GIS FOR COMMUNITY FOOD ACCESS AND ITS RELATIONSHIP TO CANCER

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Presented at
28th ESRI International User Conference, August 4th – 8th, 2008,
San Diego Convention Center,
San Diego, California

ABSTRACT

A common profession using GIS is health. In this paper we attempt to use GIS to map food accessibility in the state of Alabama and to investigate if there is a relationship to the risk of cancer. When compared with any other American group, African Americans are at the greatest risk for cancer. Data associated with the access to healthy food choices and opportunities for physical activity could impact upon cancer risk. The present study determined whether food and physical activity outlets in Macon and Bullock Counties have the appropriate foods and activities, which encourage community members, with and without cancer, to make healthy food and physical activity choices. Retail food outlets were audited using the United States Department of Agriculture Thrifty Food Basket. Results from this study would be used to identity predominantly African American communities within the Alabama Black Belt at risk for cancer.
Background and Significance

In the United States (U.S.) and abroad, cancer is a major public health issue, with the incidence and mortality rates for most cancers increasing among individuals in low-income, rural communities. Cancer from all causes is the second leading cause of death in the U.S. (ACS, 2003). Assessment of environmental risk factors in communities may be important in cancer prevention efforts. Diet, nutrition, physical activity, and cancer risk reduction in low-income, rural communities are influenced by numerous environmental factors, such as availability and accessibility of healthy foods, adequacy and quality of opportunities for exercise, tobacco smoking, ecological factors, occupational factors, water and water quality, media messages, social norms, sanitation and hygiene etc. (Crockett and Sims, 1995; Simons-Morton et al., 1988). In response to this growing threat, Americans are being urged to eat healthier foods. However, research is increasingly showing that those at greatest risk for dietary-related diseases such as some types of cancer face a substantial but little understood impediment to getting healthy foods in their community food environment (Mikkelsen and Chehimi, 2007). Although cancer occurs throughout the world, cancer risk varies widely by region, population groups (including race/ethnic groups), and country, suggesting geographic, environmental, and cultural influences (Ries et al., 1994).

Among the different ethnic groups in the U.S., African Americans have the highest cancer incidence and the lowest survival rates (Ries et al., 2005). Cancer mortality rates for all sites of cancer are almost 2.5 times higher for African Americans than for Caucasians (Fouad et al., 2001). Prostate cancer provides a clear example of the ethnic disparity in the impact of cancer in men. In 2006, an estimated 234,000 new cases of prostate cancer will occur in the US, resulting in more than 27,000 deaths (ACS, 2006). Prostate cancer is the leading cancer diagnosed in males and accounts for 10% of cancer deaths in men in the US (ACS, 2006). However, prostate cancer impacts African Americans to a much greater extent than other ethnic groups. Globally, African-American men have the highest rates of prostate cancer, with an incidence rate approximately 35% higher than among Caucasian men (Murdock et al., 2001). Prostate cancer incidence and mortality rates for African-American men exceeded that of Caucasian men in the US during the period 1997-2001 (271.3 vs. 167.4 per 100,000 and
Breast cancer provides evidence that the ethnic disparity in cancer affects women, as well. Breast cancer is the most commonly diagnosed cancer among women in the US, including African-American women (ACS, 2008). It is second to lung cancer as the leading cause of cancer-related deaths among women (ACS, 2006). In 2006, approximately 214,000 new cases of breast cancer are projected in US women, and approximately 41,000 deaths from the disease (ACS, 2006). While the incidence rate of breast cancer during the period 1997-2001 was slightly lower in African-American women compared to Caucasian women, the rate in African-American women was significantly higher than in other ethnic groups, including Asian-American and Hispanic women (ACS, 2006). Mortality from breast cancer was reported to be 28% higher for African-American women than for Caucasian women, and African-American women with breast cancer were more than twice as likely to die as Hispanic and Asian-American women (USDA, 1996; Eley, 1994). The breast cancer mortality rate was higher in African-American women than in Caucasian, Hispanic, and Asian-American women in the US during the period 1997-2001, with rates of 35.4, 26.4, 17.3, and 12.6 per 100,000, respectively (ACS, 2006).

The community food environment refers to both, the availability of healthy foods within a community and how easily residents can access those foods. There is a growing understanding that barriers to accessing healthy foods play a role in poor dietary decisions and diet-related disease risk (Mikkelsen and Chehimi, 2007). Simply put, it is difficult to make healthy choices if healthy foods are not available or require more effort or expense to obtain. Health food access in low-income and primarily African-American neighborhoods is of concern because of the linkage between food accessibility and overall community health. However, the emergence of research measuring the associations between food environments and eating habits is a recent occurrence (Mikkelsen and Chehimi, 2007).

There is accumulating evidence, which indicates that dietary choices are influenced by environmental factors, such as access to, and availability of healthy foods and food stores. Several studies have found that proper nutrition can prevent cancer. Also evidence has shown that the public in general agree that good nutrition can prevent cancer, but there may be less agreement among low-income and minority populations.
However it was reported by Hathorn et al. (2007) that a low-income, predominantly African American city had fewer healthier foods when compared to a majority Caucasian city. Reidpath et al. (2002) found that low-income neighborhoods had 4 times as many grocery stores as the wealthier neighborhoods and half as many supermarkets. It was also verified that in poorer areas and non-Caucasian areas tend to have fewer fruit and vegetable markets, bakeries, specialty stores and natural food stores. Some researchers may suspect that fast food restaurants are mostly absent from predominately white Caucasian neighborhoods. On the hand, Kwate (2008) reported that fast foods restaurants were not absents from mostly Caucasian neighborhoods. In addition, Hathorn et al. (2007) confirmed that fast-food restaurants and supermarkets were most common in a mostly Caucasian city, while the low-income city had more convenience stores.

Most studies looking at food access have looked at socio-economic status and not the effects on health and diseases such as cancer. It was against this backdrop that the present study with the following objectives was designed. A number of researchers are now depending on GIS as a tool to explore the built environment. Burns and Inglis (2007) used GIS modeling to measure access to supermarket and fast food outlets in relation to area-level social advantage in the (City of Casey) Melbourne, Australia. The study found that food access was good provided residents have transportation.

This work is apart of a boarder research project, which look at the built environment and its relationship to cancer across the Alabama Black Belt (ABB) using geographic information system (GIS). The data will be eventually used to create virtual maps of the entire ABB region and document cancer, food access and availability. The present study determined whether food and physical activity outlets in Macon and Bullock Counties have the appropriate foods and activities, which encourage community members, with and without cancer, to make healthy food and physical activity choices.

Methodology

Research Setting and Demographics

Union Springs, located in the Alabama Black Belt (ABB), serves as the county seat in Bullock County, AL Union Springs population is roughly 3,670 and 74% of the population is African American. The median family income in Union Springs is $18, 520
smaller rural city. Shorter has a population of 355 and over 80% of the city is African American and the household median income is about $18,929.

**Observational Survey**

Convenience stores, fast-food restaurants, restaurants, large supermarkets, and mass merchandisers located within a six mile radius in both cities were inventoried for opportunities for healthy food choices and physical activity. The food outlets were randomly selected and inventoried once, using a food outlet checklist based on the United States Department of Agriculture (USDA) Thrifty food basket, and an observational survey questionnaire developed by the Investigators. The food outlet checklist was separated into seven categories, namely: Grains; Vegetables; Fruits; Milk Products; Meat and Meat alternates; Other Foods; and Fast-foods.

The retail food outlets were classified as follows: i) Mass Merchandiser – Food outlet that supply food in bulk; ii) Physical Activity Outlet – Food outlet with some form of physical activity; iii) Restaurant – Food outlet which has formal menu, serving and sitting arrangements; iv) Small Supermarket – Food outlet which is small and has the basic food commonly used for home preparations; v) Convenience Store – Food outlet which supply the food items that typically run out at home and while making road trips; vi) Fast Food – Food outlet which provide quick and low cost food; vii) Large Supermarket – Food outlet which is large and has a wide range of food commonly used for home preparations; and viii) Other – Any other Food Outlet that does not fall under the above classification, for example, shops and low end gas stations that sell few food items. By classifying the type of Food Outlets, and looking at the ease of access to the various classes by the public in terms of the proximity access to such Food Outlets, Urban Regional Areas, and the population concentration at the Block Group level, then, one could have a better conclusive spatial inference that the existing food related has some relation to the existing cancer cases.

**Global Positioning System (GPS) and Geographic Information System (GIS)**

For this paper GIS was utilized as means to explore and do preliminary data sets from previous collected data on Food and Physical Activity Outlets (PAO). Spatial concentration
of the type of food and physical activity outlets were defined using a Garmin DNR Global Positioning System (GPS) and Geographic Information System (GIS) software.

Results

This project is in the initial stages of its development and as result data are still being collected from the following sample areas: i) Road Network; ii) Population; iii) Urban areas; iv) Household; v) Food Outlets; and vi) Cancer cases. As this project develops, and as useful datasets become readily available, they will also be integrated into the GIS application, which will further enhance the analysis. For the purposes of this paper, all of the above data sets were collected with the exception of the cancer cases (which is being collected).

The following visual, spatial observations shown in Figure 1 were made:

- There are more physical activity outlets in Union Springs than that at Shorter.
- Convenience stores are the most common retail food outlets in Shorter.
- There are more large supermarkets in Union Springs than Shorter (Figure 1).
- Only one Mass Merchandiser Food Outlet, (located in Union Springs), is available.
- Union Springs and Shorter have the same number of Restaurant Food Outlets.
- The proximity of Food Outlets is more in Union Springs than Shorter.
- Convenience Stores, Fast Food, and Other Food Outlets are located at the northern section of Union Springs.

Figure 2 shows access to the sampled retail food outlets at the Union Springs and Shorter. Figure 2 (a) shows the access to retail food outlets from major highways. In Shorter, seven out of 13 food outlets are 100 feet from Major Highways, while in Union Springs, 20 out of 27 food outlets are 100 feet from Major Highways. Therefore, in Shorter 54% of the Food Outlets can be easily accessed from Highways, while in Union Springs it is 74% of the Food Outlets that are easily accessed from Highways.

Another analysis approach which is used in this paper to visually present the access to Food Outlets is to look at the number of Food Outlets that fall within the Urban Regional Area as defined by each sample area. Figure 2 (b) shows Shorter as having no
Urban Regional Area defined for the town while in Union Springs, there is 3 square miles that defines the Urban Regional Area. Figure 2 (b) shows Food Outlets within its Urban Regional Areas of Union Springs. A large majority of the Food Outlets are contained in the Union Spring’s Urban Regional Area.

Figure 1. Classification of the retail food outlets of the collected datasets at Union Springs and Shorter

The population of the sample area needs to be considered because it will give a good indication of the number of people exposed to the likelihood of getting cancer by on the basis of their food choices and physical activity levels. Figure 3 shows the Block Level Population at the two sample sites. Two sets of data are presented. The first set as shown on Figure 3 (a) gives the 2003 population. In this map, Shorter has a population where the block group level for the year 2003 indicates that all of the sampled Food Outlets are located within a population that is classified as having of 1052–1772 people.
Figure 2. Maps showing access to food outlets

(a) Access from major highways

(b) Food outlets within urban regional areas

Legend
- Convenience Store
- Fast Food
- Large Supermarket
- Mass Merchandiser
- Other
- Physical Activity Outlet
- Restaurant
- Small Supermarket
- Major Highway 100ft buffer
- Food Outlets 100ft off highway
- Urban Regional Area
- Urban regional areas
Figure 3. Maps showing population statistics at the Block Group Level

(a) Population 2003

(b) Households 2000 - 2004
In Union Springs, the population data at the block group level for the year 2003 indicates that all the sampled retail food outlets are located within three population classes (0–1051; 1052–1772; and 1773–2913). Of the three classifications, the class of 0-1051 has the most Food Outlets while class of 1052–1772 has the least number of Food Outlets.

Another analysis approach which is used in this paper to visually present the access to retail food outlets was to look at Household population data at the block group level for the years 2000 to 2004. Figure 3 (b) indicates that in Shorter, five of the Food Outlets are located within a household population that is classified as having a population of 359–573 households while the remaining sampled retail food outlets are located in a class that services 574–893 households.

A similar visual analysis is done for Union Springs. The household population data at the block group level for the years 2000 to 2004 indicates that all of the sampled Food Outlets are located within three household population classes (0–358; 359–573; and 574–893). Of the three classifications, the class of 574–893 has the most Food Outlets while class of 0–358 has the least number of Food Outlets. The spatial observation made by looking at spatial accessibility to Food Outlets in terms of the Population, Road access, and Urban Regional Areas is important for understanding the community food Outlets which may be associated with cancer risk. As the project progresses, community members’ choices of food from each retail food outlet will provide the quantitative data needed to link the food choices to cancer cases.

Conclusion

The project presented in this paper is at its early stage, however, the preliminary results have shown the spatial concentration of the retail food outlets and physical activity outlets in terms of their proximity. If healthier food and physical activity choices are provided to communities, then, it is likely that diet-related cancer cases may be low. This depends upon other factors such as people’s preference, economic status, time availability, health education, eating habits, and such like. As this project develops, these factors will be explored, as well as to include the wider Alabama Black Belt region.
Acknowledgements

Gwen Lewis, District Conservationist, USDA NRCS, Tuskegee and Roger Hornsby, USDA NRCS for the GPS and initial GIS work for the project.
REFERENCES


