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Neighborhood Impact on Healthy Food Availability and Pricing in Food Stores

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Abstract

Availability and price of healthy foods in food stores has the potential to influence purchasing patterns, dietary intake, and weight status of individuals. This study examined whether demographic factors of the store neighborhood or store size have an impact on the availability and price of healthy foods in sample of grocery stores and supermarkets. The Nutrition Environment Measures Study-Store (NEMS-S) instrument, a standardized observational survey, was utilized to evaluate food stores (N=42) in a multi-site (Vermont and Arkansas) study in 2008. Census data associated with store census tract (median household income and proportion African-American) were used to characterize store neighborhood and number of cash registers was used to quantify store size. Median household income was significantly associated with the NEMS healthy food availability score (r=0.36, p<0.05); neither racial composition (r=−0.23, p=0.14) nor store size (r=0.27, p=0.09) were significantly related to the Availability score. Larger store size (r=0.40, p<0.01) was significantly associated with the NEMS-S Price scores, indicating more favorable prices for healthier items; neither racial composition nor median household income were significantly related to the Price score (ps>0.05). Even among supermarkets, healthier foods are less available in certain neighborhoods, although, when available, the quality of healthier options did not differ, suggesting that targeting availability may offer promise for policy initiatives. Furthermore, increasing access to larger stores that can offer lower prices for healthier foods may provide another avenue for enhancing food environments to lower disease risk.

Keywords

diet; obesity; built environment; economics; race

Introduction

Availability of healthy food in community stores may be an important consideration in developing food environments that support prevention of obesity [1,2], cardiovascular

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disease [3] and cancer. However, healthy foods, including fruits, vegetables, low fat milk and high fiber bread tend to be less available in areas with a higher proportion of African-Americans [4–6] and in lower income communities [4,6–9]. Availability of healthier foods likely has an impact on consumption; for instance, when greater store shelf space is devoted to products such as low-fat milk and high fiber bread, increased consumption of these products is noted [7,10,11]. Thus, racial minority and lower income populations that may be at greater risk for obesity [12,13], cardiovascular disease [14], and cancer [15] may find that availability of healthy foods is a barrier to consuming a healthy diet.

A key factor in healthy food availability may be the accessibility of supermarkets [16–21] as compared to smaller grocery and convenience stores. However, supermarkets are less likely to be located in lower income neighborhoods [4,16,17,22–24] and areas with a high proportion of African-American residents[4,20,23–25]. Proximity to a supermarket appears to be related to diet quality, even after controlling for other relevant variables [3,26].

Although food availability is clearly an important factor, accessibility of healthy foods may also be driven by other factors, such as price and quality. Research has indicated that healthier foods may be more expensive than less healthy items [19,20]. In addition to greater availability, supermarkets may have more favorable prices than grocery or convenience stores [17,20]. Store size may also associated with the quality of fresh produce and meat/fish [18], which likely influences the food's attractiveness to consumers.

Integrating information across previous studies to provide a clear picture of the associations between neighborhood characteristics and availability, pricing, and quality of healthy foods has been difficult due to the lack of standardized measures and the absence of psychometric data establishing the reliability of the instruments used. Therefore, the aim of this research was to examine the availability and pricing differences of healthy foods in food stores in relation to the racial composition and socioeconomic status of the store neighborhood as well as store size, using the recently developed Nutrition Environment Measures Survey in Stores (NEMS-S) [8]. The NEMS-S has previously shown sensitivity to food environment differences based on socioeconomic variation in store location [6,8,9], as well as differences based on the store type (i.e., convenience vs. grocery store) [6,8].

Methods

Overweight individuals (28% African American) entering a behavioral weight loss research program self-reported their primary grocery store by answering the following question: "Please list the store where you (or the person in your house who shops for food) have purchased the most food that you brought into the house in the past month." These 90 individuals lived within a 45 minute driving radius of Little Rock, Arkansas or Burlington, Vermont, and all stores were also located in these two areas. Individuals were, on average, obese (mean body mass index [BMI; kg/m^2] = 36.1±5.2, middle aged (mean age = 44.1±10.8 years) and predominately women (90%).

Food stores were classified according to the methods outlined by Morland and colleagues [25], who defined supermarkets as large, corporate-owned "chain" stores (e.g., Walmart Supercenters, Krogers, Hannafords, Shaws), while grocery stores were defined as smaller, local and noncorporate-owned food stores. Two stores were excluded from these analyses because they were warehouse stores, consistent with the NEMS-S protocol. In addition, one store was excluded because it was classified as a convenience store, and the aim of this study was to examine grocery stores/supermarkets. The final sample of stores (N=42) largely (95.2%) consisted of national and regional chain supermarkets, plus one locally-owned organic grocery store and one small locally-owned grocery store. The sample of

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grocery/supermarket stores in the present study represents 34% of grocery stores and supermarkets in the two cities studied. Internet Yellow Pages was used to enumerate the total number of grocery stores located within 45 minutes of Little Rock, AR and Burlington, VT, in order to estimate the proportion of stores represented in this sample. Overall, 122 grocery stores and supermarkets were enumerated; thus, the food stores represented in this convenience sample include approximately one third of available grocery stores and supermarkets in the selected areas.

Store observation data were collected February to April 2008. The University of Arkansas for Medical Sciences and the University of Vermont Institutional Review Boards reviewed and approved this study.

Characterization of Food Stores

Nutrition Environment Measures Study-Store (NEMS-S) instrument [8], a standardized observational measure, was utilized to characterize the nutrition environment of the selected stores, consistent with the standard protocol. Specifically, trained data collectors assessed the availability and price of 10 pairs of a healthier (e.g., higher fiber, lower fat, lower sugar) and a regular food option within the same brand if possible (e.g., whole grain vs. white bread). The measured foods represent those that contribute most to the fat and calories of a typical American diet and those that are most recommended for healthful eating [8]. The number of varieties of specified healthy items (i.e., ground beef, bread, chips, and cereals) and shelf space for different types of milk and reduced-fat frozen dinners, were also assessed. Availability and price were assessed for 20 fruit and vegetable types; in addition, quality of fruits and vegetables was assessed with a dichotomous acceptable/unacceptable rating. The number of cash registers was used to approximate store size. The three NEMS-S subscales are: Availability of healthy foods (score range: 0–30); Price of healthier options (score range: −9–18), and Quality of produce (score range: 0–6). Further, if all of the items were available (missing observations: (n=8, 9.5% of possible observations) a total cost of all healthy items and for the comparable standard food items was calculated in the manner suggested by Jetter and colleagues [19].

The primary NEMS-S rater was a PhD-level researcher who was centrally trained by the individuals who developed the inventory [8] in a 2-day workshop. Over 10% (N=5) of store ratings were duplicated independently by a master's-level trained rater on the same day to establish inter-rater reliability. Test-retest (N=5) reliability ratings were conducted within two months of the original assessment. Consistent with previously published reliability estimates [8], there was high inter-rater reliability (mean agreement 99% for Availability, 99% for Quality) and high test-retest reliability (mean agreement 99% for Availability,100% for Quality) in the present study.

Characterization of Store Neighborhoods

United States 2000 decennial Census data associated with store census tract (median household income, proportion of individuals living below the poverty line, proportion African-American) were used to characterize each store neighborhood. Racial composition of the area was limited to proportion African-American as 97% or more of the population in the selected areas self-identified their race as either African-American or Caucasian. Median household income in these census tracts ranged from $17,500 to $96,830 (mean= $48,351.1±16,651.6). Proportion of African-American residents in the store census tracts ranged from 0.2% to 86.3% (mean=12.0±19.1). The 42 food stores were distributed among 36 census tracts (1–2 stores per census tract).

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Data Analyses

Pearson correlations were used to examine associations between healthy food environment variables and neighborhood characteristics. Standard multiple regression was used, when applicable, to consider all associated characteristics simultaneously as continuous variables to examine the constellation of factors associated with the relevant food environment indices and determine which accounted for the majority of the variance. Paired sample t-tests were used to compare prices for the healthy and the unhealthy items, individually and overall. As outlined in the NEMS-S protocol, proportion of low-fat milk shelf space was calculated as the combination of skim and 1% milk shelf space compared to whole milk shelf space. The data were analyzed using SPSS 16.0. An alpha level of 0.05 was considered as significant for all tests.

Results

Description of Sample

Store size (i.e., number of cash registers) ranged from 4 to 29 (M =11.0±6.2; median= 10). There were no relationships between store size and the census track neighborhood demographic variables (i.e., median household income or proportion African-American) (ps>0.05).

Availability, Pricing, and Quality of Healthy Food Options

NEMS-S Availability scores ranged from 12 to 30, with the average Availability score nearing the maximum of 30 (M=27.9±3.0). Both the regular and healthier food options were widely available in supermarkets overall, and nearly all stores reached the ceiling of the scores by having the measure's maximum number (or more) of varieties for whole wheat bread (98% of stores), baked chips (95%), and low sugar cereal (100%). The majority of stores (88%) had 51% or greater shelf space containing reduced-fat frozen dinners. In contrast, variability in the varieties of lean ground beef ranged from zero to five (M=2.8±1.1). Shelf space for low-fat milk varied widely; proportion of low fat milk compared to whole milk ranged from 20% to 78% (M=55.2%±13.7).

NEMS-S Price scores ranged from −3 to 6 (M=2.4±2.1), a restricted portion of the possible range of −9 to 18. Overall, purchasing the 10 non-produce healthier items on the measure was significantly more expensive (M=$29.65±2.41) than the standard items (M= $27.48±2.76) ($p$<0.001), reflecting a significantly higher cost for five of the healthier items compared with the regular option. The prices for 100% juice (154% of regular, p<0.001), lean hot dogs (139%; p<0.001), lean ground beef (124%; p<0.001), baked chips (118%; p<0.001) and whole wheat bread (105%; p<0.01) were significantly greater than the regular options. There were no significant price differences between diet and regular soda; in fact, the price was exactly the same in all of the stores assessed. On the other hand, the prices of low-fat milk, reduced fat dinners, lower-fat baked goods, and low sugar cereals were actually significantly lower than the prices for the regular option. However, the package size for the healthier and regular options tended to vary widely for both cereal and baked chips; therefore, price comparisons were conducted for these items on a per-ounce basis. Considered in this way, the price difference between baked and regular chips was amplified (157% of regular; p<0.001), and low sugar cereal was no longer significantly less expensive than regular cereal (p=0.68).

All stores obtained the top score (a 6) on the NEMS-S Quality index, indicating that at least 75% of the produce was acceptable. Due to lack of variability, this variable was excluded from further analyses.

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Neighborhood Differences in Food Availability and Pricing

Even with generally high store Availability scores, median household income was significantly related to the NEMS-S Availability score (r=0.36, p<0.05). In contrast, while there were statistical trends in the expected direction, neither racial composition (r=−0.23, p=0.14) nor store size (r=0.27, p=0.09) were significantly related to the Availability score. Utilizing percent of individuals below the poverty level as the estimate of socioeconomic status instead of median household income produced similar results.

As low-fat milk shelf space and lean beef varieties varied widely in this sample, the availability of low-fat milk was examined to explore the relationship to neighborhood characteristics and store size. Store shelf space of low-fat milk was strongly associated with the neighborhoods' racial composition (r= −0.70, p<0.001) and median household income (r=0.53, p<0.001). There were no significant associations between low-fat milk shelf space and store size (p>0.05). When both neighborhood racial composition and median household income were entered simultaneously into a regression model predicting store shelf space of low-fat milk, only neighborhood racial composition remained a significant predictor, explaining 49% of the variance in low-fat milk space. The number of lean beef varieties was moderately associated with neighborhoods' racial composition (r= −0.36, p<0.05) and median household income (r=0.52, p<0.001). When both neighborhood racial composition and median household income were entered simultaneously into a regression model predicting number of lean beef varieties, only neighborhood median household income remained a significant predictor, explaining 21% of the variance in lean beef space.

In contrast to the association observed between food availability and several store neighborhood demographic variables, store size (r=0.40, p<0.01) was the only variable that was significantly associated with the NEMS-S Price score. Neither racial composition nor median household income or percent of individuals below the poverty line were significantly related to the Price score (ps>0.05). Thus, larger stores were more likely to have favorable prices for healthier food options but other neighborhood characteristics were unrelated to health food prices.

Discussion

Even among a sample of largely chain supermarkets, availability of healthier foods may present an obstacle to consuming a healthy diet in certain neighborhoods, particularly low-income neighborhoods, consistent with findings from previous research [8,9]. Further, there appears to be a significant disadvantage in the availability of low fat milk in predominantly African-American neighborhoods. However, when available, the quality of healthier food items did not differ in supermarkets and grocery stores based on the characteristics of the residents of the store neighborhood. Prices for healthier food options also did not vary markedly in the different neighborhoods studied, although larger stores consistently offered more favorable prices for healthier options, as has been shown in previous studies [6,17]. These findings are of particular concern as areas that are more vulnerable to diet-related chronic diseases (i.e., lower income, rural, and predominately African American or Hispanic) typically have limited access to large food stores [4,17,24,27,28].

Furthermore, we found that the overall price for the 10 non-produce healthier items on the measure was significantly greater than the price for the standard items, which was primarily driven by the higher prices for healthier juice, hot dogs, ground beef, chips and whole wheat bread. Given that these foods are frequently consumed in the typical American diet [8], there may be a significant disincentive, in general, for purchasing the healthier version of these common food items. Moreover, the use of brand name products as required by the NEMS-S protocol may actually underestimate the price differential between healthy and regular

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products, as individuals who are working within a very limited budget are unlikely to choose brand name products and might instead choose the store brand products or the products that are available in bulk sizes (which may not be the healthier version of the product). Examining the store brand and bulk products may produce even greater price differences between healthier and regular food items.

In addition to general healthy food availability differences based on neighborhood median household income and trends related to neighborhood racial composition, there may be some specific disadvantages in the amount of low-fat milk available in certain neighborhoods. Consistent with previous research, availability in terms of low-fat milk shelf space was significantly lower in store neighborhoods with lower median household income [7] and with higher proportion of African-Americans [5]. However, a casual relationship cannot be determined from these data; supermarket availability of low-fat milk may lead to lower demand for this product among certain populations, or lower demand for low-fat milk may lead to lower availability of this product in supermarkets. Nonetheless, lower shelf space for low-fat milk in vulnerable neighborhoods may create lower familiarity with low-fat milk or may convey social norms for drinking higher fat milk. Lack of availability of lower-fat milk in populations at high risk for chronic disease may be a crucial public health concern as whole milk is one of the top dietary sources of saturated and total fat for Americans [29] and switching to lower fat milk options is a priority in several dietary improvement interventions such as the 1% or Less campaign [30] and the CDC's Rethink Your Drink campaign [31].

When interpreting the findings of the current study, it is important to consider several limitations. First, although we followed the conventions of previous research and utilized median household income as a proxy measure of the neighborhood socioeconomic status [7,19,23,24], other researchers have selected other data to characterize socioeconomic status of neighborhoods, such as median house value [25,32] or poverty rates [4,5,17,33]. We found comparable results when using poverty rates rather than median household income and therefore have some confidence that socioeconomic status is reasonably estimated in the current study. However, future research may wish to focus on determining the most appropriate measures for socioeconomic status when characterizing the food environment. Second, previous studies have used a variety of definitions for the space in which people live (such as zip code, census tract, or state) and census tract may not be the most appropriate way in which to characterize grocery store and supermarket neighborhood; however, the most appropriate unit of analysis in evaluating neighborhood food environment has yet to be determined [34]. Finally, a convenience sample of grocery stores and supermarkets selected by overweight individuals entering a weight loss program was used. The extent to which this sample generalizes to the primary food stores chosen by other populations, such as non-overweight individuals or overweight individuals who are not entering a weight loss program, is unknown. The sample of food stores assessed represents a third of the available stores within the defined catchment area, but the possibility exists that these stores are not representative of the larger group of grocery stores and supermarkets. Because overweight and obese individuals are a group at elevated risk for developing the chronic diseases associated with energy imbalance [35], understanding the neighborhood food environment of the grocery stores in which this subset of the population shops may be of particular importance. Furthermore, Arkansas and Vermont are rural states and even the large cities within these states are not as densely populated as others have studied [6,8,16,27]; therefore, generalization to large metropolitan areas with significant inner city "food deserts" may be problematic. However, rates of obesity and diet-related chronic disease within rural states are alarming [36,37], and these regions should not be ignored when considering the built food environment. Indeed, research shedding light on the food environment within rural states provides a necessary complement to investigations of urban

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metropolitan settings and rounds out the existing scientific literature to provide a more complete picture of the nation's food environment.

Despite these limitations, these results point to possible targets for improving the accessibility of healthy foods. Environmental and policy initiatives can improve conditions for large numbers of individuals and the growing concern with the impact of the food environment on the health of the nation emphasizes the importance of considering such actions [38]. Given these current results that healthier foods tend to have more favorable prices in larger stores and lower-income areas may have reduced availability of healthier items, efforts to increase supermarkets accessibility may be particularly beneficial in developing food environments that support the prevention of diet-related conditions, especially among lower income populations and other high risk populations. Cost is reported to be only second to taste in determining food choice [39], and price reductions for lower fat foods as well as fruits and vegetables have been found to be effective in increasing healthier food purchases [40]. However, supermarket operators are likely reluctant to locate in certain areas due to crime/security, sales projections, development costs, and insurance costs [17], which creates a challenge of healthy food accessibility in these areas.

There have been recent movements to expand the focus on traditional individually-targeted interventions to reduce nutritionally-related conditions such as obesity, heart disease and cancer to also include a focus on modifying the built environment to impact these nutrition–related public health challenges. In one such case, the Food Trust is taking an innovative approach to improve the accessibility of nutritious food for underserved urban communities in Pennsylvania by assisting with the financing needs of supermarket/grocery store operators that plan to establish a store in underserved communities. So far the Food Trust's Fresh Food Financing Initiative has committed resources to over 50 supermarkets projects [41]. While the efficacy of neighborhood-level food environment interventions to promote healthier intake remains to be seen, it is possible that economic incentives or community advocacy for locating supermarkets in underserved areas could significantly improve the food environment for populations at-risk for nutrition-related chronic conditions.

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