in the prior year, and 0 represents respondents who received oral health care services in the past year [34, 35].

Independent variable

Food desert

Food desert is a variable that measures whether a respondent lives in a census tract without access to healthy food retailers at Wave IV. Food desert data is only available in Wave IV of the Add Health study. Food retailer data is from the Centers for Disease Control and Prevention (CDC) Modified Retail Food Environment Index (mRFEI). The mRFEI measures the ratio of healthy to unhealthy food retailers in a census tract and the half-mile buffer surrounding the census tract based on information on over 1 million food retailers across the United States complied in 2008–2009. Appendix B provides further details regarding the classifications of retailers in the mRFEI. The mRFEI score is calculated using the following formula [36]:

$$\text{mRFEI} = 100 \times \frac{\#\text{Healthy Food Retailers}}{\#\text{Healthy Food Retailers} + \#\text{Unhealthy Food Retailers}}$$

Based on the coding scheme recommended by the CDC and prior research using Add Health data [24, 27, 36], food deserts are classified as areas with an mRFEI score of 0, corresponding to areas with no healthy food retailers. Prior research suggests that the geographic boundary used in the mRFEI is valid for measuring food deserts in urban areas [33]. Therefore, the study is limited to respondents living in urban census tracts identified by rural-urban commuting area (RUCA) codes.

Moderating variable: Census tract poverty rate

The poverty rate is a discrete variable measuring the percentage of individuals living below the poverty threshold

in a respondent's census tract in the past 12 months. Data on poverty rates are originally from the US Census Bureau's American Community Survey.

Control variables

Several control variables are included to reduce the likelihood of unobserved heterogeneity biasing the results. These variables account for respondents' sociodemographic and health-related characteristics that may be related to food desert residence and dental care utilization. Control variables included age in years at Wave IV, self-reported race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, other race/ethnicity), biological sex (1 = male; 0 = female), and whether a respondent reported having graduated high school by Wave IV (1 = yes; 0 = no). We also controlled for the last time a respondent reported having a dental exam at Wave I interview (<1 year, 1–2 years, or >2 years), respondents self-rated health at Wave I (1 = excellent; 5 = poor), and the poverty rate of a respondent's Wave I census tract. In addition, although no measure of dental insurance is available at Wave IV of the Add Health study, we included a control variable for the number of months a respondent reported having health insurance at Wave IV. To account for typical modes of transportation, we included a control variable for a respondent's self-report of how they typically get to school or work at wave IV (car, public transit, walk or bus, none, or unknown). We controlled for the population density in a respondent Wave IV census tract, measured as the number of persons per square kilometer. Finally, we controlled self-rated health at Wave IV (1 = excellent; 5 = poor) and body mass index based on a respondent's height and weight at Wave IV (underweight, healthy weight, overweight, and obese).

METHODS

Given the binary nature of the dependent variable, the analysis was conducted using logistic regression. We first estimate unadjusted models (Panel A) and then estimate multiple logistic regression models controlling for potential confounding variables (Panel B). Importantly, for the analysis is the consideration that access to food retailers may differ based on the economic status of local areas, and food deserts are often classified as low-income areas with poor geographic access to healthy food retailers [37]. For instance, in high-affluent/low-poverty areas, not having access to healthy food retailers may indicate living in a higher-income residential area with limited commercial zoning. In contrast, those living in low-income food deserts are unlikely to experience such buffers and be more directly impacted by the food retail environment of their local community. Accordingly, our analysis considers the focal parameters of interest to be an intersection between food deserts and the census tract poverty rate where a respondent resides, estimated using a multiplicative interaction term. Supplemental analyses were conducted that stratified the sample by census tract poverty rate.

All models were estimated in Stata version 17.0/SE and were adjusted for the complex survey design of the Add Health study using the SVY command, which adjusts for the primary sampling unit (*psuscid*), sampling weight (*gswgt4_2*), and strata (*region*) [38]. The use of Add Health data for this study was approved by the [Blinded for Review] Institutional Review Board. Analyses were performed with listwise deletion given that the sample size is large and provides adequate statistical power, and only about 3% of respondents had missing data (see Appendix A).

RESULTS

Summary statistics in Table 1 show 43.3% of respondents reported not having a dental examination in the past year. Overall, 16.3% of respondents lived in a food desert. The average percentage of persons living below the poverty threshold in a respondent's census tract was 14.4%.

Table 2 provides the results of the logistic regression model interacting the measure of food desert with the census tract poverty rate. Net of control variables, there is a statistically significant interaction between food desert and census tract poverty rate on not utilizing dental care in the past year (OR = 1.020, 95% CI = 1.005, 1.035). The results are presented visually in Figure 1. The probability of not utilizing dental care was approximately the same for those living in and not in a food desert until the poverty rate of 16–20%. After that, the probability remains relatively stable for those not living in a food desert and increases for those living in a food desert. The estimates indicate that for those living in low-poverty census tracts (0–5% poverty rate), the probability of not utilizing dental care is 0.413 for those not living in a food desert and 0.374 for those living in a food desert. However, for those living in census tracts with a poverty rate of >30%, the probability of not utilizing dental care increases to 0.455 (percent change = 10.17%) for those not living in a food desert and 0.585 (percent change = 56.42%) for those living in a food desert (see Appendix C).

Supplementary analysis

As a supplementary analysis, we examined the direct association of living in a food desert on dental care utilization, restricting the sample to census tracts where the poverty rate is equal to or greater than 20 percent, which matches the threshold for considering a food desert by

TABLE 1 Weighted summary statistics of analytic sample ($N = 10,495$).

Variable	Mean	Standard deviation	Minimum	Maximum
Dependent variable				
No past year dental visit	43.3%		0	1
Independent variables				
Food desert	16.3%		0	1
Census tract poverty rate – W4	14.42	11.49	0	100
Control variables				
Age – W4	28.45	1.82	24	34
Racelethnicity				
White	64.5%		0	1
Black	14.6%		0	1
Hispanic	15.2%		0	1
Other race/ethnicity	5.7%		0	1
Male	50.1%		0	1
High school graduate	91.6%		0	1
Time since last dental exam – W1				
<1 year	68.5%		0	1
1–2 years	18.3%		0	1
>2 years	13.2%		0	1
Self-rated health – W1	2.11	0.90	1	5
Census tract poverty rate – W1	13.54	11.92	0	85
Number of months with health insurance – W4	9.26	4.61	0	12
Typical transportation to work or school				
Car	74.2%		0	1
Public	3.8%		0	1
Walk or bus	5.5%		0	1
None	2.2%		0	1
Unknown	14.5%		0	1
Population density – W4	2494.15	4879.28	5.91	83,652.24
Self-rated health – W4	2.33	0.92	1	5
Body mass index – W4				
Underweight	1.5%		0	1
Healthy weight	33.4%		0	1
Overweight	30.0%		0	1
Obese	35.1%		0	1

the United States Department of Agriculture (USDA) [37]. The results of this analysis reported in Appendix D are consistent with the main analysis. Among the subsample of high-poverty census tracts, the results show that net of control variables is a positive and statistically significant association between living in a census tract and self-reported dental care utilization (OR = 1.403; 95% CI = 1.061, 1.855). Appendix E stratifies the sample by race and ethnicity and repeats the analysis performed in Table 2. The results in Appendix E show that the magnitude of the interaction coefficient is substantively similar among non-Hispanic White, non-Hispanic Black, and Hispanic respondents. However, it is important to note that this coefficient is not statistically significant among White respondents and is marginally significant at the $p < 0.10$ level among non-Hispanic Black and Hispanic respondents. However, this change is statistical significance is due to higher statistical error due to reduced sample size rather than a reduction in the magnitude of the coefficient size.

DISCUSSION

The current study is the first to investigate the association between food desert residence and dental care utilization. The findings revealed that individuals living in food deserts, specifically areas marked by high levels of

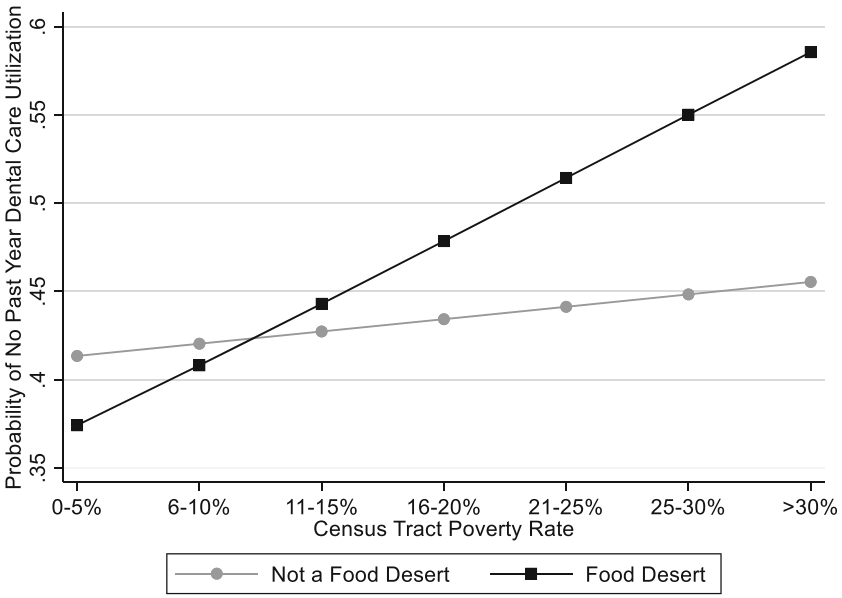

FIGURE 1 Logistic regression of no dental visit in past 12 months on food desert × census tract poverty rate ($N = 10{,}495$).

TABLE 2 Results of logistic regression of no dental visit in past 12 months on food desert × census tract poverty rate ($N = 10{,}675$).

	Model 1: Bivariate		Model 2: With controls	
Variables	**OR**	**95% CI**	**OR**	**95% CI**
Food desert	0.830	(0.638–1.081)	0.820	(0.628–1.070)
Census tract poverty rate	1.017***	(1.011–1.023)	1.006*	(1.000–1.013)
Food desert × census tract poverty rate	1.021**	(1.006–1.036)	1.020**	(1.005–1.035)

Note: Control Variables in Panel B include age, race/ethnicity, high school graduate, last dental exam (W1), self-rated health (W1), census tract poverty rate (W1), number of months with health insurance (W4), typical transportation (W4), population density, self-rated health (W4), and body mass index (W4).
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

poverty and no access to healthy food retailers, were significantly more likely to report not having a dental examination in the past year than those who do not live in food deserts. These results illustrate that residing in a food desert may be an overlooked risk factor associated with the underutilization of dental care. For instance, the results highlighted that among those living in the poorest census tracts in the study (i.e., poverty rate of >30%), there was an approximately 13 percentage point difference in the probability of dental care utilization between those living in a food desert (46.5%) compared to those not living in a food desert (59.9%).

While this study is the first to explore this association, there are reasons to suspect that food deserts could be related to the lower use of dental care services. One possibility is that these areas are food and dental care deserts that lack adequate access to dental care providers. While the current data lacked information on the number of dental care providers near a respondent, a key area of future research would be investigating whether food deserts also have low access to dental care providers and other health care services. Second, prior research also finds that because individuals who live in food deserts must travel further distances to acquire food, this can reduce their available time for other activities, such as visiting dental providers [31, 39]. It would be valuable for future qualitative and practice-based research to understand the association between living in a food desert and barriers to healthcare services.

The findings suggest ways to improve dental care utilization in low-income food deserts. First, to the extent that food deserts in low-income urban areas also lack resources, including dental providers, efforts to open more affordable dental care clinics in food deserts may be critical to expanding access to dental care. Second, expanding mobile dental services to food deserts can also be another helpful initiative that expands access to dental care in areas where resources may be lacking, and time or transportation constraints can create challenges with accessing dental care services [40]. Third, providing greater education on the influence of nutritional hardships, including food deserts for dental care utilization through dental school curriculum and continuing education programs can be valuable in raising awareness of how dental care providers can play an important role in improving dental care access among populations living

in food deserts. In addition, such efforts can expand awareness of how dental care providers can form collaborative partnerships with community-based organizations such as food banks to assist with nutrition deficiencies. Related, implementing oral health and nutrition education programs in schools located in food deserts, coupled with mobile dental services, may be an effective dental care intervention [41–43].

Limitations

There are limitations to the current study that can be expanded upon in future research. First, it would be helpful for future research to consider alternative measures of food deserts, such as that used by the USDA to assess robustness across different ways of measuring food deserts. Second, it is important to investigate other built environment features, such as the number of dental care providers available. Third, based on the measurement of food deserts in the mRFEI data, the sample was restricted to individuals living in urban areas. Accordingly, the results cannot be generalized to rural areas. Fourth, the measure of dental care utilization was based on a binary self-report item of dental care visits in the past year. This does not include information on the reason for the dental visit or when a respondent last saw a dental provider. Relatedly, because this variable is based on a respondent's self-report, it could be subject to recall or social desirability bias. Fifth, the data used for this study lacks measures on oral health, including conditions such as dental caries or periodontal disease. An important direction for future research is to investigate whether living in a food desert is related to worse quality oral health and whether this relationship is partially due to or exacerbated by not regularly utilizing dental care services. Sixth, this study used data from Wave IV, which was conducted in 2008. To our knowledge, this is the only available data with food desert residence and dental care utilization measures. Relatedly, in the Add Health data, the measure of food deserts is only available at Wave IV. However, a valuable direction of future research would be to use longitudinal data that includes measures of food desert residence and dental care over time to assess how changes in food desert residence correspond with changes in dental care utilization patterns. Indeed, circumstances may have changed since 2008, such as the economy's improvement following the Great Recession, and dental care utilization may have increased more recently, especially due to the Affordable Care Act (ACA), which increased dental insurance coverage [44]. Finally, because of the possibility of unobserved heterogeneity, the findings of this study should be considered associations rather than causal relationships.

CONCLUSIONS

The results of the current study provide initial but important evidence that food deserts may be linked to lower utilization of dental care services. The findings also suggest the need for further research to investigate whether this relationship can be replicated in other data and, if so, what mechanisms underlie the relationship between living in a food desert and less dental care utilization. By better understanding this relationship through further research, designing and implementing programs and interventions that improve dental care utilization in food deserts can be possible.

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CONFLICT OF INTEREST STATEMENT

Authors do not have any conflicts of interest including financial interests or relationships or affiliations relevant to the subject of the manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from National Longitudinal Study of Adolescent to Adult Health. Restrictions apply to the availability of these data, which were used under license for this study. Data can be requested from https://addhealth.cpc.unc.edu/data/.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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