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Disparities in Retail Store and Fruit and Vegetable Access by Area Racial Segregation



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Background

Racial and ethnic disparities in consumption of healthful foods exist among the major racial groups in US. Lower rates of fruits and vegetable consumption have been documented for African Americans, and Hispanics compared to whites (Blanck et al, 2007; National Center for Chronic Disease Prevention, 2007). Given the beneficial effects of fruits and vegetables consumption on many diseases including obesity, cancers and cardiovascular diseases, and the disparities in the disease conditions along racial and ethnic lines, it is important to understand the influences on fruit and vegetable consumption. The food environment characterized by the numbers and types of food stores and eating places influence shopping alternatives for consumers. The differential distribution of the food sources and the availabilities of healthy food within communities would potentially contribute to health disparities within communities.

Objective of Study

To examine neighborhood disparities in the availability of food retail outlet types, and healthy food availability along residential racial lines in Guilford County, NC.

Data Description

Data on availability of food items from a market basket survey conducted in 2010 Guilford County, NC, were used to conduct comparisons of food availability in the four different store types: supermarkets, small grocery stores, convenience and convenience/gas combo stores, and other ethnic stores.

To assess whether food availability differed by area racial composition, we created three categories of races based on the predominance of whites, and African American within zip codes where surveyed stores were located in the county. Predominantly white –zip codes with 60% or higher whites, predominantly black was defined as zip codes with less than 40% whites and greater than 50% African American, and mixed race areas was defined as zip codes with less than 55% blacks, and whites ranging between 40% and 59%. The average racial composition of Guilford county is whites 60.29%, African American 33.95%, Asian 2.1% , Hispanic 3.5%, and others 3.16% (U.S. Census Bureau, 2000.).

Model Specification

Given that the outcome variables store types and, food items availability were measured as count data, we employed Poisson regression with robust error variance to evaluate the relationship between store, and food availability and area racial distribution. Prevalence, adjusted prevalence ratios and confidence intervals were calculated using STATA 11 program. The reference category is white.

Poisson Regression Model

$$\Pr(Y_i = y_i) = \frac{e^{-\lambda_i} \lambda_i^{y_i}}{y_i!}, y_i = 0,1,2.. \quad 1$$

Where $\ln \lambda_i = x_i' \beta$ and $E[y_i | x_i] = \lambda_i = e^{x_i' \beta} = \text{Var}[y_i | x_i]$

$$\frac{\partial E[y_i | x_i]}{\partial x_i} = \lambda_i \beta_i \quad 2$$

$$\ln L = \sum_{i=1}^n [-e^{x_i' \beta} + y_i x_i' \beta - \ln y_i!] \quad 3$$

$$\frac{\partial L}{\partial \beta} = -\sum_{i=1}^n [x_i [e^{x_i' \beta} - y_i]] = 0 \quad 4$$

$$PR_T = \frac{1 + \exp\{-\beta_0 - \dots - \beta_k \bar{x}_k\}}{1 + \exp\{-\beta_0 - \beta_T - \dots - \beta_k \bar{x}_k\}}, T = 1, 2, \dots, K \quad 5$$

Equation (1) states the basic Poisson model where y_i is the count of events within an observation period with parameters λ_i . Taking logs of equation (1), we derive a log likelihood function, Equation (3) and the likelihood equations are given as equation (4). We estimated the parameters of Equation 4 by maximum likelihood methods using Stata 11.

The prevalence ratios were calculated as in equation 5.

Results

Compared to white areas, African American areas were less likely to have larger food store types like supermarkets and grocery stores (Table 1). Furthermore, predominantly mixed races areas were less likely to have supermarkets than in white areas. Smaller food stores were more likely to be found in African American and Mixed race area neighborhoods than in white areas.

Table 2 shows the availability of fruits and vegetables by neighborhood racial segregation. Stores located in white neighborhoods were more likely to carry all fresh fruits and vegetables items than in African American areas. All fresh fruits items surveyed were carried in at least 40% of stores located in predominantly white neighborhoods compared to at least 19% of stores in African American and racially mixed neighborhoods. Stores located in African American areas were less likely to carry fresh fruit in all cases than in White neighborhoods. For a few items, apples, melons and watermelon racially mixed areas were more likely to carry them than white and African American neighborhoods. Availability of fresh vegetables was higher in white area stores compared with both African American and racially mixed areas.

Table 3 shows the availability of dairy products, breads and other products. White area stores were three times more likely to have 1% low fat milk than racially mixed areas, and two times more likely than African American areas. Both predominantly African American and mixed race area stores were less likely to carry whole wheat breads than white areas. Starchy food items like spaghetti, and white rice were carried more in minority neighborhood stores.

Table 1: Race, Food Store Types and Food Availability in Guilford County, NC

Food Store Type	White (N=58)				African American (N=22)				Mixed Race (N=25)				Total
	N	P	PR	(95% CI)	N	P	PR	(95% CI)	N	P	PR	(95% CI)	
Supermarket	22	0.73	1.00	(ref.)	5	0.17	0.62	(0.27-1.45)	3	0.1	0.33	(0.10-0.93)	30
Grocery	5	0.45	1.00	(ref.)	1	0.09	0.55	(0.07-4.50)	5	0.45	2.23	(0.70-7.08)	11
Convenience & gas	26	0.5	1.00	(ref.)	10	0.19	1.06	(0.62-1.81)	17	0.31	1.46	(0.98-2.18)	53
Other store types	5	0.42	1.00	(ref.)	5	0.5	2.26	(0.88-8.63)	1	0.08	0.45	(0.05-3.67)	11

N=Number of food store type; P= prevalence of food store type; PR= prevalence ratio; CI =confidence interval

Table 2: Availability of Fruits and Vegetables by neighborhood type

Food Items	Predominantly White (Number of stores=58)				Predominantly African American (Number of stores=21)				Mixed Race (Number of stores=26)			
	N	%	PR	95% CI	N	%	PR	95% CI	N	%	PR	95% CI
Fruits	36	62	1.00	0.84	11	52	0.84	0.53-1.33	18	69	1.11	0.80-1.55
Apples	38	66	1.00	0.80	11	52	0.80	0.51-1.25	15	58	0.88	0.60-1.29
Bananas	26	45	1.00	0.74	7	33	0.74	0.38-1.46	7	27	0.60	0.30-1.21
Grapes	22	38	1.00	0.50	4	19	0.50	0.20-1.29	4	15	0.41	0.15-1.06
Melon	31	53	1.00	0.89	10	48	0.89	0.53-1.49	16	62	1.15	0.78-1.69
Oranges	24	41	1.00	0.58	5	24	0.58	0.25-1.32	5	19	0.46	0.20-1.09
Cantaloupe	26	45	1.00	0.42	4	19	0.42	0.17-1.08	9	35	0.77	0.42-1.41
Peaches	26	45	1.00	0.53	5	24	0.53	0.23-1.21	5	19	0.43	0.18-0.99
Strawberries	26	45	1.00	0.64	6	29	0.64	0.30-1.33	12	46	1.03	0.62-1.71
Watermelon	23	40	1.00	0.48	4	19	0.48	0.19-1.23	7	27	0.68	0.33-1.38
Oranges, Mandarin Canned	19	33	1.00	0.72	5	24	0.72	0.31-1.71	9	35	1.06	0.55-2.02
Peaches Light Syrup	23	40	1.00	0.96	8	38	0.96	0.51-1.81	13	50	1.26	0.76-2.08
Vegetables	26	45	1.00	0.64	6	29	0.64	0.30-1.33	9	35	0.77	0.42-1.41
Carrots sun peeled	25	43	1.00	0.55	5	24	0.55	0.24-1.26	6	23	0.54	0.25-1.15
Celery	27	47	1.00	0.41	4	19	0.41	0.16-1.04	10	38	0.83	0.47-1.44
Green Pepper	29	50	1.00	0.67	7	33	0.67	0.34-1.29	6	23	0.46	0.22-0.98
Lettuce, Leaf	28	48	1.00	0.80	8	38	0.79	0.43-1.45	10	38	0.80	0.46-1.39
Onions	31	53	1.00	0.93	9	43	0.80	0.46-1.39	11	42	0.79	0.47-1.32
Tomatoes	29	50	1.00	0.76	8	38	0.76	0.42-1.40	9	35	0.69	0.38-1.25
Potatoes	26	45	1.00	0.64	6	29	0.64	0.30-1.33	8	31	0.69	0.36-1.31
Corn	26	45	1.00	0.53	5	24	0.53	0.23-1.21	5	19	0.43	0.18-0.99
Broccoli Bunch	24	41	1.00	0.58	5	24	0.58	0.25-1.37	9	35	0.84	0.45-1.55
Cucumbers regular	27	47	1.00	0.71	7	33	0.71	0.37-1.40	9	35	0.74	0.41-1.35
Cabbage Head	25	43	1.00	0.55	5	24	0.55	0.24-1.26	3	12	0.27	0.09-0.81
Cauliflower	27	47	1.00	0.72	7	33	0.72	0.37-1.40	10	38	0.83	0.47-1.45
Mushrooms	38	66	1.00	0.87	12	57	0.87	0.57-1.32	17	65	0.99	0.71-1.40
Spaghetti Sauce	32	55	1.00	1.21	14	67	1.21	0.82-1.77	16	62	1.12	0.76-1.64
Tomato Sauce												

N=number of stores carrying item, % = percentage of food stores by neighborhood; PR=prevalence ratio; 95 % confidence interval; ref.=reference category

Table 3: Availability of Dairy products (fresh and dry) and Bread and other products (fresh and dry) by neighborhood type

Food Items	Predominantly white (Number of stores=58)				Predominantly African American (Number of stores=21)				Mixed Race (Number of stores=26)			
	N	%	PR	95% CI	N	%	PR	95% CI	N	%	PR	95% CI
Dairy	30	52	1.00	0.55	6	29	0.55	0.27-1.14	5	19	0.37	0.16-0.85
Milk, 1% low fat	44	76	1.00	0.9	43	0.56	0.34-0.95	14	54	0.71	0.48-1.04	
Milk, 2%	53	91	1.00	0.78	15	71	0.78	0.59-1.04	23	88	0.97	0.82-1.14
Milk, Whole	31	53	1.00	0.89	10	48	0.89	0.53-1.49	7	27	0.50	0.26-0.99
Cheese, cheddar, any variety	26	45	1.00	0.53	5	24	0.53	0.23-1.21	3	12	0.26	0.09-0.78
Cheese cottage, any variety	24	41	1.00	0.46	4	19	0.46	0.18-1.18	3	12	0.28	0.10-0.85
Cheese, mozzarella, whole	34	59	1.00	1.14	14	67	1.14	0.78-1.65	14	54	0.92	0.60-1.40
Evaporated milk, any variety												
Breads and other Grains Products, Fresh and Dry	49	84	1.00	0.84	15	71	0.84	0.63-1.13	24	92	1.09	0.93-1.28
Bread White, enriched	32	55	1.00	0.9	43	0.78	0.45-1.34	10	38	0.70	0.41-1.20	
Bread, whole wheat	42	72	1.00	0.83	8	38	0.83	0.30-0.93	19	73	1.01	0.76-1.34
Hamburger Buns Enriched	23	40	1.00	0.60	5	24	0.60	0.26-1.38	4	15	0.39	0.15-1.01
Rolls, dinner, enriched	24	41	1.00	0.23	2	10	0.23	0.06-0.90	3	12	0.28	0.10-0.85
French and Italian Bread enriched	26	45	1.00	0.42	4	19	0.42	0.17-1.08	4	15	0.34	0.13-0.89
Bagels plain enriched	25	43	1.00	0.55	5	24	0.55	0.24-1.26	2	8	0.18	0.05-0.70
Bread crumbs, plain	30	52	1.00	0.46	5	24	0.46	0.21-1.03	15	58	1.12	0.74-1.69
Ready to eat Cereal Cornflakes	31	53	1.00	0.29	5	24	0.29	0.10-0.85	16	62	1.15	0.78-1.70
Ready to eat Cereal Toasted Oats	36	62	1.00	0.84	11	52	0.84	0.53-1.33	16	62	0.99	0.69-1.43
Flour, White, All purpose, enriched	37	64	1.00	0.82	11	52	0.82	0.52-1.29	22	85	1.33	1.03-1.71
Macaroni elbow-style, enriched	24	41	1.00	0.58	5	24	0.58	0.25-1.32	9	35	0.84	0.45-1.54
Noodles, yolk-free, enriched	33	57	1.00	0.50	6	29	0.50	0.25-1.03	17	65	1.15	0.80-1.65
Popcorn, Microwave, any variety (Un popped)	35	60	1.00	1.18	15	71	1.18	0.84-1.67	24	92	1.53	1.21-1.94
Rice, White, Long-grain, enriched	37	64	1.00	1.12	15	71	1.12	0.80-1.56	21	81	1.27	0.97-1.66
Spaghetti, any variety, enriched												

N=number of stores carrying item, % = percentage of food stores by neighborhood; PR=prevalence ratio; 95 % confidence interval; ref.=reference category

Conclusion and Recommendations

Our results point to the existence of disparities in the distribution of store types and food availabilities along racial segregation of neighborhood in Guilford County. African American neighborhoods significantly lacked supermarkets and larger stores that are associated with healthy food availabilities. The lower availabilities of fruits and vegetables and low fat milk found in African American neighborhood stores is affirmation of the racial disparities in store availability. These findings are of public health concern as lower availability of healthful foods in one's locality may influence the consumption of these foods by residents in these localities and impact health negatively.

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This study was supported by National Institute for Food and Agriculture (NIFA) project # NC.X-230-5-09-531-1.