Park disparity based on income

Lily Hayward Carmen Pergerson

Problem Statement

Amenity accessibility in America has been a significant problem over the history of this nation, from Central Park to private developers not being considerate of community connectivity. Beyond this, the amount of funding for an area comes from tax revenues which are more if property values are higher. One of the most beneficial amenities for both the natural and the anthropogenic world is the presence of parks and green spaces. It both works to offset anthropogenic impacts on the environment and to support human health by aiding in strengthening the cleanliness of important natural processes. This includes absorbing carbon and also filtering some water runoff and thus supporting clean water. The problem lies in the fact that these natural spaces are less accessible to low-income communities based on location and transportation constraints. the disproportionate access that lower-income individuals in North Carolina have to these amenities does not help combat the obesity epidemic they are experiencing and is an important issue for city planners when making decisions. The combination of income levels with parks and walkable infrastructure could make a point for the accessibility of recreational spaces. The goal is to analyze the relationship of income status with access to greenways and outdoor recreational spaces.

Literature Review

There have been many studies that found that higher income was correlated with access to parks. One study used NAIP data to find vegetation density then related it to income levels and found that there was a positive correlation between both high income and proximity to parks (Florida, 1). Another study was done by Ming Wen et al (Wen, 1) that concluded that there was no correlation between racial minorities and access to parks. Even though there is one piece of research concluding that there is no correlation, many more sources are saying there is (Lakhani, 1). Beyond that, in Charlotte, less than 50%

of the population lives within driving distance of a park (Lakhani, 1). This would mean with less walkable park infrastructure one of the main ways to get to parks is by car which is an added expense.

One public health epidemic more prevalent in low-income communities is obesity which could be combated by access to public spaces to be active. This being said, to get to a park there needs to be access and the disparity in park access is more apparent in low-income communities or communities with racial minorities(Parks and Recreation, 1). This article then compares the levels of obesity in racial minorities and how white people have a lower obesity rate to attempt to create a correlation between the variables (Parks and Recreation, 1). The reading determined that there is an unequal distribution of access to green spaces and "that physical activity levels and park use are dependent on demographic, socioeconomic (SES) and regional characteristics (Parks and Recreation, 1)." All data proves that it is at least worth it to investigate how accessible parks are in Wake County and see if there are improvements to what can be done to allow people to improve both their mental and physical health!

Several studies have revealed a positive correlation between access to environmental amenities and physical activity levels of the surrounding community. A study conducted on the youth population in Atlanta, Georgia revealed that youth who lived in proximity to open natural spaces were 2-3 times more likely to take walks in 2 days than their peers who did not have access to these amenities (Cohen, 1). The same data was found to hold true for adults as well. While parks are an easily found space in urban areas and places with higher concentrations of people experiencing poverty, the distribution of the parks does not allow for social access to parks "is a term recently coined to refer to sociodemographic features such as safety, traffic, and walkability that may directly affect park utilization" (Wen, 1). The findings indicate that park users were engaged in moderate to vigorous physical activity on athletic courts, sports fields, and playgrounds. Moreover, parks that provide supporting amenities such as bicycle racks and restrooms are more likely to be used for physical activity (Parks &amp, 1)

Data Collection

For the acquisition of data, we used the census database to get fine-scale data on income and poverty at the census tract level. For the polygons, Tigerfile census tract data was used. This means that there is an opportunity to join spacial and nonspacial data. Next, we looked at Wake County's open data program to be able to get the shapefiles and CSVs of the variables we are interested in. Because the area of interest was public parks in Wake County, Wake County open source data was used. In the open source data, we decided on using Park Point and Greenway polyline shapefiles to display greenspaces. Another place we turned to was the US Census database to use the U.S. Census Bureau Poverty Status in the Last 12 months of North Carolinians and Income estimates to provide the data for an economic breakdown of Wake County.

Study Area Map

The study area is Wake County with the smallest extent of polygons being census-level tracts as seen in *Figure 1*. We intend to look at this extent as it would provide good information while looking at the big picture. In Wake County, there are 230 census tracts and around 1.175 million people meaning that we will hopefully be able to get a good estimate on the income and poverty distribution.

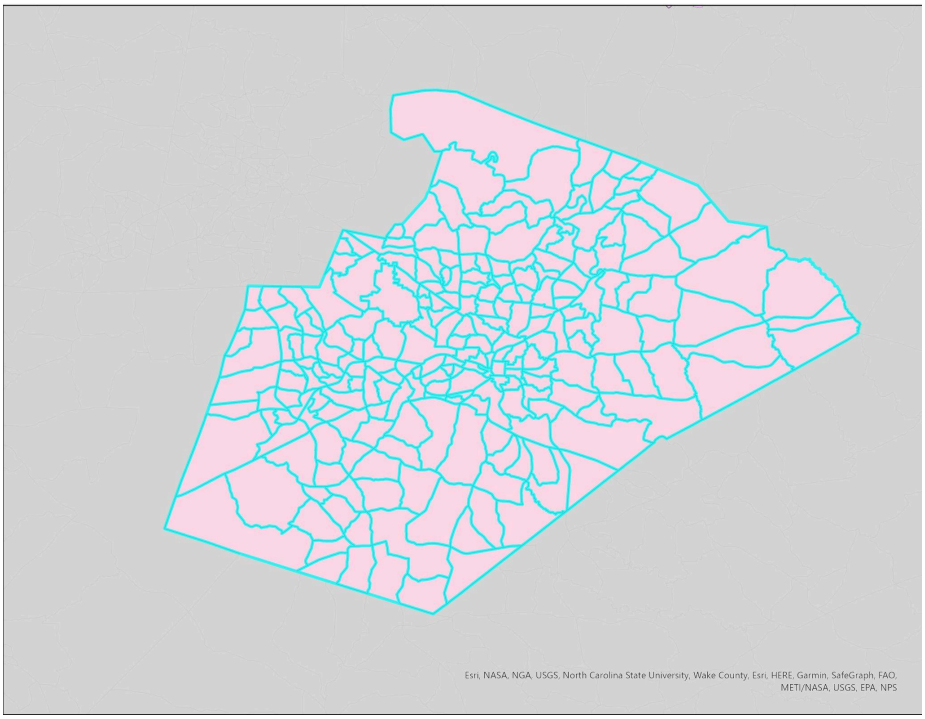


Figure 1: Map displaying Study Area (Wake County at a census tract level)

Methodology

One of the most important factors in this project is working to provide accurate information showing the difference in incomes. We used census tract data to observe a finer scale of patterns rather than city-data. Data cleaning to ensure the correct values (ie; number of amenities and poverty ratio) to join to spatial data. A combination of Rstudio and Excel was used for this process. In Excel, we did the basic removal of rows and columns and conversion from text values to numerical. In Rstudio we worked to transform our park dataset into a dataset that would be proportional to the quality of parks. For this, we used the amenities listed as either “yes” or “no”, and changed them into numerical values (zeroes and ones) in order to summarize the total amount of recreational spaces in each census tract. In R we also created a ratio to determine the number of people experiencing poverty in Wake County using census data.

To create Figure 5 data was externally cleaned and was moved to Arcgis to be able to visually show the relationship of income and access to parks. Using table joins, the census datasets were joined to the polygon using the GEO ID, and the park amenities CSV were joined to the park polygon (which were both downloaded in different forms) by object ID. Since there were now differing nonspatial values attached to the spatial layers the symbology was changed in both cases to display it. For the polygon and census data layer, there was the use of graduated colors to create a choropleth of the values and then inverted the color scheme to make it more understandable. For the park point layer joined with the amenities CSV, a proportional symbol map was created attempting to show the qualitative differences between the parks. This creates a choropleth that would work to provide a visual representation of where lower-income communities are, the differences in the parks, and also try to see if there are any important clusters

For Figure 3, the park point data was added to a new map. After that, the shape of a park was surrounded by a walkable buffer. For the walkable buffer, half a mile was used due to this being considered a reasonably walkable distance. Next, a greenway shapefile was put on the map because greenways are pedestrian-friendly. This would show a more complete proximity to natural spaces through parks and greenways. The next choice which moves into Figure 4 is to include an income choropleth under the data. This income choropleth was not reversed like Figure 5 and the color scheme was changed.

For Figure 6, a census tract shapefile was joined to census data containing the percentage of individuals living below the poverty line in each census tract by the GEO ID field. A choropleth was made to show the density of low-income areas.

Figure 7 used the choropleth from Figure 6. In order to attain the count of amenities per census tract, a spatial join was done of the park's point layer and the census shapefile. In Excel, the join count of the amount of amenities in each census tract was divided by the population in each census tract, in order

to adjust the amount of amenities for the population so that the ratios can be compared accurately. Then to display the join count on the choropleth, the CSV of the amenities ratios was uploaded to ArcGIS, and the values had to be converted from a text field to a numerical field. Lastly, a spatial join of the amenities ratio to the poverty choropleth was done. The ratio of amenities per census tract was displayed by proportional point symbology in order to make the differences in park accessibility more obvious and the potential relationship with income easier to see visually.

Implementation

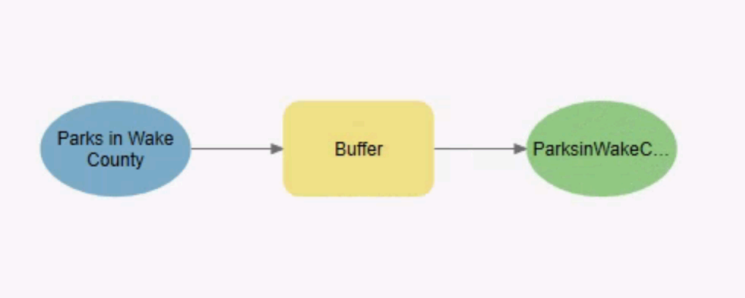


Table join

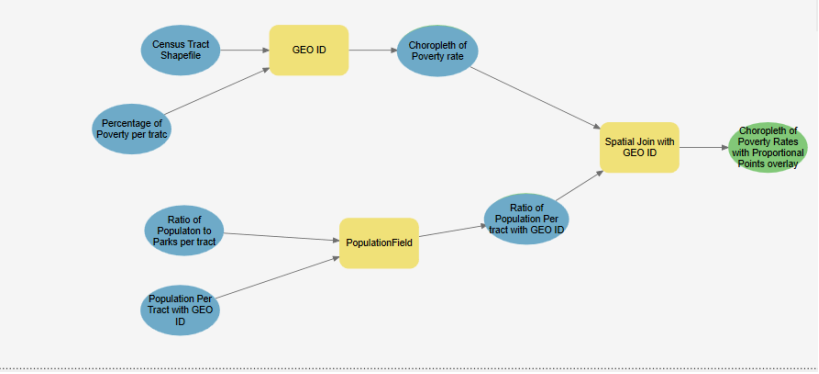
- Income to Tigerfile
- Amenities to park point data

Inclusion of greenway line shapefile

- Change symbology

Tigerfile

- Change symbology to graduated to create a choropleth



- Joins are renamed to the key field.

Results discussion.

For figures 3 and 4 there is a cluster of parks around the Raleigh area which makes sense based on its density and its traffic for both jobs and tourism. Going further from Raleigh towards the outskirts of Wake County there are tracts with lower expected income and very few or no parks in the polygons. This shows that there are some gaps in access to parks. For Figure 5, with the amenities becoming a new variable, there further is a clustering of good quality parks in the Raleigh area and there are some low-income areas without a good park or any park at all. The polygons with higher incomes and less park access are important under the guise of green infrastructure. For the specific topic of park accessibility, an increased income could infer more mobility.

The map displays several instances of correlation between low income with lack of access to parks and greenways. There are five census tracts with 30-50% of their population living below the poverty line, and four of the five have disproportionately low access to recreational spaces. If you were to disregard boundaries, however, it would seem that the denser the poverty becomes, the higher the proportion of access to recreational spaces becomes. This is likely due to poverty rates having a strong relation to population density/urban areas; city developers tend to put more recreational spaces in densely populated urban areas rather than more sparsely populated rural or suburban developments.

Project evaluation,

For this project in the future, there are a couple of ways that there could be an expansion. The first is with the scale of the maps. If we used a finer scale like neighborhood blocks then it may be easier to see the patterns between income and parks. Also, expansion beyond Wake County could provide more evidence of a consistent pattern.

Another way that the maps could be improved is by creating a suitability model. This could use a digital elevation model to find a good spot for a park, high poverty levels, the ability for pedestrian-friendly infrastructure surrounding the park, high-density areas, and lack of parks near it. This could work to show the places that would be good to increase park access.

Another good expansion is to replicate or do something similar to a map seen in the literature looked over. Using NAIP and creating a plant density map could be good to show overall greenspaces based on income. This expands from just parks and greenways to all green infrastructure in communities.

Future investigations would better illustrate whether the base amenity of green spaces is easily accessible for all income levels or if there is a disparity present. It would also be beneficial for city planning practices.

APPENDIX

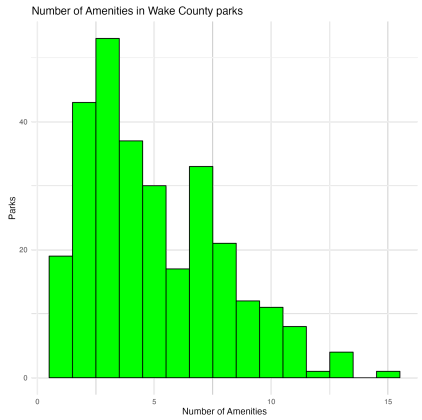


Figure 1: Histogram of Park Amenities in Wake County (Hayward)

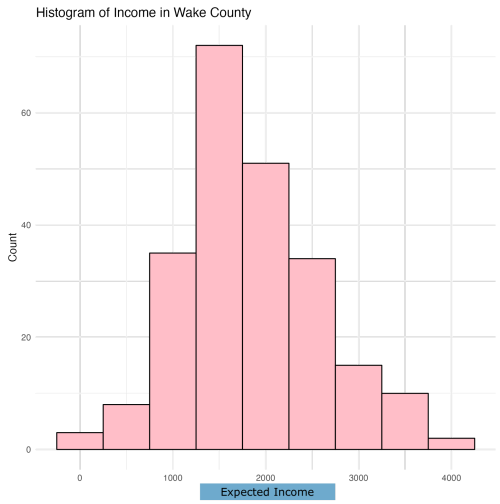


Figure 2: Histogram of Expected Income in Wake County (Hayward)

	Vars	n	Mean	sd	min	max	range	se
Income	**1**	**230**	**1835.4**	**747.1**	**0**	**4072**	**4072**	**49.3**
Amenities	**2**	**290**	**5**	**2.9**	**1**	**15**	**14**	**0.2**

Table 1: Statistical data of variables of interest (hayward)

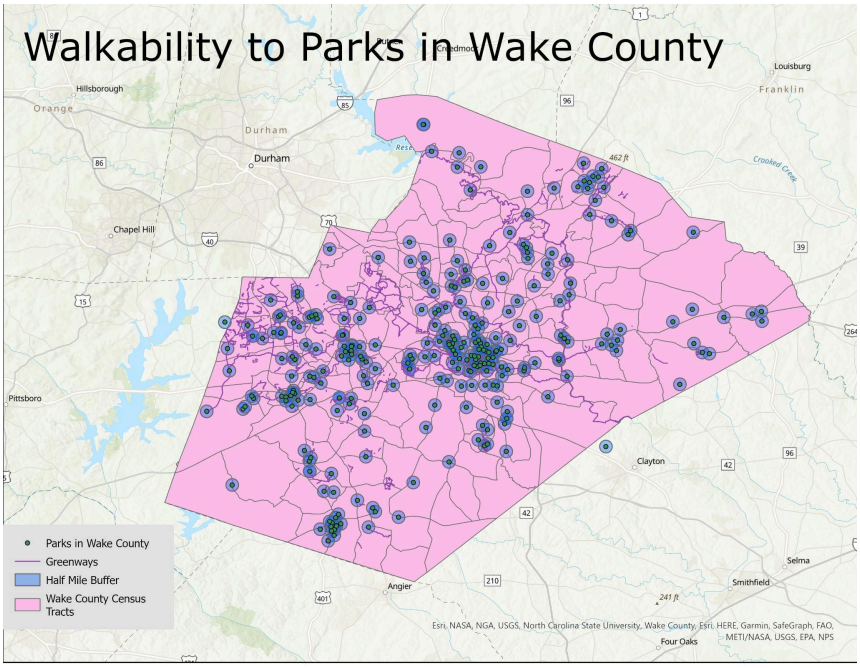


Figure 3: walkability to maps in Wake County using a half-mile buffer (Hayward)

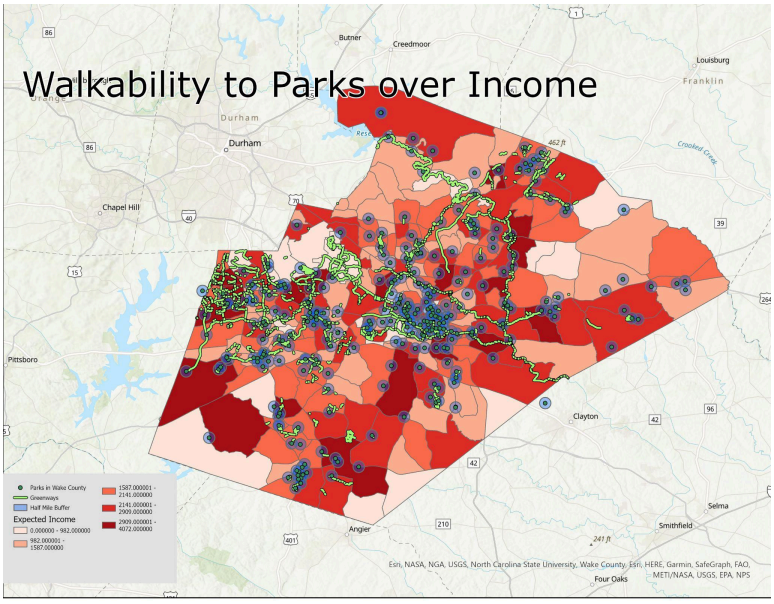


Figure 4: walkability to maps in Wake County using a half-mile buffer over Income Choropleth (Hayward)

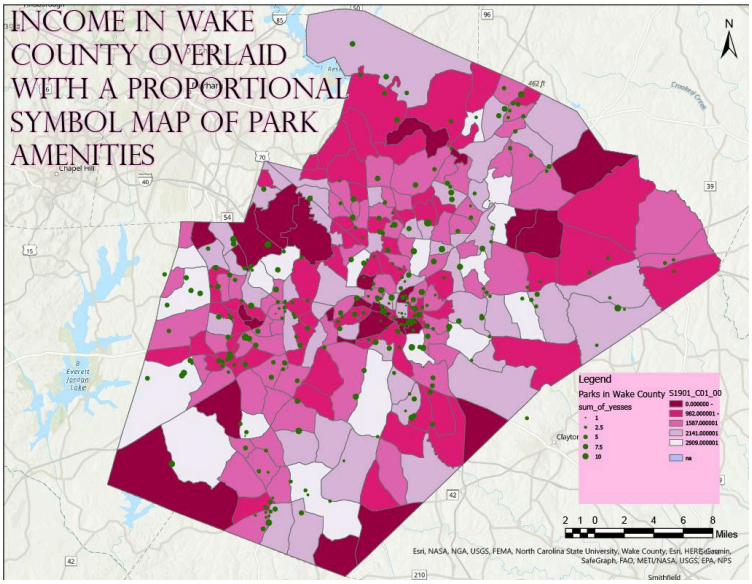


Figure 5: Proportional Symbol map of Park Amenities over an Income choropleth (Hayward)

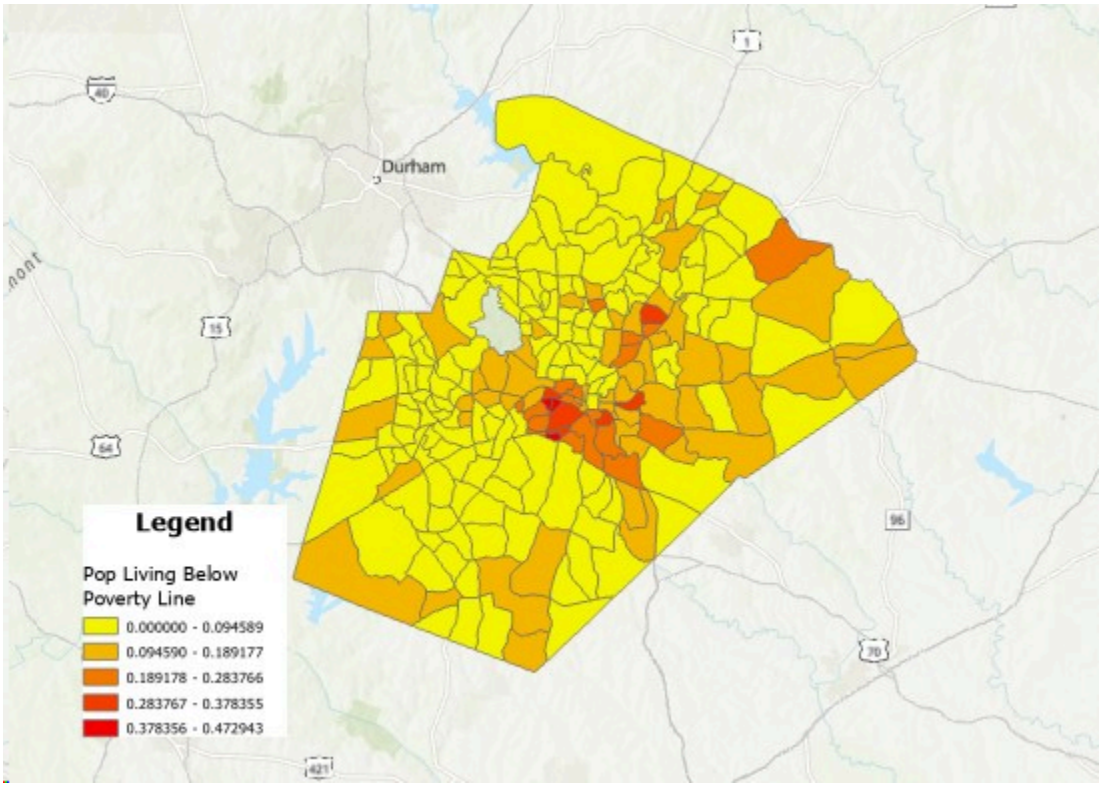


Figure 6: Percentage of Individuals in each Census Tract Living under the poverty Line.

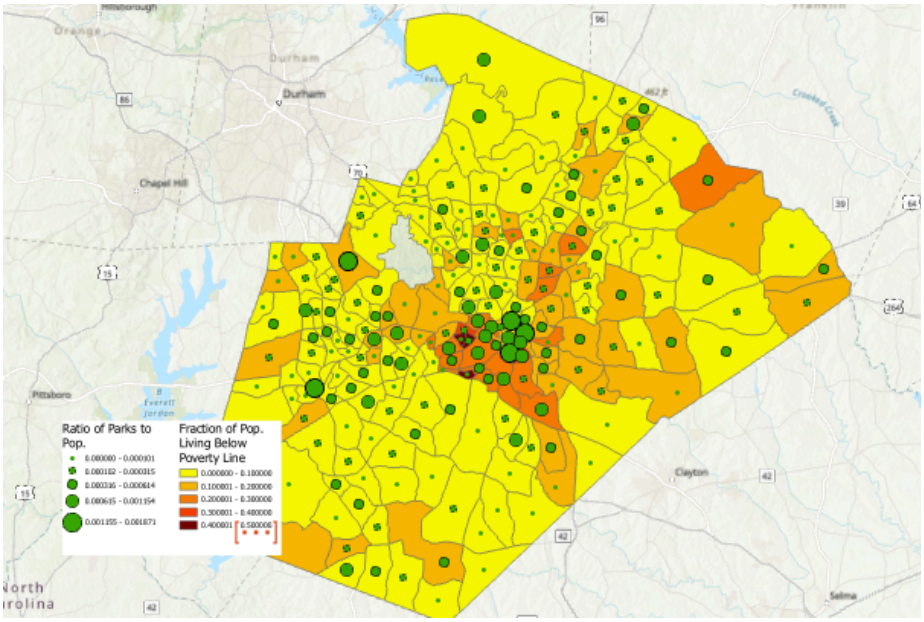


Figure 7: Proportional Symbols of Access to Recreational Space (adjusted to population) on a choropleth of Rates of People Living Under the Poverty Line

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