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Does distance decay modelling of supermarket accessibility predict fruit and vegetable intake by individuals in a large metropolitan area?

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Abstract

Background—Obesity, a major risk factor for hypertension, diabetes, and other chronic diseases is influenced by a person's local environmental setting. Accessibility to supermarkets has been shown to influence nutritional behaviors and obesity rates; however the specific local environmental conditions and behavioral mechanisms at work in this process remain unclear.

Purpose—To determine how individual fruit and vegetable consumption behavior was influenced by a distance decay based gravity model of neighborhood geographic accessibility to supermarkets, across neighborhoods in Los Angeles County, independent of other factors that are known to influence nutritional behaviors.

Methods—A distance decay based accessibility model (gravity model) was specified for a large sample (n=7,514) of urban residents. The associations between their fruit and vegetable consumption patterns and their local accessibility to supermarkets were explored, while controlling for covariates known to influence eating behaviors.

Results—Significant variation in geographic accessibility and nutritional behavior existed by age, gender, race and ethnicity, education, marital status, poverty status, neighborhood safety and knowledge of nutritional guidelines. Logistic regression showed an independent effect of geographic accessibility to supermarkets, even after the inclusion of known controlling factors.

Conclusion—A basic gravity model was an effective predictor of fruit and vegetable consumption in an urban population, setting the stage for inclusion of supply and demand parameters, and the ability to estimate local directions and magnitudes of the factors that contribute to the differential obesity rates found in United States urban areas. This knowledge will facilitate more targeted interventions that can help eliminate health disparities.

Introduction

In recent years there has been a steady rise in obesity rates in the United States. For example, between 2006 and 2007 there was an increase from 19 to 28 states reporting more than a quarter of their adults were obese and obesity rates have continued to rise in nationally through 2009.[1] These trends have continued and by 2010, 37% of all adult

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Americans were obese.[2] Obesity has also been linked to many chronic diseases including type 2 diabetes, certain cancers, cardiovascular disease, and hypertension.[3,4] In understanding the causes of this obesity epidemic many investigators have researched how dietary behaviors are influenced by the local neighborhood contexts within which an individual lives.[5,6] In United States metropolitan areas in particular, the characteristics of the local retail food environment are an important determinant of individual dietary intake and can be critical factors in the regulation of body weight in individuals.[7,8]

Supermarket accessibility: an important indicator of localized nutritional behaviors

A key neighborhood characteristic that has been associated with greater adherence to recommended dietary practices by individuals is their geographic accessibility to chain supermarkets.[9] Supermarkets carry many affordable choices of fruits, vegetables and other products and as such, are important indicators of the robustness of the local food environment in a given locality. In a study of the Atherosclerosis Risk in Communities (ARIC) research cohort, African Americans showed an average increase of 32% in consumption of fruits and vegetables for each additional supermarket located in their census tract of residence and the increased intake of fruit and vegetables was associated with a decreased incidence of obesity.[10] In two other studies of a sample of ~2600 residents across 65 neighborhoods in Los Angeles County, greater supermarket accessibility was associated with lower BMI and higher self reported health status.[11,12] However, an adequate supply of supermarkets are not located in every neighborhood, and in general, the local food accessibility environment varies along with the socio-demographics of the neighborhood.[13] The uneven retail food availability landscape in the United States is the product of historical practices of discrimination and economic disinvestment in urban areas occupied by African Americans and other minorities.[14] Urban land use patterns and suburbanization trends associated with increased automobile ownership have created multi-nodal cities with distinct sets of social and spatial relationships governing the distribution of retail food vendors in a given metropolitan environment. This situation severely hampers the availability of affordable and nutritious foods for individuals living in many urban contexts, contributing to entrenched health disparities.[15–18]

This study addresses these issues by using fruit and vegetable consumption data from the 2002 and 2005 Los Angeles County Health Survey, along with a geographically derived measure of respondent's spatial accessibility to chain supermarkets to develop a predictive model of the impact of geographic accessibility on nutritional behavior. Our main research hypothesis was that a simple distance decay based spatial accessibility model of proximity to large supermarkets will independently influence fruit and vegetable consumption even after controlling for other relevant individual level factors that are known to affect fruit and vegetable intake. An additional goal of this project was to demonstrate that the incorporating a distance decay method allows us to better quantify the impact of adding supermarkets on individual nutritional behaviors, thus opening the door to better decision making at the policy level.

Understanding the importance of Geographic Accessibility on nutritional behaviors

It has been reported that that the potential for interaction between two locations declines with increasing distance between them and is also associated with the amount of demand and supply (i.e. population vs. stores) at each location.[19,20] Individual use patterns of public facilities such as supermarkets have been shown to follow a distance decay pattern, where utilization declines with increasing distance from place of residence, place of work, or some other highly frequented place. Various statistical models of this relationship, often termed "gravity models" are commonly used in transportation planning, trade market analysis, retail location theory, and increasingly in health services research as a method of quantifying the distance decay relationship and including demand/supply parameters.[21] Distance decay based gravity models have been demonstrated to approximate underlying functional relationships that describing the aggregate use patterns of facilities of all types.[22,23] The rate of declining interaction through geographic space varies by context, and thus these functions require parameters, such as the supply of goods or services, and a distance decay parameter.[24] The gravity model is an effective way of measuring “potential accessibility”, which can be defined as the “potential” for an individual living in a given locale to access a given amenity, such as a supermarket produce section. Potential accessibility must be distinguished from actual or “realized” accessibility, yet the two are highly correlated. Measuring potential accessibility is very important as it provides the baseline from which to understand actual accessibility and utilization. We operationalize this within the context of access to chain supermarkets and fruit and vegetable consumption within a large metropolitan population.

Previous literature on local environments and nutritional behavior

Larsen et al, presented a comprehensive review of the United States literature on neighborhood food environments, dietary behavior and obesity conducted between 1985 and early 2008.[25] This review showed that the strongest evidence exists for the positive effects of greater accessibility to supermarkets on nutritional behaviors and outcomes. The evidence for independent effects of small markets and restaurants was more mixed, with inconsistent findings, yet some evidence that neighborhood accessibility to fast food restaurants having a negative effect on dietary behaviors and obesity. The Larsen review also identified a number of common limitations that limit the interpretability of the results and impair cross study comparison. The major limitations identified were 1) the complexity in defining a relevant neighborhood, 2) the cross sectional, observational nature of most research designs, 3) reliance on commercially (e.g. Dunn and Bradstreet, InfoUSA) or publicly availably (telephone directories, corporate websites) data sources on food outlets. 3) Lack of "ground truthing" and reliable in-store observation of product availability 4) GIS/Geocoding related errors 5) Poor conceptualization of neighborhood boundaries and distances travelled to shop for food. 6) Few longitudinal and/or multilevel studies 7) The need to consider co-varying characteristics of neighborhoods such as population size, urbanization, region and commercialization. 8) Need for studies that consider the entire food availability context (both food stores and restaurants) together.

Other recent national level studies have found 1) persistent disparities in the distribution of food resources by neighborhood race and income across the U.S.[26] and 2) associations between geographic accessibility to supermarkets and fruit and vegetable consumption nationally.[27] Both of these studies noted, however that there appeared to be differences in the strength and significance of the relationships based upon the type of neighborhood (rural, vs. suburban vs. urban). Finally, some recent studies have shown lack of association between local food environments, nutritional behavior and obesity[28,29] but these studies used questionable methods,and/or had limited sample sizes and remain as outliers within the larger body of literature on food accessibility.

In this paper, we contribute to problem areas 1, 3, 4, and 5 identified by Larsen above, including suggesting a straightforward distance decay based method of establishing a robust score for an individual's residential and/or workplace locations that can captures their accessibility to key features in the environment. This distance decay base approach to modeling the local effects on behaviors and outcomes is well established in diverse fields (business analytics for example), but has yet to become widely utilized in epidemiological, health disparities and health outcomes research. We also diverge from much of the existing work by making use of a comprehensive local administrative database of food vendors (LA County Dept of Environmental Health) to explore the influence of geographic accessibility to one specific class of large food vendors, chain supermarkets, upon fruit and vegetable among consumption by adult residents in a large urban setting. Much of the existing work has relied upon commercially available databases.

In this projects supermarket accessibility is defined by geographic access to *multi-site* grocery stores (supermarket chains operating two or more stores), an more expansive category of chain supermarkets, that also captures full service local grocery stores that operate on a smaller scale than the large regional chain supermarkets, yet whose stores are still likely to carry similar products lines as the major chain supermarkets. Other stores that may carry limited food products, such as (CVS, Walgreens, Target, Walmart etc…) were excluded unless they had a full service Supermarket. Below the design and implementation of the research are presented.

Study Design, Data Sources and Analytical Methods

Given the importance of multi-site grocery store accessibility in shaping the local retail food environment in large U.S. metropolitan areas, a research strategy was designed: 1) to construct a basic gravity model that captured potential accessibility of Los Angeles County Health Survey respondents to multi-site grocery stores. 2) to estimate the relationships between our gravity model derived accessibility to multi-site grocery stores and self reported fruit and vegetable intake in a large sample (n=7,514) of 2002 and 2005 LA County Health Survey respondents, after controlling for the effects of other individual factors known to influence dietary behaviors.

Spatial Contextualization of the LA Health Survey

The Los Angeles County Adult Health Survey is a single-stage, geographically stratified, equal probability sample conducted every two – three years via random digit dialing of each telephone exchange area in the county. Designed to be representative of the entire adult population of Los Angeles County, the LACHS is one of the largest population base health surveys conducted in the United States, and contains self reported data on health related behaviors and outcomes for LA County residents. In order to better understand the role of accessibility to chain grocers on individual dietary habits, the nearest cross streets of the survey respondents for the 2002 and 2005 waves of the LACHS were obtained. We then implemented a logistic behavioral model to assess the independent influence of grocery store accessibility on fruit and vegetable consumption in a large population-based sample, the LA County Health Survey (LACHS),[30] using the basic form of the function for calculating gravity-based accessibility:

$$A_i = \sum_j (s_j/d_{ij}^{\beta})$$

Where; A_i is the spatial accessibility from population point i, (nearest cross street to the LA health survey respondent's home), S_j is the service capacity at chain grocery store location j, and d is distance between the respondent's nearest cross street and the chain grocery store location, weighted by β, a distance decay exponent.

In the absence of data on supermarket store size and product offering, the value of S_j was set equally for all the chain supermarkets to 1, and the distance decay Beta was also set to 1, yielding a simple arithmetic distance decay slope as shown in Figure 1.

ArcGIS 9.3.1 and ArcINFO 7.2.1 geographic information systems software were used to calculate all distance matrices and to generate the individual respondent’s accessibility scores.

Existing literature indicated that the more geographically accessible ones preferred place(s) to shop for fruits and vegetables is, the greater one's fruit and vegetable consumption, with individuals living at distances greater than 5 miles from their preferred place to shop consuming significantly less fruit and vegetables than living in areas with a supermarket within 1 mile.[31] Based on this limited but useful available knowledge on distance effects on fruit and vegetable consumption, as well as pilot empirical testing of an arithmetic vs. exponential decay parameter, an arithmetic distance decay (power) function was found to be most appropriate for this study.

Outcome Variable – approaching or exceeding USDA fruit and vegetable consumption guidelines

The outcome variable utilized in this study was the probability of a respondent either approaching or exceeding USDA recommended daily dietary guidelines. During the questionnaire LA Health survey respondents were asked about how many servings of fruits and vegetables they ate in the previous day. Current USDA guidelines for adults recommend eating five or more servings of fruits and vegetables daily. We used this guideline as the initial threshold for our dichotomous variable of fruit and vegetable consumption, and worked down to 3 servings.

Predictor variable – Gravity derived geographic accessibility to multi-site grocery stores

The source of multi-site supermarket locations was a longitudinal food licensure file that is maintained in an ongoing collaboration with the LA County Department of Public Health - Environmental Health Division, who shared their longitudinal database of food licenses by location with the Charles Drew Medical GIS lab. This database was used to extract all multi-site grocery stores as defined as having two or more stores operating in Los Angeles County in 2002 and 2005, the years of the study. Spatial accessibility scores based on the inverse weighted Euclidean distances from the nearest cross street of residence to all multi-site grocery stores in the county were generated for each of the 2002 and 2005 LA Health Survey respondents. The score was constructed using the basic gravity model formula detailed above. Respondents living in the cities of Pasadena and Long Beach were excluded from the analysis as food license data for those cities are not reported to LA County Department of Public Health. The outcome measure and the independent variables are derived directly from the survey. The sample was limited to only those survey respondents who had nearest cross street of residence (n=7,514). leaving out those whose census tract centroid of residence only was known.

Controls and Confounding variables

Age, gender, education, income, race/ethnicity, neighborhood safety and knowledge of the USDA dietary guidelines have been shown to be associated with neighborhood environment and physical proximity to healthy food sources.[32] To account for these associations, the individual survey respondents socio-demographic characteristics were included in the model, along with answers to 1) a question regarding how safe respondents felt in their local neighborhood, and 2) a question about their knowledge of the importance of nutritional guidelines. Neighborhood poverty levels were disaggregated down to the individual level to control for neighborhood effects associated with high poverty neighborhoods using data from the 2000 census.

Statistical Analysis

Statistical analysis was performed using Stata 11.0 (Stata Corporation, College Station, Tx). Analysis of variance and chi-square tests were used for comparisons of means and proportions. Multivariate logistic regression analyses were used to examine the relationship between accessibility score and nutritional behavior (eating >= 3 serving of fruit and vegetables a day or not). All logistic regression models were adjusted for age, race or ethnicity, sex, marital status, education, poverty level, neighborhood safety and USDA guideline. Odds ratios (OR) and 95% confidence intervals (95% CI) and marginal effects were used to report associations obtained from the multivariate logistic regression models. Possible multiplicative interactions between meeting USDA guideline, accessibility score, and education were investigated. All reported *P* values were 2-tailed, and statistical significance was defined at the 0.05 level.

Results

There were pronounced differences in both nutritional behavior and in geographic accessibility observable in the sample. Analysis of Variance indicated that statistically significant variation in geographic accessibility to supermarket existed by age, race and ethnicity, education, marital status, poverty status, neighborhood safety and knowledge of nutritional guidelines. Chi Squared tests showed significant differences between those whose diets approached or exceeded the USDA fruit and vegetable intake guidelines and those who did not for the same variables as above. In addition gender also exhibited significant differences in the Chi Squared tests. These descriptive and bivariate relationships are reported in Table 1.

African Americans and Latinos, poorer populations, and less educated populations tended to have higher overall accessibility scores, due to the fact that the wealthier, predominantly White and Asian suburban areas having lower population densities and more open space. However, this greater overall accessibility did not mitigate the racial and ethnic effects. Despite the overarching trends in accessibility however, there were significant differences in nutritional behavior for the relevant individual characteristics that are available in L.A. Health survey. Whites, females, older people, more educated people, wealthier people, and people who live in safer neighborhoods all are more likely to have reported approaching or exceeding the USDA guidelines. Based on these findings the analysis was extended to consider predictive capability of a gravity model derived accessibility score when accounting for variation in the individual factors. Table 2 reports the results of a logistic regression analysis with gravity modeled accessibility to multi-site grocery stores as the predictor variable.

A simple distance decay based accessibility score was able to predict fruit and vegetable intake of 4 or more servings per day in our sample of over 7,514 individuals from the L.A. Health survey. Although not signifigant in predicting 5 or more fruits and vegetables (achieved by only 14% of the sample), our model did predict changes in consumption of 4 or more servings, a slight relaxation of USDA standards that was achieved by 25% of the sample.. This relationship persisted even when race, age, education, marital status, poverty status, neighborhood safety, and knowledge of USDA guidelines were controlled for. Despite one's individual characteristics, geographic accessibility to multi-site grocery markets, as defined by a very basic gravity model is associated with increased fruit and vegetables intake in the Los Angeles County population that the LA County Health Survey is designed to represent.

Interpreting the marginal effect of the geographic accessibility score

The marginal effect of the main predictor variable, a basic geographic accessibility score to chain supermarkets was .031. This means that adding a store adjacent (100 feet) to the nearest cross street increases the odds of a respondant eating four or more fruits and vegetables by three percent. This allows us to quantify the geographic relationships described in our model. Our accessibility score was a log10 of the actual score and ranged from ~ .03 to 3.0. We unitized our score into 100 foot interval thus we used $\sum 100/d_i$ where d_i is the distance to each store in feet. The average accessibility score for the cross streets reported by individuals in our sample is 1.307. Accordingly if we added a hypothetical 10 additional stores all at 1 mile (5280 feet) from the average individual, then this would add 100 × 10/5280 = 0.19 to the score or about 15%. This translates into about a 15% additional increase in the odds of eating 4 or more servings from 1.031 to about 1.035.

Discussion

The validity of a basic gravity model in understanding retail market shopping behaviors has been well established outside of the health and nutrition literature, and is one of the dominant paradigms in the economics of business location. Given that food consumption in most large American metropolitan areas is driven by retail food markets, it follows that gravity modeling as an approach will be helpful in untangling the complex relationships between the built environment, energy balance related behaviors, obesity and chronic disease outcomes. This study was limited in scope, and did not address restaurants, small markets and other factors that may contribute to fruit and vegetable intake. Also the data on nutritional behavior was self reported, and is subject to inaccuracies and biases related to measurement error. Another limitation is the lack of complexity in the gravity model, rooted in the assumption that all multi- site grocery stores exhibit the same influence on their surroundings. This implicit assumption of an unlimited supply of groceries would be more problematic were our observations not chain supermarkets. However, the high volumes and complex multinational food markets that this class of store are able to tap into guarantees a near limitless supply of food types, if not each individual food products themselves. The lack of supply side data for each grocery store is being addressed by this team as part of ongoing research projects, and these results will be reported in the future. Finally, we had no information on individuals work place locations, or other places they might frequent, thus our model is based solely on place of residence.

Much of the previous research on the association between retail food availability and nutritional behavior has relied on aggregated administrative units such as zip codes or census tracts to capture environmental and geographical relationships. In this project each respondent's local nutritional environment was modeled based upon real world data obtained from local government food sale licensure records, using a simplified form of a standard gravity function that has been shown to reliably explain many retail behavioral interactions, including food consumption. This permitted us to quantify the geographic relationship observed, using hypothetical examples.

There is promising space for further development of gravity style distance decay based accessibility model used in this research. Supply side parameters can be constructed via in-store surveys of product type and amount. This would likely strengthen the explanatory power of the model and provide new insight on the nature and magnitude of the relationships between local environmental contexts and individual nutritional behavior. Additionally, although a simple arithmetic gravity function was found to have predictive capability in this study, there is a still a need for further calibration and understanding of the distance parameter. This study found that distance for accessibility to grocery stores Beta = 1 ($1/x^1$) an arithmetic Decay (power) function, has explanatory power and that Beta = 2 ($1/x^2$), an exponential distance decay function does not. This work cannot, however, establish that a basic decay function of ($1/x^1$) is the the most appropriate decay function until further model calibration can be completed. Research projects are underway by the Authors that will permit the inclusion of empirically observed supply and demand parameters, as well as model calibration in the Los Angeles county context. With an optimized local accessibility model, it will be possible to delve deeper into questions of what the differential behavioral impacts of local geographies are on specific age, gender, race, or income groups nutritional behaviors. Ultimately, the goal is to provide information on the critical interventional entry points that move beyond the crude targeting of entire age/gender/racial groups or entire classes of neighborhoods, and instead focus in on the key vulnerable groups who are likely to be most impacted by living in compromised states of accessibility to key amenities such as supermarkets. This knowledge can guide intervention efforts designed to encourage healthier behaviors. By understanding how local environments and individual characteristics interact to influence behavior related to obesity and its related chronic conditions, a "roadmap" to intervention can be developed that will help chart the path to the translation of medical knowledge into communities and the eventual elimination of health disparities.

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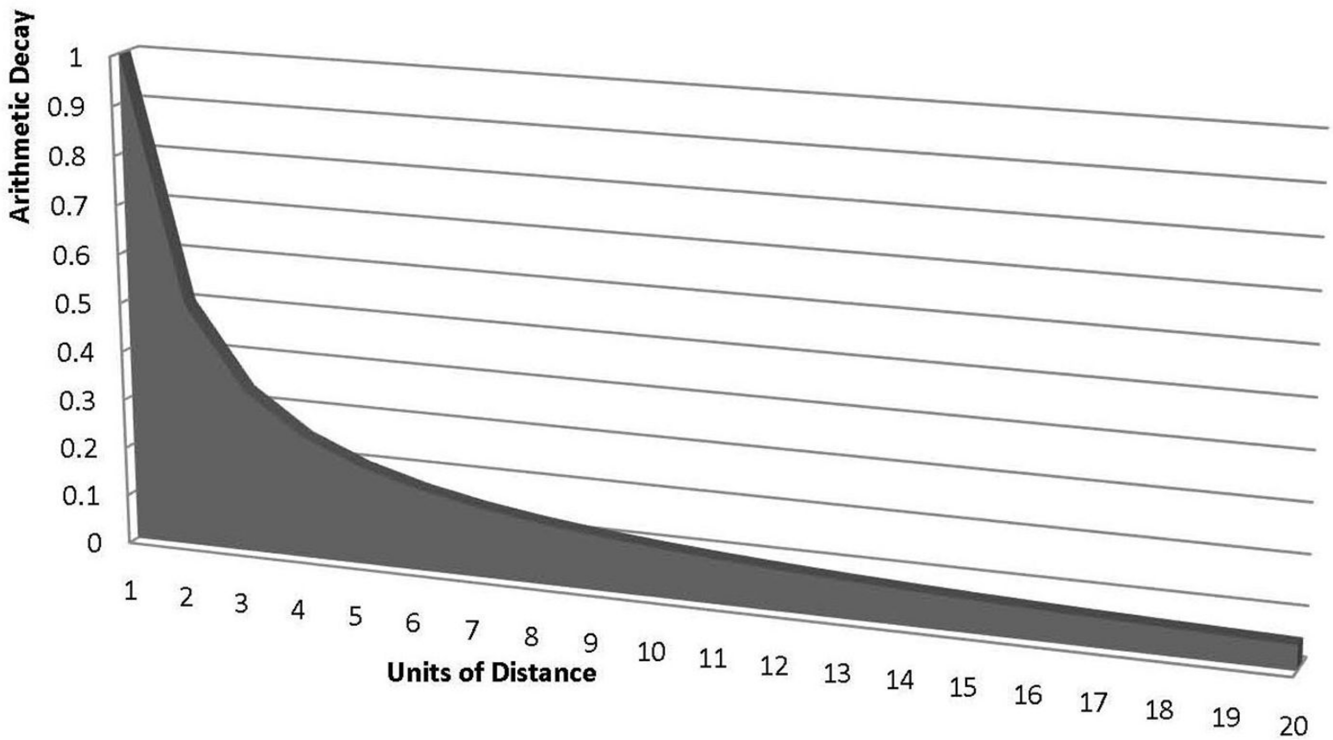

Figure 1.
Arithmetic distance decay function used to weight supermarkets by distance to respondent's nearest cross-street

Table 1

Descriptive factors associated with geographic accessibility and fruit and vegetable consumption Sample Characteristics, Fruit and Vegetable Consumption

Patient characteristics	Overall Sample (N= 7514)	< 4 Servings of Fruit & vegetables/day N (%)	>= 4 Servings of Fruit & Vegetables/day N (%)
Gender			
Male	3413(45.4)	2612(80.0)	661 (20.0)
Female	4101(54.6)	2756 (69.7)	2028 (30.3)
			P ***
Race/Ethnicity			
White	3222(42.2)	2099(67.4)	1014(32.6)
Latino	2687(38.7)	2064(79.6)	528(20.4)
African American	658(8.9)	505(78.8)	136(21.2)
Asian/pacific islander	762(8.7)	567(81.0)	133(19.0)
Other	101(1.5)	74(75.5)	24(24.5)
			P ***
Age			
>=65	920(12.2)	569(66.5)	287(33.5)
60–64	419(5,6)	295(74.1)	103(25.9)
50–59	1250(16.6)	876(72.4)	334(27.6)
40–49	1597(21.3)	1172(75.8)	375(24.2)
30–39	1835(24.4)	1345(75.8)	429(24.2)
25–29	736(9.8)	548(77.2)	162(22.8)
18–24	757(10.1)	563(77.0)	168(23.0)
			P ***
Education			
College/post Grad/Trade	4697(62.6)	3212(70.7)	1313(29.3)
High School	1583(21.1)	1198(79.4)	311(20.6)
<High School	1218(16.3)	949(82.0)	208(18.0)
			P ***
Marital Status			
Married	4444(59.3)	3137(73.5)	1133(26.5)
Not Married	3047(40.7)	2219(75.6)	716(24.4)
			P *
Federal Poverty Level			
>= 300 FPL	3346(44.5)	2266(69.9)	977(30.1)
200–299% FPL	1425(20.0)	1031(75.3)	338(24.7)
100–199% FPL	1473(19.6)	1112(79.2)	292(20.8)
0–99% FPL	1270(16.9)	959(79.3)	251(20.7)
			P ***
Neighborhood Safety			

Patient characteristics	**Overall Sample (N= 7514)**	**< 4 Servings of Fruit & vegetables/day N (%)**	**>= 4 Servings of Fruit & Vegetables/day N (%)**
Very Safe	2446(32.8)	1667(70.9)	683(29.1)
Somewhat Safe	3661(49.1)	2652(75.1)	879(24.9)
Unsafe	1352(18.1)	1013(78.2)	283(21.8)
			P ***
Total Serving of Fruit & Vegetables you should eat everyday			
Don't know the Guideline	3200(48.2)	2791(89.9)	314(10.1)
Knows the Guideline	3306(51.8)	1966(58.3)	1404(41.7)
Accessibility Score			**P** ***
Mean(SD) = 1.31(0.37)			
Range =1.71			

P* <.05,

P** <.01,

P*** <.001

chi-square tests for the comparison of ≤2 servings per day group with the ≥3 servings per day group

Table 2

Fruit and vegetable consumption and its association with geographic accessibility, while controlling for known covariates

Logistic regression analysis [OR (95% CI) for Adults meeting USDA fruit and vegetable guideline by Accessibility to grocery store and socio demographic characteristics

Variable	Beta	OR	95% CI	P-Value
Accessibility Score(Marginal Effect =.031)	.0.181	1.20	1.00 – 1.43	**0.040**
Gender				
Male	**referent**			
Female	0.268	1.31	1.15 – 1.49	<**0.0001**
Race/Ethnicity				
White	**referent**			
Hispanic/Latino	−0.246	0.78	0.65 – 1.01	**0.007**
African-American	−0.371	0.69	0.58 – 0.80	**0.002**
Asian/Pacific Islander	− 0.195	0.82	0.70 – 0.98	0.104
Other	−0.208	0.81	0.62 – 1.24	0.437
Age				
>=65	**Referent**			
60–64	−0.395	0.67	0.49– 0.92	**0.013**
50–59	−0.468	0.63	0.50 – 0.78	<**0.0001**
40–49	−0.682	0.51	0.41 – 0.63	<**0.0001**
30–39	−0.686	0.50	0.30 – 0.63	<**0.0001**
25–29	−0.705	0.49	0.37 – 0.65	<**0.0001**
18–24	−0.684	0.52	0.40 – 0.70	<**0.0001**
Education				
College/post Grad/Trade	**referent**			
High School	−0.269	0.76	0.64 – 0.91	**0.002**
<High School	−0.306	0.74	0.58 – 0.93	**0.010**
Marital Status				
Married	**referent**			
Single	−0.191	0.83	0.74 – 0.89	**0.004**
Federal Poverty Level				
>= 300 FPL	**Referent**			
200–299% FPL	−0.104	−0.90	0.76 – 1.08	0.232
100–199% FPL	−0.049	0.95	0.78 – 1.16	0.628
0–99% FPL	−0.001	1.00	081.– 1.09	0.995
Neighborhood Safety				
Very Safe	**referent**			
Somewhat Safe	−0.082	0.92	0.80 – 1.06	0.254
Unsafe	−0.164	0.84	0.69 – 1.04	0.122
Total Serving of Fruit & Vegetables you should eat everyday				
Don’t know the Guideline	**referent**			
Knows the Guideline	1.789	6.0	5.20 – 6.90	<**0.0001**

Variable	Beta	OR	95% CI	P-Value
PCT 100 POV	0.001	0.99	−0.03 – 0.03	0.968
PCT 200 POV	0.002	1.00	−0.98 – 1.02	0.984

CI, confidence interval; OR, odds Ratio