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Intro to GIS - URBSUN2200_2019
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Final Report

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1. Title of Project

Diabetes Hospitalizations and Food Deserts in Chicago

2. One-Sentence Project Summary

This project analyzes the correlation between food deserts (lack of grocery stores), diabetes hospitalizations, and poverty within Chicago neighborhoods, finding that food deserts and the majority of diabetes hospitalizations are concentrated on Chicago's south and west sides.

3. Purpose & Background

In recent years, Chicago has received much criticism regarding its high levels of segregation and concentrated poverty in specific neighborhoods.[1] Less discussed among political elites is how Chicago's concentrated poverty contributes to lack of infrastructure, such as grocery stores, and public health crises like Type 2 diabetes. Type 2 Diabetes as a direct result of economic and racial segregation also remains overlooked in terms of research. However, estimates show that nearly 300,000 Chicago residents reside in food deserts, primary on Chicago's south and west sides.[2] Other research shows that distance to a grocery store has a direct impact on body mass index, thereby increasing the risk for Type 2 diabetes.[3] That said, the topic of food deserts is beginning to receive more attention from Chicago's policymakers. At the beginning of April, Chicago elected Lori Lightfoot as their new mayor who campaigned on "reinvigorating neighborhood commercial districts that have been left behind" and "eliminating food and healthcare deserts."[4] While Mayor Lightfoot made clear her goal of eliminating food deserts, her office has not released any maps or data indicating where these food deserts exist and how food deserts relate to one's health. Therefore, this topic is worth considering for the formulation of a variety of policies on the municipal level, relating to city planning and economic inequality. As such, I intend the

[1] Kolak, M. (2018, October 14). Food deserts persist in Chicago despite more supermarkets.
[2] Taliabeechick. (2016, February 17). Hospitalization due to diabetes on the rise on South and West sides.
[3] Examining the Impact of Food Deserts on Public Health in CHICAGO. (2006, July 18).
[4] Taking on the tough issues - Lightfoot for Chicago Mayor 2019. (n.d.).

primary audience for my maps to be policymakers, activist groups, and organizations in the Chicago area.

My research aims to identify the relation between food desserts and diabetes hospitalizations in Chicago neighborhoods. In doing so, I answer the following questions: 1) Is there a positive correlation between food deserts and diabetes hospitalizations within Chicago neighborhoods? 2) Are food deserts (areas with fewer grocery stores) more prevalent in impoverished areas or certain zip codes of Chicago? 3) Are diabetes hospitalizations more prevalent in impoverished areas or specific zip codes of Chicago? 4) Are the locations of hospitals indicative of the diabetes hospitalization count? Using ArcGIS, I plan to bring a new perspective to the topic of diabetes and food deserts, through highlighting the spatial characteristics of Chicago. These characteristics include insight into grocery store locations, the number of diabetes hospitalizations, and the percentage of households below the poverty line. Instead of viewing abstract statistics, my perspective will allow policymakers to use my maps to precisely pinpoint areas where diabetes is most prevalent and where grocery stores lack on the neighborhood level. Because Chicago still has a hierarchical structure of municipal governance, in which neighborhood alderman coordinate with activist groups who then work closely with the mayor's office to pass policies, neighborhood data becomes useful in stimulating neighborhood changes. When policymakers consider investments to incentivize neighborhood economic growth, or where to build infrastructure, I hope my maps will inform which neighborhoods should be prioritized most. Similarly, public health and diabetes activist groups can use my maps to identify which areas of Chicago should be targeted in terms of educational outreach.

4. Literature Review

In recent years, Chicago neighborhoods have received press attention after studies found Chicago's Humboldt Park and other west side neighborhoods have diabetes mortality rates at nearly twice the national average.[5] Prior research has analyzed diabetes hospitalizations that have been rising on Chicago's south and West sides, however, none of this research has mapped grocery store locations along with diabetes hospitalizations. Northwestern analyzed this increase, noting that some neighborhoods on the south side of Chicago had a 30-47 percent increase in diabetes hospitalizations while more affluent communities have had a 40-50 percent decrease.[6] Northwestern also used zip codes to create a bar graph of areas with the highest rate of diabetes

[5] Taliabeechick. (2016, February 17). Hospitalization due to diabetes on the rise on South and West sides.

[6] Taliabeechick. (2016, February 17). Hospitalization due to diabetes on the rise on South and West sides.

hospitalizations; however, this analysis was limited because unless one has memorized the spatial location for each zip code in the bar graph, the graph tells the audience little about where these hospitalizations are spatially.[7] Northwestern also used Google Maps to create a map of the hospitalizations and depict how the rate of hospitalizations has changed over time; however, no food deserts are mapped.[8]

The Illinois Advisory Committee to the United States Commission on Civil Rights similarly produced a report on food deserts in Chicago, discussing their work to pilot a program to educate residents in food desert areas on diabetes. The report highlights GIS maps of food deserts in Chicago in 2007, dividing the maps into types of grocery stores such as large supermarkets, chain full-service, and chain discount stores.[9] NBC Chicago has also publicized the association between food desert neighborhoods and diabetes, noting that people living on the south side of Chicago are as much as 14 times more likely to have diabetes than residents near Wrigley Field (Chicago's north side).[10] The NBC story also uses a mapping software (unnamed) to show an obesity, blood pressure, and a diabetes gap between neighborhoods, however, NBC does not map grocery store location either.[11] Lastly, Mari Gallagher Firm published a report on Chicago food deserts and public health, using GIS to map "Out-of-balance tracts when it comes to food access in Chicago."[12] In this map, food deserts are measured in terms of "few grocers to the number of fast food restaurants, as it correlates to race instead of income-level.[13] My maps intend to approach this topic in a new way, focusing on spatial characteristics instead of abstract statistical analysis.

5. Data

Map 1 – Chicago Grocery Store Locations and Households Below the Poverty Line

- Zip Code Boundaries for Chicago – Chicago City Data Portal
  - Created September 26, 2014, and updated on August 24, 2016.
  - I used this data to create divide Chicago into zip code tracts.
- Grocery store locations in Chicago – Chicago City Data Portal
  - Created August 26, 2013.

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[7] Taliabeechick. (2016, February 17). Hospitalization due to diabetes on the rise on South and West sides.

[8] Ibid.

[9] Food deserts in Chicago: A Report of the Illinois Advisory Committee to the United States Commission on Civil Rights. (2011, October).

[10] Coffey, C., Campbell, R., & Capitanini, L. (2019, February 20). Your Health May Be Defined By Your Neighborhood.

[11] Ibid.

[12] Examining the Impact of Food Deserts on Public Health in CHICAGO. (2006, July 18).

[13] Ibid.

        - I used this data for geoprocessing the location of grocery stores, indicating areas of food deserts. This data can be cross-referenced with the city's business license data.
    - Selected socioeconomic indicators in Chicago – Chicago City Data Portal
        - Created January 5, 2012.
        - This dataset contains a selection of six socioeconomic indicators of public health significance and a "hardship index," by Chicago community area, for the years 2008 – 2012. I only used the percent of households living below the federal poverty level to create a choropleth map.

Map 2 – Chicago Diabetes Hospitalizations and Households Below the Poverty Line

- Diabetes Hospitalizations in Chicago, 2000-2011 – Chicago City Data Portal
    - Created May 9, 2012.
    - This dataset contains the annual number of hospital discharges, crude hospitalization rates with corresponding 95% confidence intervals, and age-adjusted hospitalization rates with corresponding 95% confidence intervals, for the years 2000 – 2011, by ZIP code. I only used the data from 2011 as it is most recent and relates to the grocery store data from 2013. I used this data to create graduated points.
- Selected socioeconomic indicators in Chicago – Chicago City Data Portal
    - Created January 5, 2012.
    - See above.

Map 3 – Chicago Grocery Store Locations and Diabetes Hospitalizations

- Grocery store locations in Chicago – Chicago City Data Portal
    - Created August 26, 2013.
    - See above. This data was used for graduated points in Map 3.
- Diabetes Hospitalizations in Chicago, 2000-2011 – Chicago City Data Portal
    - Created May 9, 2012.
    - See above. This data was used for a choropleth map in Map 3.

Map 4 – Chicago Hospital Locations and Diabetes Hospitalizations

- Hospital locations in Chicago, 2011 – Chicago City Data Portal
    - Created August 28, 2011.
    - I used this data to geocode the hospitals by address within Chicago.
- Diabetes Hospitalizations in Chicago, 2000-2011 – Chicago City Data Portal
    - Created May 9, 2012.
    - See above. This data was used for a choropleth map in Map 4.

6. Methodology

I first obtained all of my data from the Chicago City Data Portal, exporting each data set into a CSV file for Excel. I organized each file into a folder titled "Final Project" on my flash drive to keep track of all of the data. I utilized ArcMap for each map discussed below. I first created a map of Chicago grocery store locations and the percentage of households below the poverty line (see Map 1 under the "data section" above). I began by downloading the shapefile of Chicago zip code boundaries. I added a black and white base map of Chicago underneath the zip code tracts. I then geocoded the addresses of grocery stores as points onto the map. After soliciting advice from my peers, I altered the grocery store locations from individual points to graduated points, in an attempt to make the map look less cluttered. I then completed a data join of the percentage of households below the poverty line to the existing table containing zip code tracts. I then visualized the data join in a choropleth map, using a monochrome color ramp to display the data on poverty. I exported this data join as a new shapefile for later use, saving it to my Final Project folder. I initially classified the poverty data into three manual breaks, but finally decided on four classes showing 10, 20, 30 and above 30 percent below the poverty line. I found that this classification best visualizes poverty within Chicago zip codes, without overlooking the differences between the classes. Finally, I created a map layout including a legend, title, source, scale bar, and north arrow, using clear labels for my public audience.

For my second map of Chicago diabetes hospitalizations and households below the poverty line, I used similar methodology (see Map 2). I downloaded the zip code shapefile and the already saved shapefile containing the data join of zip codes to the percentage of households below the poverty line, using the shapefile I kept when creating Map 1. Instead, this map visualizes diabetes hospitalizations using graduated points. I downloaded the data on diabetes hospitalizations and joined it to my base layer of the zip code shapefile. Under properties, I then used graduated points to show diabetes hospitalizations under three categories that I manually classified. I thought to normalize the diabetes hospitalizations by population, however; data on Chicago's population by zip code tract was unavailable. Therefore, I kept the classifications in raw numbers, indicating diabetes hospitalization by zip code. I created a similar layout to the map above. As a result, Map 1 and Map 2 have the same choropleth maps indicating the percentage of households below the poverty line, but their graduated points visualize different variables.

For my third map of Chicago grocery store locations and diabetes hospitalizations, I used map layers already discussed above (see Map 3). I similarly downloaded the Chicago zip code shapefile and added a base map. I then joined the diabetes hospitalization data to my zip code tracts and created a choropleth map indicating the

diabetes hospitalizations. I decided on three manually classified breaks in the hospitalizations, similar to Map 2; however, I used a monochrome color ramp instead of graduated points. I then added the previously saved layer on the geocoded grocery stores by address. I dissolved the grocery stores and then visualized the stores as graduated points, similar to the process for the groceries in Map 1. I then created a layout identical to the other two maps for consistency purposes. The main difference between Map 3 and the first two maps is that the choropleth background visualizes diabetes hospitalizations, instead of poverty.

My fourth and final map depicts Chicago hospital locations and diabetes hospitalizations (see Map 4 above). I used the diabetes choropleth layer that I saved from Map 3 and added a base map of Chicago. I then added the CSV sheet containing Chicago hospital addresses and geocoded the addresses into points. I then added labels for visualization and research purposes later on, which allows the audience to pinpoint outliers among the Chicago hospitals and diabetes hospitalizations. I purposely chose not to visualize the hospitals as graduated points based on the number of hospitals within a given zip code, similar to the grocery stores, because I felt it was essential to know the names of each hospital for possible research later on. I then created a layout similar to the last three maps.

7. Findings

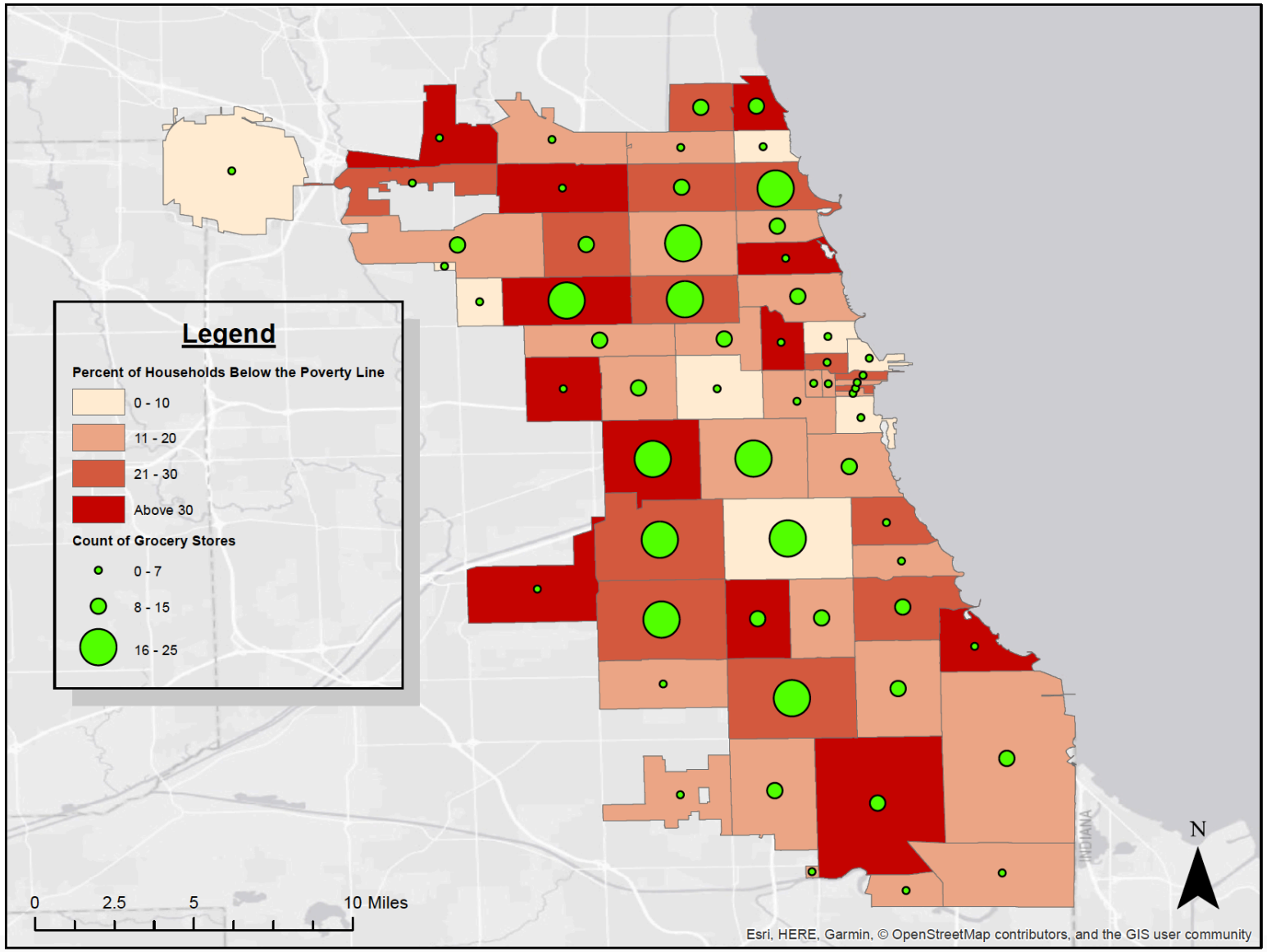
As a result of my maps, I found that a correlation does exist between food deserts, diabetes hospitalizations, and poverty in Chicago. That said, the correlation is small and contains several outliers. After analyzing Map 1, this map indicates that high levels of poverty (above 30 percent below the poverty line) are not concentrated on Chicago's south and west sides, as research suggests. Additionally, in areas that are darker red and thus indicate higher levels of poverty, there does appear to be fewer grocery stores, as depicted by the graduated green points. The correlation between high levels of poverty and lack of grocery stores is especially apparent in the tracts that have above 30 percent poverty. However, there are some outliers within this map. First, the tracts lining Lake Michigan in the central part of Chicago indicate low poverty levels and a low count of grocery stores. This is most likely because these tracts make up Chicago's "Loop," a neighborhood characterized as Chicago's financial and industrial district, where few people inhabit. Other outliers to the data include the 11-20 percent poverty tracts on Chicago's south side, which mostly contain large areas of railroad tracks still used today.[14] While the correlation is slight between grocery store count and poverty, it is clear that the neighborhoods with the highest poverty levels contain less

[14] (2015). Illinois Railroad Map - Chicago Area/East St. Louis Area.

grocery stores. Map 2 has the same choropleth map indicating the percentage of households below the poverty line; however, the graduated points show a count of diabetes hospitalizations. When completing this map, I expected to find higher rates of diabetes hospitalizations in areas with high levels of poverty. In reality, the results are mixed. The zip code tracts with the lowest levels of poverty do contain low levels of diabetes hospitalizations. That said, the areas with high levels of poverty, especially those on Chicago's north side, include points depicting the lowest class (0-125) of diabetes hospitalizations. More significantly, the largest points (highest number of diabetes hospitalizations) seem to be clustered on Chicago's south side, indicating a spatial pattern. Similar to Map 1, Chicago's Loop area presents outliers in the data.

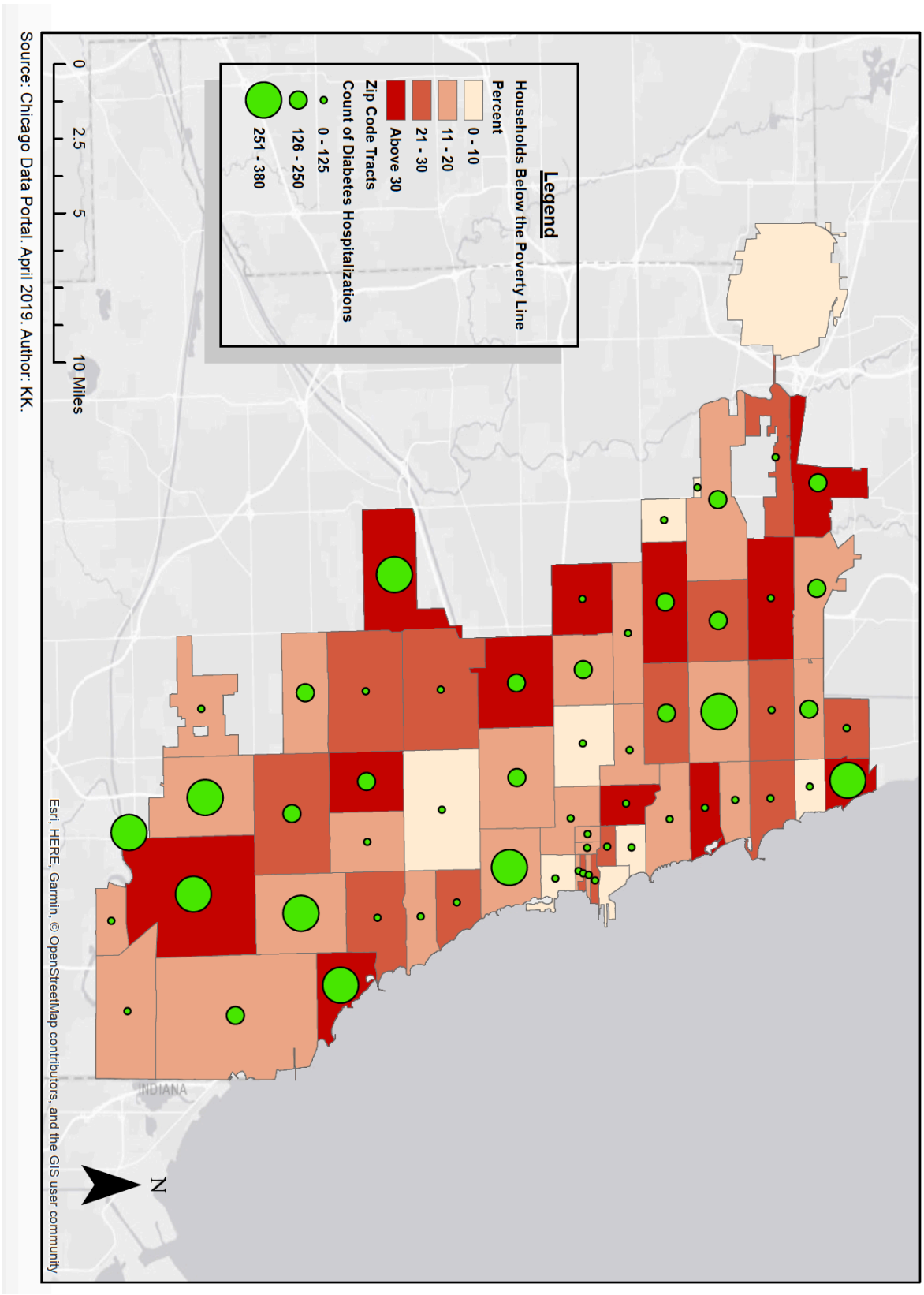
Map 3 presents grocery store count and diabetes hospitalizations. According to the choropleth map indicating diabetes, it is clear that the highest levels of diabetes hospitalizations are concentrated on Chicago's south and west sides. The zip code tracts in the north part of Chicago and along the lake, contain less diabetes, but also have surprisingly small numbers of grocery stores. The zip codes near the lake are considered to be more crowded which could perhaps result in less available space for groceries. As a result, this map indicates that the highest numbers of grocery stores are in the western part of the city. Regarding outliers, the two zip code tracts in the most southern part of the city indicate a low grocery count and low diabetes hospitalizations. As noted above, these three tracts most likely contain railroad areas and few inhabitants. Overall, map 3 does indicate a correlation between high levels of diabetes hospitalizations and less grocery stores within Chicago neighborhoods. Lastly, Map 4 highlights hospital locations on top of the same choropleth map indicating the count of diabetes hospitalizations from Map 3. Interestingly, Map 4 shows that the majority of hospitals are located in the northern part of Chicago, especially in areas with low diabetes rates. A few outliers to this map exist, including the zip code tract on Chicago's west side that has contains the highest category of diabetes hospitalizations, but no hospitals. Similarly, the zip code tract containing "Roseland Community Hospital" also contains high counts of diabetes but only one hospital. While these tracts indicate outliers in the data, this could show that Chicago citizens may commute to access to healthcare. Further, diabetes patients on Chicago's south side may have to commute longer distances to receive care than residents on Chicago's north side, despite having a higher prevalence of diabetes.

Chicago Grocery Store Locations and Households Below the Poverty Line, 2011

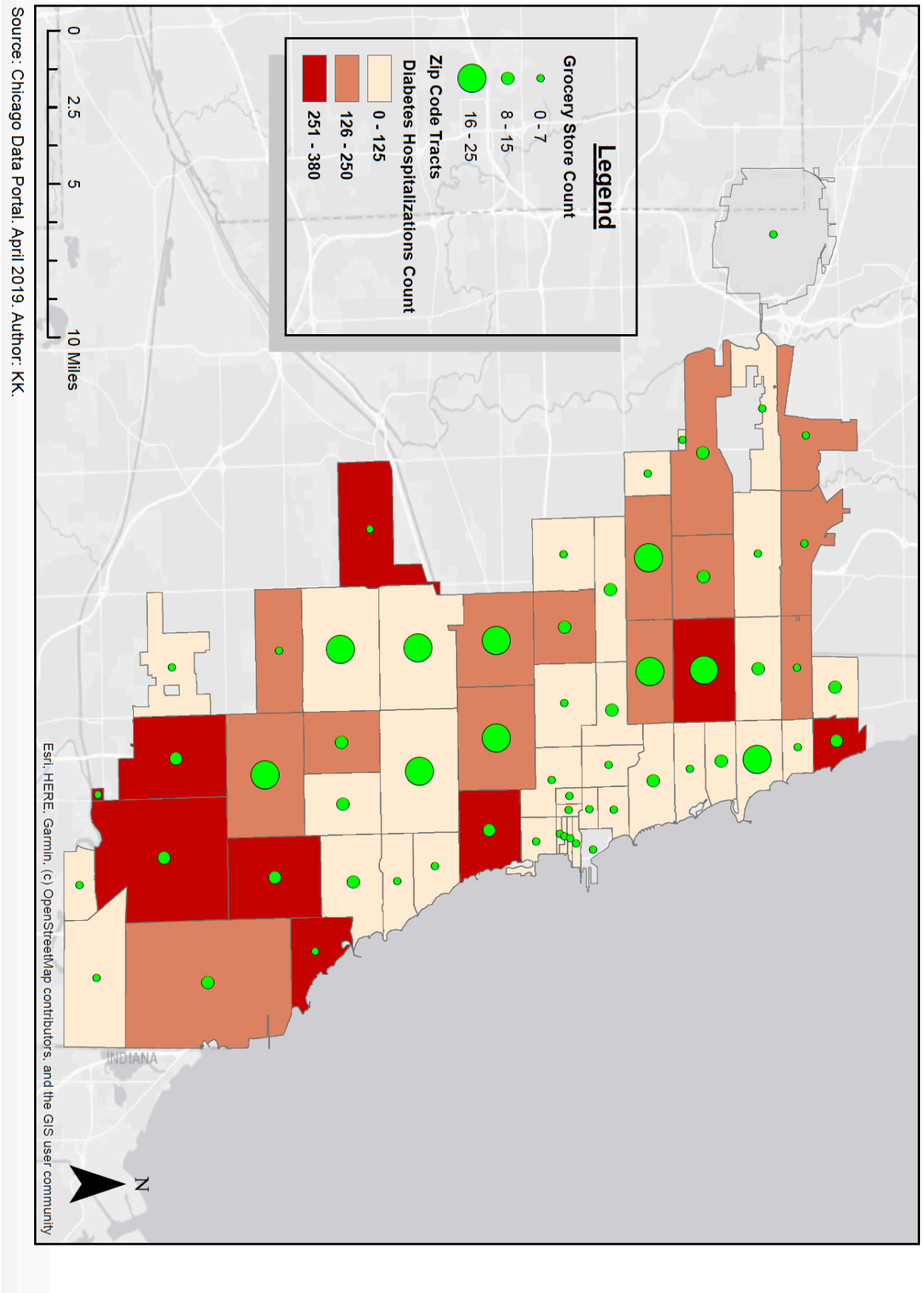


Source: Chicago Data Portal. April 2019. Author: KK.

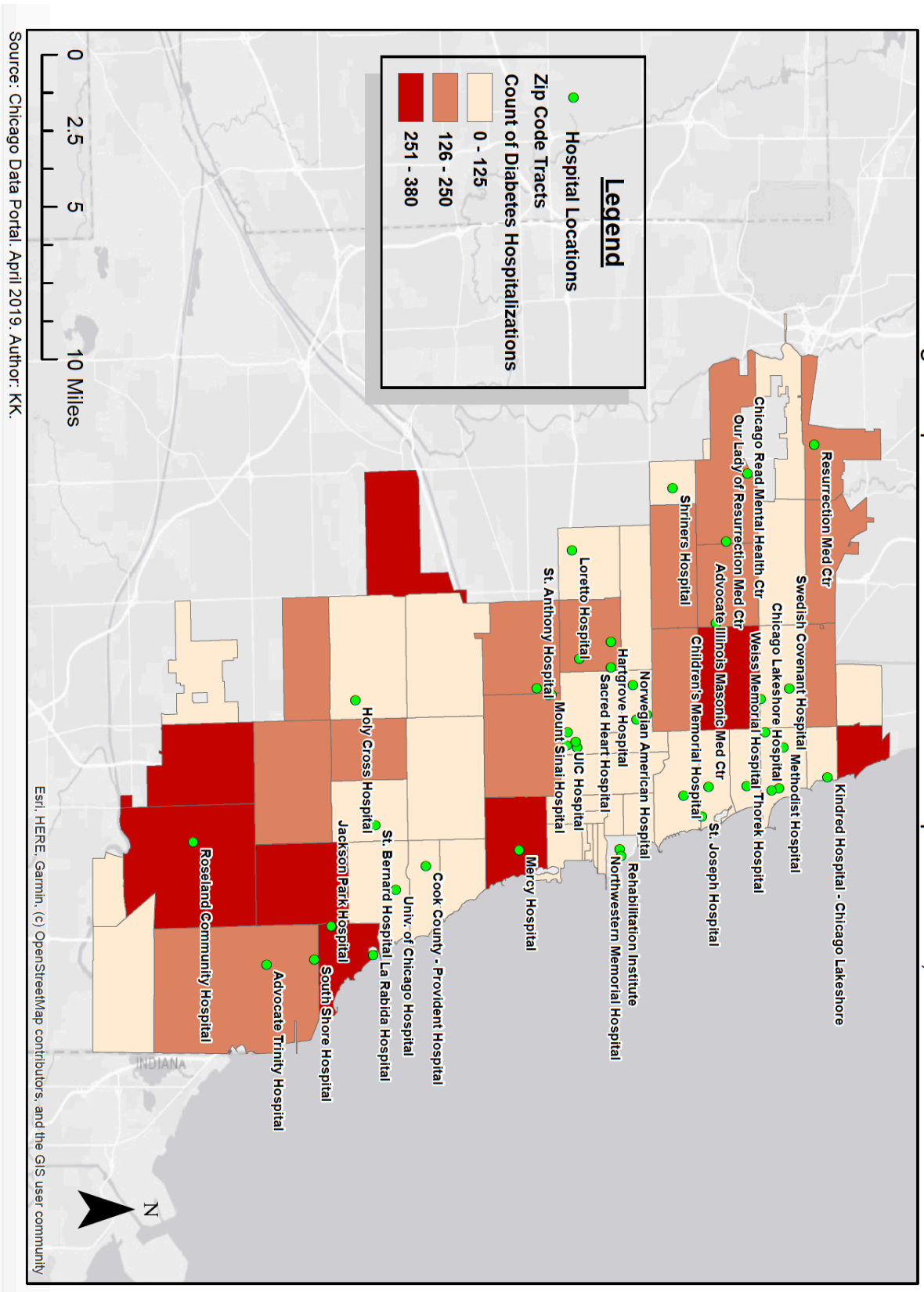
Map 1


Chicago Diabetes Hospitalizations and Households Below the Poverty Line, 2011
Legend
Households Below the Poverty Line
Percent
0 - 10
11 - 20
21 - 30
Above 30
Zip Code Tracts
Count of Diabetes Hospitalizations
0 - 125
126 - 250
251 - 380
0
2.5
5
10 Miles
INDIANA
N
Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community
Source: Chicago Data Portal. April 2019. Author: KK.

Map 2


Chicago Grocery Store Locations and Diabetes Hospitalizations, 2011
Legend
Grocery Store Count
0 - 7
8 - 15
16 - 25
Zip Code Tracts
Diabetes Hospitalizations Count
0 - 125
126 - 250
251 - 380
0
2.5
5
10 Miles
INDIANA
N
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Source: Chicago Data Portal. April 2019. Author: KK.

Map 3


Chicago Hospital Locations and Diabetes Hospitalizations, 2011
Legend
Hospital Locations
Zip Code Tracts
Count of Diabetes Hospitalizations
0 - 125
126 - 250
251 - 380
Resurrection Med Ctr
Kindred Hospital - Chicago Lakeshore
Swedish Covenant Hospital
Methodist Hospital
Chicago Read Mental Health Ctr
Chicago Lakeshore Hospital
Our Lady of Resurrection Med Ctr
Weiss Memorial Hospital
Thorek Hospital
Shriners Hospital
Advocate Illinois Masonic Med Ctr
St. Joseph Hospital
Children's Memorial Hospital
Norwegian American Hospital
Rehabilitation Institute
Hartgrove Hospital
Northwestern Memorial Hospital
Loretto Hospital
Sacred Heart Hospital
St. Anthony Hospital
UIC Hospital
Mount Sinai Hospital
Mercy Hospital
Holy Cross Hospital
Cook County - Provident Hospital
Univ. of Chicago Hospital
St. Bernard Hospital
La Rabida Hospital
Jackson Park Hospital
South Shore Hospital
Roseland Community Hospital
Advocate Trinity Hospital
INDIANA
N
0
2.5
5
10 Miles
Source: Chicago Data Portal. April 2019. Author: KK.
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Map 4

8. Limitations

There are several limitations to my project. First, the data used for diabetes hospitalizations aggregates Type 1 and Type 2 diabetes. Because Type 2 diabetes is the only type associated with food deserts, the aggregation of Type 1 may skew the results. However, Type 1 diabetes is much less common, therefore the impact on the data set is most likely minimal. Next, the data sets were sourced from different years, as a result of what data was available to complete the project. Another limitation is that zip codes in Chicago encompass several smaller neighborhoods. Due to Chicago's hierarchical style of government, in which "neighborhood wards" are governed by aldermen, some neighborhoods have different resources and characteristics that larger zip code tracts overlook. Also, when analyzing the grocery store data, I found that the list of grocery stores contains small convenience stores and liquor stores which may skew the data representing "food deserts." Lastly, the data on households below the poverty line may misrepresent the correlation of income to the rest of the data, especially in "high-income" neighborhoods that contain public housing buildings that house a large number of residents below the poverty line. It may be more accurate to use average income based on zip code tract; however, this data was unavailable.

9. Recommendations/Conclusions

Using my four maps as evidence of an ongoing problem, policymakers should reconsider economic investments and the location of infrastructure in Chicago. As Maps 1, 3, and 4 depict, few grocery stores and hospitals exist on Chicago's south side. As a result, food and healthcare are more accessible on Chicago's north side, creating an inequity in resources. As Maps 3 and 4 show that diabetes is more prevalent on the south and west sides of Chicago, policymakers and organizations should concentrate educational and planning resources in these zip code tracts. Not only should access to healthy food options be available, but Maps 1 and 2 on poverty levels depict that healthy food must be made affordable, not just accessible. Several solutions to combatting food deserts exist, which should also lessen diabetes hospitalizations, including subsidizing healthy grocery stores and providing training on growing fresh produce at home. An organization called Growing Home is already providing education on access to fresh food in Chicago's Englewood area. More healthcare and nutritional efforts are needed in the areas with high diabetes rates and fewer grocery stores, as all four maps represent. Going forward, future research on this topic could repeat my methodology, using an income measure that is not poverty, such as raw income levels. Future researchers could also categorize grocery stores by size and type to gain a clearer picture of what food options are available in certain

areas. Other recommendations for future research include obtaining data that separate Type 1 and Type 2 diabetes, and using a different unit of measure beyond zip codes to highlight smaller Chicago neighborhoods.

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