WPI

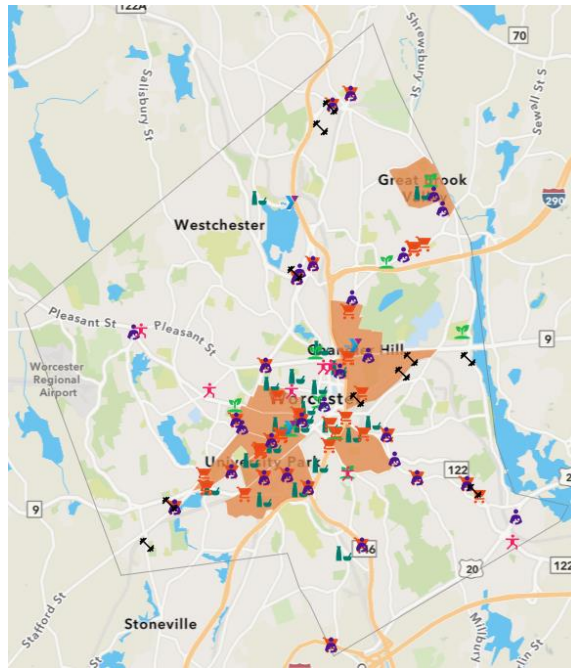## Walking in Worcester: Nutrition and Fitness Resources for the Latino Community

Screenshot of Web Application Detailing Nutritional and Physical Activity Resources

An Interactive Qualifying Project submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirement for the Degree of Bachelors for Science

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Submitted to Prof. John-Michael Davis and Prof. Hektor Kashuri.

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Abstract

Maintaining healthy lifestyles is difficult for the Latino communities of Worcester due to limited access to nutrition and physical activity resources. This project created interactive maps of these resources for the Division of Public Health (DPH) to provide Latino communities with valuable tools to locate nearby resources and assist the DPH to prioritize which regions require support to increase access to them. We recommend that the DPH prioritize the northeastern census tract while updating the web application to increase community awareness.

Acknowledgements

Authorship

The following paper and its associated deliverables are a representation of the extensive work we did over the past seven weeks. We all contributed to the extensive research and editing involved with creating this paper. However, each member of the team had different roles to which they dedicated most of their time.

Derek Byrne: Wrote the methodology of both Objective 1 and Objective 2, the Findings section, portions of the background sections concerning census tracts, and the executive summary of the paper. Derek also modified the U.S. Census Data Downloader program in Python and used this data to create the charts and tables detailing Latino population statistics in the nine Worcester census tracts of interest. He used this data to make several web applications using ArcGIS Web AppBuilder detailing Latino socioeconomic statistics in a map format. Derek built the team's main deliverable in the form of nutritional resource and physical activity web applications and created the geocode locator that provides proximity data for the resources. Derek performed the walkability analysis on each resource which was then put into the web applications. Lastly, he made several instructional videos for the Worcester Division of Public Health so that the sponsor can continue to update the web application in the future.

Kayla Krom: Wrote an extensive amount of the paper including the introduction, two sections of the background which were "The Latino population in MA" and "The Effects of Poverty on the Health of the Latino Population" and the "Testing of the Nutrition Web Application" portion of the results section. The introductions to both the background and methods sections were a result of Kayla's work. As well, Kayla did a lot of restructuring and work on the background section "Our Research." Along with writing these sections, Kayla also helped with the deliverables. Creating two of the side projects, including a literature review of the different types of maps and mapping out two new WOO Moves walking routes. Kayla was in charge of the testing done for the web application which involved creating a survey, writing a paragraph in the methods and communicating with test participants.

Kyle Marquez: Wrote the abstract, the conclusion segment of the executive summary, the section "Minority Faced Disparities in the United States" in the background, the conclusion and recommendations section as well as contributing to the methodology pertaining to the physical activity resources map. Additionally, Kyle made contributions to the "Our Research" section of the paper by providing context to the problem and additional information the purpose of project section. Along with writing and contributing to these sections, Kyle also helped by providing information that would later be placed into the group's deliverable. Utilizing several online mapping software, Kyle was able to collect information about physical activity resources and was then able to upload said information to ArcGIS to create a map.

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Executive Summary

The purpose of this report is to investigate the nutritional access disparities that exist within the census tracts with the highest Latino populations throughout the city of Worcester. These disparities in public access to nutritional and physical activity resources contribute to the unfair and preventable health outcomes of individuals. Accessing healthy nutritional resources is essential to maintaining overall community health while preventing disease and chronic conditions. The focus of this study is on the Latino population, as it is the largest ethnic minority in the United States. Most of the health inequalities within Latino communities are due to the social injustice that is present for individuals based not only on race/ethnicity, but also on income, gender, geographical area and education level. Latino communities often lack healthy options on account of these factors, and therefore have a higher prevalence of conditions such as obesity (47%) and diabetes (18%) (Centers for Disease Control, 2020).

Providing equal access and support to the Latino population has become a focus of both non-governmental and governmental organizations to reduce racial and ethnic health disparities. To amend these disparities in Worcester, the U.S. government's Centers for Disease Control and Prevention (CDC) provided funding through the Racial and Ethnic Approaches to Community Health (REACH) Grant. This 2018 grant provides the city of Worcester with $780,648 a year for five years toward public health prioritization. This form of developmental prioritization is carried out at the local level within Worcester, as the City of Worcester Division of Public Health (DPH) is tasked with analyzing which areas of the city require increased access to high quality food resources based on where the sizable populations of disadvantaged Latino communities are located. To assist the DPH investigate these resources, this project determined which areas are in need of prioritization by creating interactive walkability maps and heatmaps demonstrating the location of nutritional and physical activity resources. The capacity to easily view the regions outside of walkability range with low nutritional resource allocation is an invaluable tool to determining the interventions the city must take in accordance with the CDC's funding.

This core principle of public health concerns the necessity of every person to be able to reach his or her full health potential by removing barriers to healthy living linked to race or ethnicity, education, income, location, and a variety of other social factors that create disadvantaged communities (CDC, 2020). Our research offers several reasons for these health

discrepancies, giving the Division of Public Health the necessary information to make changes and provide the necessary support. A current knowledge gap exists concerning the lack of geographical data available for the health discrepancies of the predominantly Latino population of nine census tracts within Worcester County, which is needed to justify the CDC's funding for the REACH grant in future years. In order to bridge the knowledge gap concerning the different communities' access to resources, more recent data from the American Community Survey in conjunction with the U.S. census data detailing the Latino population numbers and health demographics were used. This created more informed research essential to detailing how long it takes to travel between nutrition and physical activity resources such as food banks, public pantries, community centers, faith-based organizations, parks, playgrounds and recreational centers while providing graphical demonstrations of the disproportionate health statistics for these residents. This data, along with the ArcGIS Online map-making tool, allowed us to answer questions the DPH is currently investigating within the department concerning the public health, all while making these resources known and publicly accessible via walkability web applications.

Findings

To analyze the multiple disparities present for Latinos living in Worcester, nine census tracts with the highest population of Latinos were identified. A census tract can be defined as an area approximately the size of a typical neighborhood (in the United States) with individuals numbering 2,500 to 8,000, with the optimal size of 4,000 for taking a population count of a relatively permanent area (Weessies, 2017). A census tract is smaller than a city but larger than a block group and contains similar cultural ties and resources. To better determine which resources supported healthy living in the most inclusive manner, stores that provide Supplemental Nutrition Assistance Program (SNAP) benefits as well as fresh produce, stores that provide Women, Infants, and Children (WIC) care, farmers' markets, food pantries, and physical activity centers were included.

The web application was made using ArcGIS Web AppBuilder and allows the walkability maps of regions with food and physical activity resources from 5- and 10-minute walk times to appear around their location. Any nutritional resources will be shown at the user's choice, with a pop-up screen indicating initial instructions for how to utilize the site's features. This application

was created with the intention of allowing the Worcester DPH to add the tool to the Mass.gov website to inform the Worcester public of access to the nutritional resources available around them.
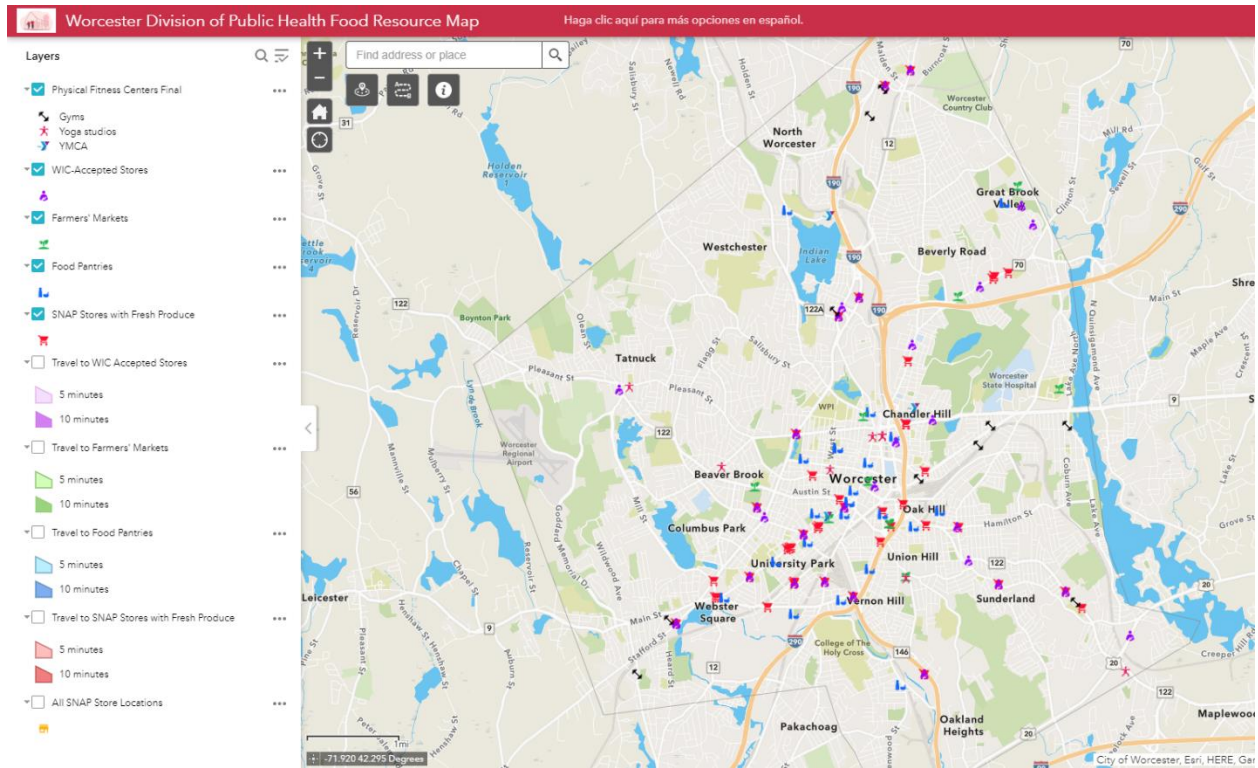
Figure i. Worcester DPH Nutritional Resource Web Application

This web application was distributed among members of the Worcester community from several backgrounds, ethnicities, ages, and regions of the city. Their feedback was essential to providing a streamlined user experience with data relevant to everyone's specific needs.

The required data for the study was collected using a modified open-source U.S. census data downloader program written in the Python programming language. Along with the data provided by the decennial U.S. Census, this data also compiles information from the annual American Community Survey. This survey provides vital information about the United States population with respect to jobs, educational attainment, household income, homeownership, as well as racial and ethnic demographics (U.S. Census Bureau, 2020). To better reveal the disadvantages of Latino communities in these regions, the resultant map from this objective's findings detail the distribution of resources throughout the city of Worcester. Areas of concern with few resources and low income are circled in each map.
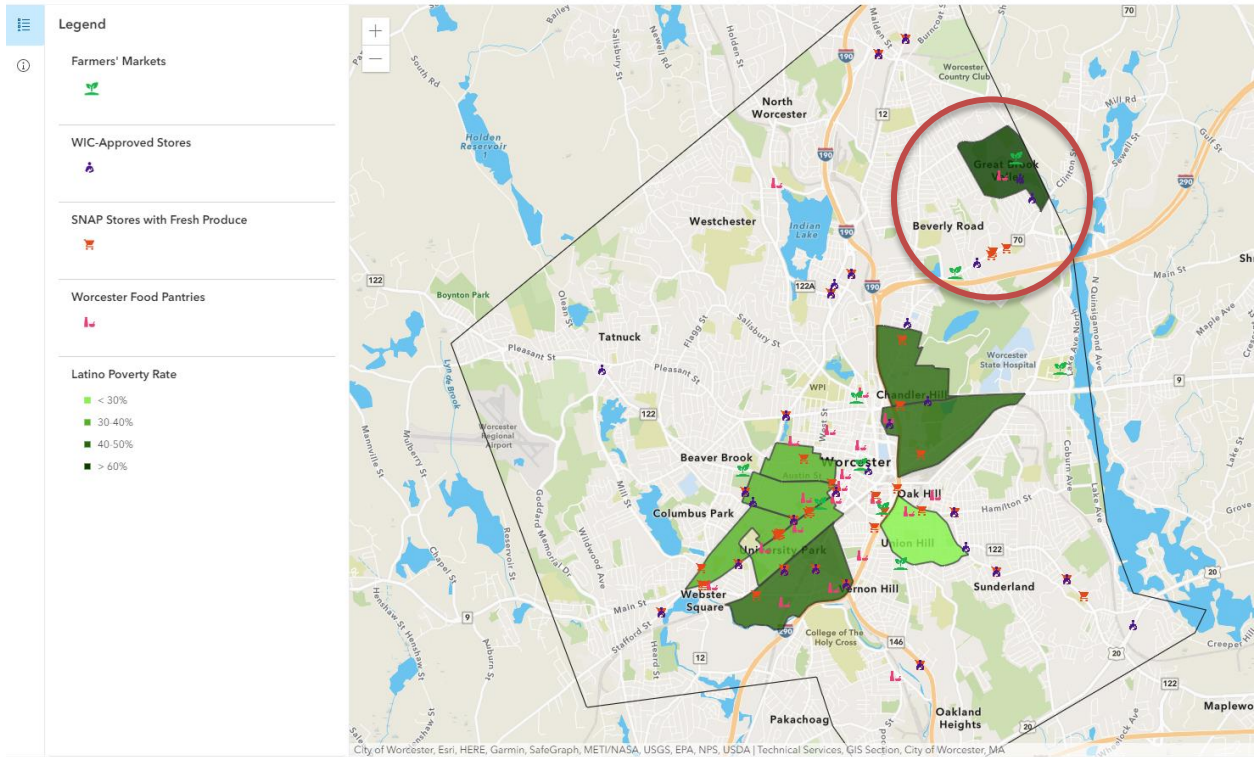
Figure ii. Worcester Food Resource Map by Latino Poverty Rate (see circled area of concern)
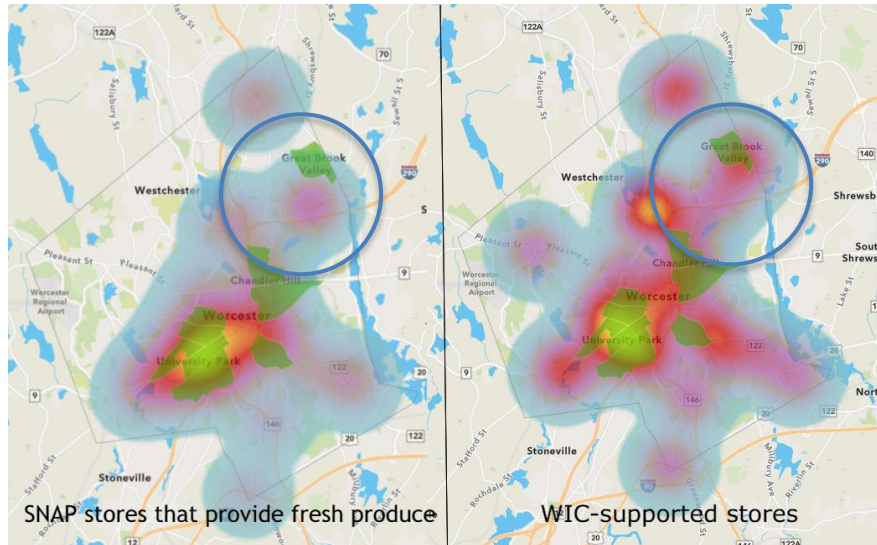
Figure iii. Heatmap examples of lack of food resources in northeastern Latino census tracts

The data present in the density map indicate that the Latino poverty rate is greater than 60% in the Great Brook Valley census tract. This census tract also had a Latino per capita income of $10,000. This indicates economic difficulty not only for the working population with lower

income, but also the difficult conditions of the non-working classes including children and the elderly living in poverty. The Latino population rate is also above 60% of the total population, indicating a substantial challenge for the Latinos that constitute most of this census tract. Based on the maps' visuals, it is evident that this census tract also has the least amount of direct access to SNAP stores with fresh produce compared to the other Latino census tracts. None of these stores are within the same proximity to the Great Brook Valley tract as they are to any of the other eight Latino census tracts.

Conclusion

In summary, the Latino communities of Worcester do not have equal access to the necessary healthy food and physical activity resources. After obtaining our results, we advise that the DPH recommends the expansion of grocery stores that sell fresh produce, accept SNAP, and are within a comfortable walking distance of Worcester's isolated Latino communities, including the Great Brook Valley census tract. We also recommend that after subsequent testing and revision, our web applications be used by the Worcester DPH to promote public awareness of stores available through public service announcements, events, and community outreach. As well, an increased number of physical activity resources within walking distances should be implemented to promote healthy and active lifestyles. Future research should be conducted to expand upon the web application by mapping other public resources such as schools and transportation. Additionally, future groups can expand the extent of community surveying in order to better assess the user-friendliness of the application. These different research ideas would work to further diminish health disparities experienced by the Latino communities of Worcester.

1.0 Introduction

The Latino population throughout the United States has faced inequalities for a long time, which affect the community's quality of life. These inequalities are not just seen in areas such as education and income, but also within their health. In fact, childhood obesity is the highest among the Hispanic population at 22.4%, which compares to 14.1% among white non-Hispanic Americans (Krueger & Reither, 2015).

To combat this issue of health inequalities, programs such as the Racial and Ethnic Approaches to Community Health (REACH) Grant have been developed in the United States. This national program is administered by the Centers for Disease Control (CDC) to reduce racial and ethnic health disparities through the implementation of local programs to help every person achieve their full health potential (CDC, 2020). The City of Worcester's Division of Public Health (DPH) is one of 31 locations nationwide to receive this funding. This grant has enabled the DPH to further their goal in assessing community health resources as well as using data visualization to support the developmental prioritization of the ethnic Latino community in nine regions with the most Latino residents throughout Worcester. The DPH has prioritized identifying the nutrition and physical activity resources available in the city of Worcester, which our team achieved through creating maps. The focus of the mapping was on how these resources interact with the nine census tracts within Worcester that have the highest Latino population. We not only identified the available resources but also created an informative tool that the community can use to identify what resources are available closest to them.

To gain funding for the CDC REACH grant in 2018, the DPH demonstrated health discrepancies present for the Latino population within Worcester. Although the DPH knows there are health discrepancies, they do not know what resources are available to the Latino communities, and therefore, further evidence-based research is needed to uncover this. Through analysis of the current resources seen on our maps, we identified if there is a lack of resources in a particular area that would limit the Latino population from receiving the necessary access to maintain a healthy lifestyle. Providing this information will better position the DPH allocate the REACH grant funding to prioritize areas with the least access to resources.

The following report presents a plan for identifying and mapping nutrition and physical activity resources throughout Worcester with a focus on the areas with the highest Latino population. A literature review was conducted, first focusing on inequalities in minority groups

throughout the United States. Then the study shifts focus to both the Latino population in Massachusetts as well as the correlation between poverty and health disparities of Latino individuals. The final section of the background provides the justification and motives for the research being conducted. Following this section, the methodology for the study is presented. In this section, we describe the process for creating interactive maps and the analysis of Latino demographics in comparison to nutrition and physical activity resource locations. This procedure includes both interactive maps for the Worcester Division of Public Health as well as the community members themselves. Following this section is the findings portion of the report. Here, we discuss our results including graphs, tables, and maps of the nutritional and physical activity resources as well as demographic information for the Latino population. Along with the visuals, a detailed analysis is located in this section which takes into consideration the demographics and location of these resources by analyzing the socioeconomic influences through which the Latino community has limited access. Lastly, the conclusion section gives an overview of the resources and patterns we identified. Some of the patterns include resultant geographical observations such as the urban centralization of resources and the outer-lying effects of locating resources on the edge of Latino census tracts. Finally, we offer recommendations for interventions for the DPH and opportunities for others to expand upon our research.

2.0 Background

Health inequalities refer to the unfair and preventable health outcomes of certain segments of the population. Most health inequalities are due to the social injustice that is present for individuals based on race/ethnicity, income, gender, geographical area or education level. Although the United States has come a long way in proposing equal opportunities for disadvantaged populations over the past few decades, there is still a dire need for improvement. This need is especially prevalent when observing the health inequalities among minority populations. One of the largest populations of interest has been the Latino population, which serves as the largest ethnic minority in the United States. Providing equal access and support to individuals in this population has become a focus of many organizations. To investigate this further, this section discusses the disparities of minority groups in the United States. To supplement this inquiry, more in-depth research was conducted on the Latino population

specifically in Massachusetts and Worcester. In addition, the implications of poverty on the health of individuals in Massachusetts was analyzed.

2.1 Disparities Minorities Face in the United States

The United States has a long and troubled history of social inequality for minority groups. The ripples of these previous injustices can still be felt in today's society, as a number of social disadvantages still exist for minorities across the United States. Disparities can be seen across the board; healthcare, physical activity, and access to food are all areas where minorities face inequalities not felt by other majorities in the community.

Minorities have faced disparities in healthcare throughout history, many of which are still noticeable. Almost all inequalities in healthcare are heavily connected to a number of other factors, including social, economic, and educational disadvantages. Factors of accessibility, affordability, and quality come together to create the healthcare disparities experienced by minorities in the United States. Where an individual lives has remained one of the most important factors to their health. According to the U.S. Department of Housing and Urban Development, many minorities tend to live in older, more affordable homes. These older homes tend to have mold, moisture, and lack safe building materials seen in houses constructed more recently (USD HUD, 2005). Employment also plays a large role in healthcare. Many minorities work low-wage jobs where health benefits are rarely offered. Based on a study conducted by the Kaiser Family Foundation (KFF), only 33% of low-wage employers offer their workers' healthcare benefits (KFF, 2019). As a result, many minorities are not offered sick days, which can discourage minorities from seeking proper healthcare. Minorities tend to work more hazardous jobs than other ethnic groups. For example, Seabury, Terp & Boden (2017) found that minorities tend to work in more dangerous lines of work, which has led to an increased rate of work-related injury and disability among these populations. The quality of homes, a lack of employer provided health benefits, and hazardous jobs have heavily contributed to healthcare disparities in minority communities.

Disparities in physical activity and access to fitness resources are closely related to these health disparities in minority communities. In a 2016 article published in the *SSM - Population Health Journal*, researchers examined several findings indicating a connection between neighborhoods' pedestrian streetscapes and the level of activity occurring in these areas. Pedestrian streetscape environment features included sidewalks, crosswalks, and general neighborhood

aesthetics. Certified observers accessed neighborhoods in major United States metropolitan areas, including Baltimore, San Diego, and Seattle. The collected data demonstrated that in all three urban areas, low-income neighborhoods and neighborhoods with higher ethnic minority populations were considered to have poorer aesthetics and social elements present. Graffiti, broken windows, and general signs of dilapidation were higher in these regions when compared to higher-income areas and neighborhoods with smaller ethnic minority populations (Thorton et al., 2016). Additional findings made by Kruger et al. (2008) showed that suburban centers had more recreational activity in a given neighborhood than urban centers. As a result, these urban communities tend to lack required levels of physical activity in order to meet physical health recommendations. According to findings published by the Robert Wood Johnson Foundation (RWJF), adults who resided in walkable neighborhoods, i.e. densely populated areas with well-connected streets, tend to be more physically active than individuals who do not (RWJF, 2018). However, most urban neighborhoods comprised of African-American and Latino populations revealed poor health conditions as a result of these lower-income areas lacking features that support walking, such as maintained sidewalks and pedestrian walkways.

While physical activity plays a large role in community health, an equally important measure is ensuring access to nutritious food resources. As defined by the United States Department of Agriculture (USDA), food insecurity involves lacking regular access to enough food to lead an active healthy lifestyle. (USDA, 2019). While anyone in the United States can suffer from food insecurity, minority populations are shown to be more vulnerable than others. According to statistics compiled in 2018 from the USDA, 22.5% of African Americans homes are food insecure and 18.5% of Hispanic households are food insecure. These statistics are particularly alarming when compared to the national average of food insecurity of only 12.3% for the U.S. total population (USDA, 2018). There are several reasons why minorities tend to find themselves affected by hunger, including problems surrounding poverty and access to government programs.

Poverty has a significant role in creating food insecurity by limiting the amount and quality of food families are able to secure. In a 2018 review, the United States Census Bureau found that 25.4% of Native Americans, 20.8% of African Americans, and 17.6% of Hispanics fell below the national poverty line. The national mean poverty rate in the United States was 11.8% (U.S. Census Bureau, 2018). Minority workers still make up a large majority of the low paying workforce, and therefore, a substantial number of minority families that live paycheck to paycheck cannot afford

food for their families. The wealth gap that exists in the United States has played a significant part in the creation of food insecurity. American wealth is unevenly distributed by race with minorities bringing in significantly less annual income than white Americans. Based on 2018 data collected by the U.S. Census Bureau, annual income in 2017 for African Americans was $40,258. For Hispanics, annual income was $50,486. Both of these incomes fall below the average annual income for all Americans of $61,372, and below the annual income for non-Hispanic whites of $68,145 (U.S. Census Bureau, 2018). The poverty an individual experiences influences the public resources they have access to and the healthcare the individual can afford.

According to the USDA, approximately 40 million Americans relied on government programs such as the Supplemental Nutrition Assistance Program (SNAP) in 2018 to put food on their tables. On average, SNAP benefits provided to members is $126 per month (SNAP to Health, 2016). While programs like SNAP provide critical assistance to millions of U.S. families, it is important to highlight that many families still cannot afford to eat nutritious food. A number of minorities live in areas where healthy affordable food is not assessible. To make matters worse, the Associated Press found that from 2011-2015, of the 10,300 stores opened by the United States' top food providers, only around 250 stores were opening in low-income areas (Associated Press, 2015). Despite being offered a significant amount of aid by the government, many of these families still remain vulnerable within their economically isolated communities.

2.2 The Latino Population in Massachusetts

As previously mentioned, the Hispanic population makes up the largest minority population in the United States. These individuals face an increased number of discrepancies when it comes to education, income, food insecurity, poverty and physical activity. The scale of the problems this population is facing are different on a state-to-state basis. For the purpose of this study, we focus on Massachusetts, with a particular interest in the Latino population. In Massachusetts, there are around 850,000 Latinos, which comprise 12% of the total population. The majority of the individuals in this Latino community are Puerto Rican, making up 42% of the total number of Latinos (Lima, Kim & Schuster, 2019). The county of origin for the Latino population in Worcester can be seen in Figure 1 below. Around half of the state's Latino population is split up between 6 different cities which include Boston, Chelsea, Lawrence, Worcester, Lynn and Springfield (Granberry & Mattos, 2019). The growth of the Latino population within

Massachusetts over the past few years has heavily influenced the growth of the state. The Latino population contributed to a growth of 73% from 2005-2010 and then 64% of the overall growth in 2010-2015 (Granberry & Mattos, 2019).
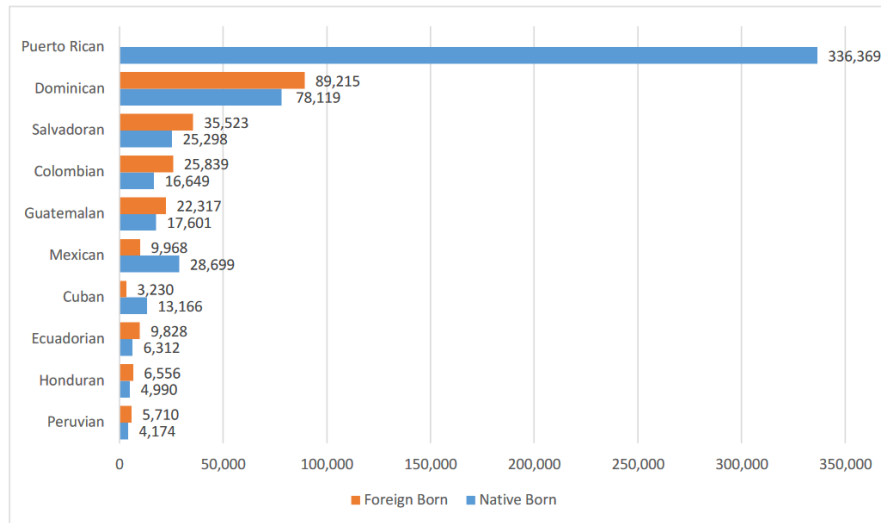
Source: 2017 ACS PUMS 1-year Estimates

Figure 1. Based on data collected in the 2017 American Community Survey the Latino population was categorized into their country of origin.

Based on combined socioeconomic factors, Massachusetts is the worst state for Latinos in the nation. Compared to other states, Massachusetts has the highest discrepancies in income and home ownerships between Latino and non-Latino populations (Stebbins & Comen, 2018). Latinos in Massachusetts also have discrepancies in poverty, educational attainment, unemployment and incarceration leading to inequality between Latinos and non-Latinos (Stebbins & Comen, 2018). The average wage for Latinos in Massachusetts is around $40,000 a year, while for non-Latinos it is double that at around $80,000 a year (Granberry, 2020). In addition, the number of Latinos who own their own home is only 26%, while this rate is 69.3% for non-Latinos (Stebbins & Comen, 2018). The unemployment rate of Latinos in Massachusetts is higher than the national average at 6.4% despite the unemployment rate for non-Latinos being below the national average at 4.2% (Granberry, 2020). Apart from this, there is a higher labor participation seen by Latinos when compared to non-Latinos (Granberry, 2020). However, the participation seen in the labor force is within jobs which historically have lower pay rates. This is likely due to the education of Latino individuals. As can be seen in Figure 2 below (see column 1 and 2), there is not a pronounced difference between the education of Latinos in Massachusetts and the U.S. (Granberry, 2020).

However, the education of Latinos when compared to non-Latinos, in both cases, is extremely different (see columns 1 and 3 as well as 2 and 4). Significantly more non-Latinos have a bachelor's degree or higher (represented by the purple color in the columns) which allows for more job opportunities as well as higher pay. This difference in education plays an integral role in all the demographics previously discussed.
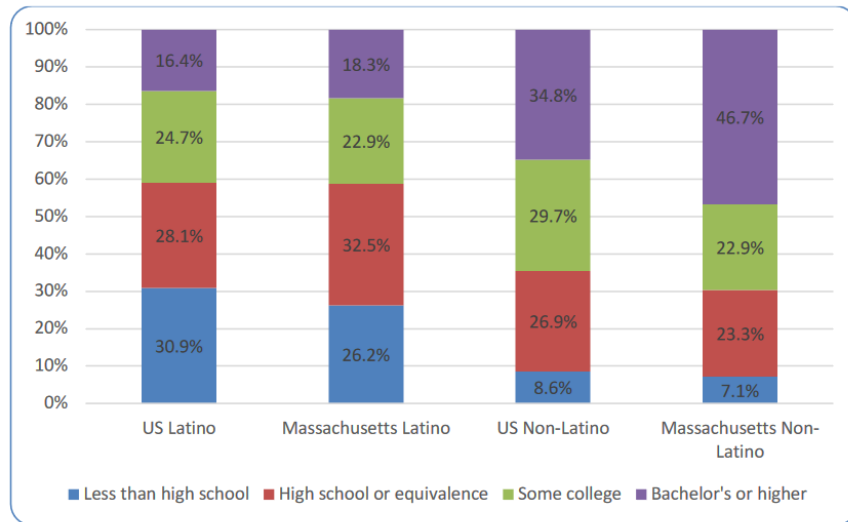
Source: 2017 American Community Survey

Figure 2. Data from the 2017 American Community Survey shows the differences in educational attainment between Latinos and non-Latinos in both the United States and Massachusetts (Granberry, 2020)

2.3 How Poverty Influences the Health of Latino Communities

The demographics previously presented give an overview of the Latino population in Massachusetts, which appears to be skewed in many areas. This is due to the fact that race/ethnicity plays a large role in the likelihood of poverty and other economic issues. In Figure 3 below, it can be seen that the poverty level of individuals with a Latino background in Massachusetts is not only larger than that of non-Latino whites but also larger than the national average by 5% (Massachusetts Department of Public Health, 2017). These issues of poverty are not limited to just adults, but is also highly influential on the population of children in Massachusetts. There are currently 200,163 children living in poor families in Massachusetts. A poor family is defined as any family whose income is below that of the federal poverty threshold. This data is not very accurate however, as it is based on legislation developed in the 1960s (National Center for Children in Poverty, 2018). The fact that the legislation is outdated implies that there are actually more

children and families suffering from poverty than depicted by the data. Of the children who are living in poor families, 36% of them are Hispanic. This makes up the greatest percentage of any race/ethnic background and is five times higher than that of white non-Latino children (National Center for Children in Poverty, 2018).

Individuals with Incomes Below the Federal Poverty Level, by Race/Ethnicity
US and Massachusetts, 2011-2015

Race/Ethnicity	US	MA
Black	27	22
Latino (any race)	24	29
American Indian/Alaska Native	28	23
Asian	13	15
White, non-Latino	11	8
Native Hawaiian/Other Pacific Islander	21	22
Other	27	32
2 or More Races	20	20

Percent of Population

■ US ▨ MA
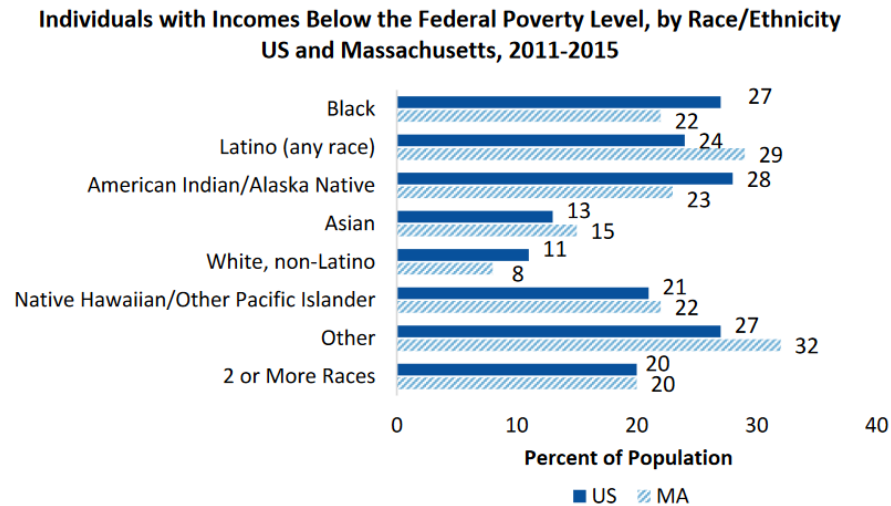
SOURCE: US CENSUS BUREAU, AMERICAN COMMUNITY SURVEY 5-YEAR ESTIMATES

Figure 3. This graph shows the breakdown of percent of individuals below the federal poverty line level. It is broken down by race/ethnicity and is compared to that of the national average (Massachusetts Department of Public Health, 2017)

The prevalence of poverty has led to many investigative studies that explore its effects on and correlations to an individual's health. One of the most comprehensive studies conducted in the state is the Massachusetts State Health Assessment. The Massachusetts State Health Assessment is a tool for assessing the health of residents within Massachusetts based on state-wide datasets. This analysis tool is used by the Massachusetts Division of Public Health along with other partner organizations. The information collected from the 2017 assessment is used throughout this paper repeatedly as there is an extensive amount of pertinent information available. This assessment tool defines the social determinants of health through six different factors. The six categories are violence, social environment, built environment, education, employment, and housing. The Massachusetts State Health Assessment demonstrates that education level, race, geographic area, gender and income levels will influence whether an individual will suffer from health inequalities. In regions where the household income is lower, there is a disproportionally large number of children suffering from childhood obesity.

A variety of factors influence an individual's health, most of which can be controlled by promoting access to nutrition and physical activity. That is why these two factors will be the focus of the study. First, we will discuss physical activity, which is seen to be heavily influenced by different factors, including household income, education and race/ethnicity. This can be seen in Figure 4 below where the correlation between percentage of adults who are inactive and these different factors are depicted. Some of the reasons these disparities are seen in minority groups is due to safety concerns, lack of recreational space, and fear of being deported. These trends are seen among youth as well as adults. The number of white adolescents that meet physical activity requirements is 50.8%, while that of minority groups is only 32.4% and 31.8% for black non-Hispanic and Hispanic adolescents, respectively.
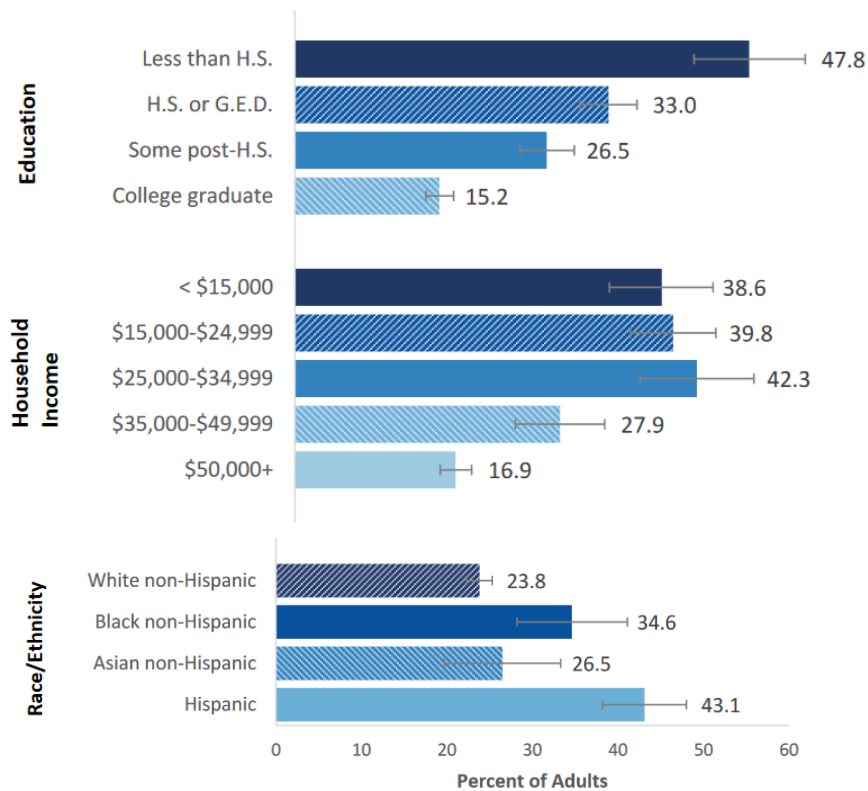
Figure 4. The three graphs above draw correlations between physical inactivity seen in adults compared to three different factors: household income, education and race/ethnicity (Massachusetts Department of Public Health, 2017)

Research conducted by the Division of Nutrition, Physical Activity, and Obesity, National Center for Chronic Disease Prevention and Health Promotion found that to increase physical activity within an area, a number of evidence-based strategies could be implemented. These

strategies include creating activity-friendly routes to everyday destinations, providing access to places of physical activity, creating school and youth programs, implementing community-wide activity campaigns, providing prompts for physical activity and providing access to support systems. Worcester is using some of these strategies, including access to locations for physical activity and starting community-wide campaigns. For example, there are over 60 parks in the Worcester Park system (The City of Worcester, 2020). Many of these parks have other physical activity resources such as playgrounds, pools, outdoor fitness centers, fields and basketball courts. Another example of ways Worcester is promoting fitness is the WOO Moves campaign. The WOO Moves campaign was started in August of 2015 by the City of Worcester Employee Wellness Program in partnership with the Worcester Division of Public Health (WOO Moves, 2020). This program uses walking routes throughout the city to promote walking for fitness among the community members.

Lastly, we will look at nutrition as another integral factor of health. The Massachusetts State Health Assessment of 2017 revealed that 45.4% of cardiovascular and metabolic diseases throughout the nation can be directly linked to poor diets. This is due to the widespread food insecurity marginalized subpopulations face. Food insecurity entails not only direct access to food, but most importantly access to healthy food. Many low-income communities have issues with accessing supermarkets that provide fresh produce. This is due to both the limited number of facilities in addition to transportation issues.

As previously mentioned, food insecurity has to do with access to healthy foods as well as general access to supermarkets. Individuals who eat fresh fruits and vegetables have better health outcomes. There is a correlation between education and consumption of fresh fruits and vegetables, where those with a 4-year college degree are almost twice as likely to have consumed fresh fruits and vegetables than those with no high school degree. Education plays a large role as access to fresh fruits and vegetables is largely economic-based due to the high price threshold of healthy food, high cost of living in the city, and transportation issues within the city. This is why food insecurity has become such a big issue within many different communities throughout the state of Massachusetts. This issue led to the development and identification of food deserts. These are areas classified by the U.S. Department of Agriculture as low-income communities that have limited access to healthy foods. These food deserts tend to be centralized around the larger cities/towns in the state, one of which was Worcester. In these areas there is a surplus of

convenience stores and fast food restaurants while there is a limited number of supermarkets adding to the already existent food insecurity.

The Worcester County Food Bank is a database that collects information on all the food pantries and meal programs available in Worcester. This resource is the focus of the methods, as these are the only resources which have physical locations and are available to everyone who is in need of the services. This food bank partners with other organizations to provide 115 different resource centers for Worcester County residents (Worcester County Food Bank, 2020). These services provided 5.1 million meals in 2019. This impacted the lives of 75,000 individuals all over Worcester County which spans 60 different towns and cities (Worcester County Food Bank, 2020). These cities and towns themselves have different proportions of minority populations, which is not considered in this data. Therefore, the research into how food insecurity affects the different groups of people living in the state would be a beneficial study.

2.4 Our Research

In Worcester, there is research showing that many health disparities are present for the Latino population (City of Worcester, M.A., 2019). As the largest minority population living in poverty, Latinos make up 26.6% of individuals below the poverty line (Worcester, MA, 2017). However, there is not sufficient information on what resources are available to this population. Without information on what resources are available to the Latino communities, the solution to fixing these disparities cannot begin. Based on the trends seen in the United States and Massachusetts, we expect to see that the Latino population in Worcester will have less access to resources than the non-Latino population. In our project, we aimed to test this hypothesis and provide the Worcester Division of Public Health with the necessary evidence to address these health inequalities. If improvements can be made and access to public resources expanded, Latino communities would become healthier as a whole by increasing standards of living.

The purpose of this research is to analyze and identify the nutrition and physical activity resources available to improve public health in the largely Latino communities throughout Worcester. We will identify the number and location of these resources throughout Worcester and analyze their location in comparison to the location of the Latino population. An inventory of these resources and a walkability map of healthy food options and physical activity resources will better reveal the nutritional and fitness needs of each community. Walkability has been linked with a significant positive impact on the social, health, and economic aspects of entire communities, and

has even been associated with up to a 9% increase in property value (Gilderbloom et al., 2015). With this data, the City of Worcester will be able to provide justification for sustained funding under the CDC's REACH Grant to better inform Latino neighborhood prioritization and thereby reduce racial and ethnic health disparities.

To accomplish this goal, the following questions were addressed: What areas within the city Worcester have the least access to nutrition and physical activity resources? How does the demographics of the Latino population correspond to the number and type of resources present? Are there less resources available to those in the areas with a higher Latino population when compared to those with a higher non-Latino population?

In the following section, the methods which we conducted in order to answer these questions will be presented. We created interactive maps to be used by the Worcester DPH and the community. These maps will show the location of all the nutrition and physical activity resources available, the walkability to each of these resources, and allow community members to navigate from their homes to the available resources. Along with this, we created maps for analysis to better inform the Worcester DPH of the areas where there are not enough resources. These maps include both heatmaps and demographic/resource location maps. From this information we hope to both inform the community and DPH of the available resources as well as provide information to allow the DPH to use the REACH Grant funding to solve the health disparity issues.

3.0 Methodology

The City of Worcester DPH works to improve the quality of life and health of residents by implementing evidence-based services. They emphasize the importance of equality for all people regardless of race and/or ethnicity (City of Worcester, MA., 2019). To assist the DPH in understanding inequalities in access to public health services for Latino communities, they require evidence-based data to support the development of new services and improve on the quality of existing services. To support the DPH collect and visualize data on Latino access to nutrition and physical activity resources, our team focused on two main objectives:

Objective 1: Create an interactive community-facing tool of all the nutrition and physical activity resources in Worcester

Objective 2: Map the location of nutrition and physical activity resources to identify the areas with the least access

3.1 Objective 1: Create an interactive community-facing tool of all the nutrition and physical activity resources in Worcester

To analyze the multiple disparities present for Latinos living in Worcester, nine census tracts with the highest population of Latinos were identified. A census tract can be defined as an area approximately the size of a typical neighborhood (in the United States) with individuals numbering 2,500 to 8,000, with the optimal size of 4,000 for taking a population count of a relatively permanent area (Weessies, 2017). A census tract is smaller than a city but larger than a block group and contains similar neighborhood and often cultural ties. The city of Worcester provides Massachusetts GIS (Geographic information system) data in order to use KML and shapefiles to create boundaries of the census tracts as well as the state. These files were then modified in ArcGIS Online and Google Earth Pro to be accompanied by demographic statistics obtained via the U.S. Census Bureau in order to create several analytic maps detailing public resources influenced by relevant socioeconomic factors.

Google Earth Pro was used in conjunction with the KML (Keyhole Markup Language) file that sets the boundaries of each census tract. This allows the boundaries to be seen on Google Earth Pro, whose search engine capabilities permit the filtering of different grocery stores within the confines of the city of Worcester. After compiling a list of every grocery store, deli market, or other food stores, the results were exported as a KML file. This KML file was then converted into a shapefile to be opened in ArcGIS Online as an additional layer to the census tract maps.

In addition to food resources such as grocery stores, food pantries were also recorded as a separate KML file. To retrieve these locations, we inspected the Worcester County Food Bank's website, which included a map based on the Google Maps API (Application programming interface) of all community food banks and pantries in the city of Worcester. We observed the JavaScript source code of the site, which was then converted into a CSV (Comma-separated values) file with a table of all the names and addresses of every food bank and pantry in the city of Worcester. We then converted this file into a shapefile to be opened in ArcMap GIS to accompany the regular grocery stores on the map.

The grocery store locations were elaborated upon using data from the MassGIS database. This data included a more comprehensive list of stores that accept SNAP in order to better display resources that employ programs to inhibit food insecurity. The state of Massachusetts hosts the SNAP program to provide a monthly benefit to buy nutritious foods for low-income individuals

(Mass.gov, 2020). A shapefile of these resources that provide healthy foods as well as an array of organic farmers' markets were converted into shapefiles to be displayed in ArcGIS Online as part of the growing food resource map. However, after determining that some of these SNAP locations were corner stores or other convenience stores that did not provide fresh produce as required by our sponsor's expectations for food security, each of the 200 SNAP locations were viewed in Google Street View and evaluated. The shapefiles were converted into an Excel format in order to filter out the undesirable locations and then converted back into shapefiles to create new layers. Only those that met the team's criteria for fresh produce were included in the resource maps and the walkability map.

To create the walkability map for the food and food insecurity resources a walk-time feature on ArcGIS Online was used. This feature creates a display of the areas within a specific walk-time of a location-based on the average walk speed of an individual (3 mph) and analyzes the paths/roads which a pedestrian is able to walk on (Zurn, 2018). For our research, we used each individual food resource as the centroid of the map and created a radius of 5- and 10-minute walk times. The average walking distance for an individual to consider walking to a store which sells fresh produce is ~0.5 miles (Rattan, Campese & Eden, 2012). Since the average walk speed is 3 mph, this means the average walk time to go 0.5 miles would be 10 minutes which was used as the walkability cut off for our study. This map then displayed the communities which are within those walk-times and provided individuals a relative time in which it would take them to access the food resources. An example of the ArcGIS feature being implemented can be seen below in Figure 5.
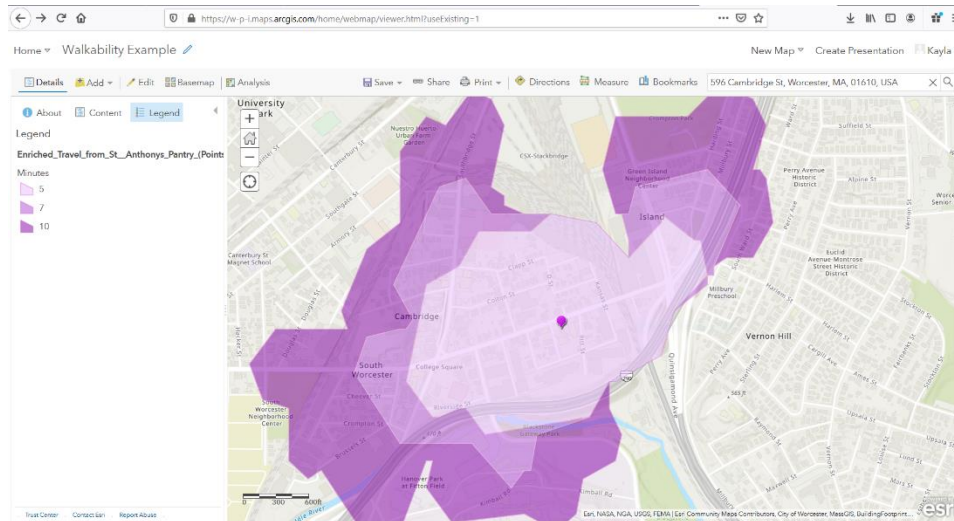
Figure 5. An example of a walk-time map created with the ArcGIS feature, it shows three different walk times to the St Anthony's Food Pantry based on color shades

Similar to the maps of food resources and food insecurity, the team also created a map that recorded physical activity resources available in Worcester. We looked at three separate types of physical activity resources: gyms, yoga studios, and YMCA organizations. We utilized Google Earth Pro to collect information such as names, addresses, and coordinates of these facilities. We then downloaded the data as a KML file and put it into Excel. The information was then uploaded to ArcGIS Online as a CSV file where the resources were plotted on a separate map using relevant coordinates.

We created a web application using ArcGIS Web AppBuilder to allow any individual with an external link to access a user-friendly site showing all of the nutritional resources available. Walkability maps of any food and physical activity resources will be shown at the user's choice, with a pop-up screen indicating initial instructions for how to utilize the site's features. The map allows the user to pinpoint and interact with specific resources such as SNAP food locations with fresh produce, WIC-accepted stores, farmers' markets, food pantries, and gyms. The directions widget allows the user to find step-by-step directions via walking or driving to any of the resource locations the individual selects. A widget can also be used to zoom to the user's location to better indicate what resources surround the individual. This application was created with the intention of allowing the Worcester DPH to add the tool to the Mass.gov website to inform the Worcester public of easy access to the nutritional resources available around them. Rather than pinpoint specific regions or census tracts considered disadvantaged, this tool covers the entirety of the city

of Worcester to better inform all Worcester residents of their nearby nutritional resources to positively impact the public health sector.

The ease of access for this web application was tested so that is could be successfully implemented into the Worcester community. This testing was done by surveying a number of individuals throughout the Worcester community, with the help of our sponsor. The target population was those in the Latino community aged 13+ ensuring there is a variety of individuals within the sample, including parents. These individuals, once contacted by the DPH, would receive an email containing information and instructions pertaining to testing. The participants tested out the application, following prompts for four different activities. They then completed a Google survey where each question explains the activity and then the individuals will rank the activity based on how easy or difficult it was to use. The ease/difficulty of use was based on time. The survey will also collect demographic information on the individual including where they are located, if they are a parent, if they consider themselves Latino and what age they are. As well, there was an open response section at the end of the survey for general feedback and suggestions. The full survey can be found in Appendix A. Along with this survey the participants had the option to participate in Zoom calls with the team as well. There were three times available when participants could sign up to talk with the team about their experience using the application and give any suggestions for improvement.

3.2 Objective 2: Map the location of nutrition and physical activity resources to identify areas with the least access

The required data for the study was collected using a modified open-source U.S. census data downloader program written in the Python programming language. This data is provided by the U.S. Census Bureau to those with an official Census Data API key. Along with the data provided by the decennial U.S. Census, this data also compiles information from the annual American Community Survey. This survey provides vital information about the United States population with respect to jobs, educational attainment, household income, homeownership, as well as racial and ethnic demographics (U.S. Census Bureau, 2020). As the survey is taken every year, this data is recent and presents an accurate representation of the population characteristics of each census tract of interest in the city of Worcester, Massachusetts. To better demonstrate the disadvantages of Latino communities in these regions, the following data details the physical

locations, education level, median household income, annual income per capita, and language barriers that together restrict access to food resources in the nine census tracts with the highest number of Latinos in Worcester.

Using the Census Data Downloader in Python with the API key requested from the U.S. Census Bureau, an Excel file with all education data was retrieved by census tract across the country. Using the GEOIDs for each census tract with the highest number of Latinos in Worcester, a filter was created to exclude tens of thousands of other census tracts to only pinpoint the regions of interest. The education data is based on the American Community Survey (ACS) data regarding reported education levels for those 25 years of age or older. The data showed a breakdown of education level for each grade attended by all the individuals in these census tracts. We then categorized education levels into a comprehensive understanding of those with no formal schooling, those who did not finish high school, those who graduated high school or received a GED but did not attend college, high school graduates that attended some college, and those who received a bachelor's degree or higher. This data can better show how education affects economic inequality and thereby food insecurity in these census tracts. This was done for each of the nine census tracts and then averaged.

To gain better insight into the Latino demographics of these census tracts, the entire program was run and filtered again for the population statistics as demonstrated in the results section. Note that twenty nine keywords were used to define 'Latino' in order to gain a better grasp on the number of ethnic minorities in the regions without isolating any particular group (see Appendix B). These keywords consist of nationalities from all Latin America (including South American countries which are not considered 'Hispanic' but are considered 'Latino', such as Brazil). To better analyze the potential disparities Latinos may face in these areas compared to the non-Latino white majority population, the program was run again to investigate average income for the population within the census tracts. Income by ethnicity was compared, so that Latino resident income was compared with non-Latino white residents in the same areas. Initially, the income was determined by median household income as demonstrated in results. However, after subsequent research on the familism of Latinos in the United States, this process needed to be further developed. This is due to the fact that there are on average 3.52 people per Latino household compared to only 2.48 people per non-Latino household in the country (U.S. Census Bureau,

2002). Therefore, the program was run to search for income on a per capita basis to better determine annual income per Latino individual rather than for a household of varying size.

To match food resource locations with each census tract's appropriate demographics, we used a JavaScript function to generate three sets of color schemes that become darker in four different ranges. Using the statistical data, the Python program retrieved from the U.S. Census Bureau, a series of maps were created in ArcGIS Online. The darker colors indicate a higher percentage of Latinos out of the total population, a higher poverty rate among Latinos, and a higher per capita income within the Latino community, respectively.

Heatmaps were created via a layer-editor tool utilized by ArcGIS Online by modifying the area of interest color gradient surrounding each feature (food resource/activity center) of the layer. Blue details a low concentration of food resources, while "warmer" colors such as red and then yellow indicate higher concentrations. These maps indicate where low concentrations of resources exist and therefore need developmental prioritization in the future.

4.0 Findings

This section reveals informative maps and charts of all nutritional and physical activity resources throughout Worcester and establishes valuable data to support whether ethnic and socioeconomic factors influence the resources found in the city. This section begins with a generated map of the nine census tracts followed by a table with the Latino demographics of each region. After this, the Python program results such as educational level, income, language barriers, choice of work, and poverty rate were investigated. Several density maps then show the distribution of these statistics for each census tract. Then, several maps demonstrate the concentration of nutritional resources such as grocery stores with fresh produce, food pantries, and farmers' markets throughout Worcester. This is followed by heatmaps used to determine which regions of Worcester are prone to a smaller concentration of food resources in need of prioritization, particularly within the nine census tracts. With these regions in mind, web application screenshots then show regions of walkability so that members of the Worcester community can identify previously unknown resources around them within 5 and 10 minute walking distances. We consider this collection of results the first important step to helping the largely Latino communities identify and access health resources while providing justification for continued development of these resources to bridge ethnic disparities under the city's REACH

grant. The nine census tracts containing the largest Latino populations serving as the focus of the study can be observed below (see Figure 6).

Figure 6. This map rendered in ArcMap GIS overlays the nine census tracts with the highest Latino populations within the boundaries of the city of Worcester, MA.

4.1 Demographics in the Census Tracts with the Highest Latino Population

The data collected from each of the nine census tracts can be seen below as a user-friendly form of the Census Data Downloader Python program output, which draws on the latest American Community Survey (ACS) data made available by the U.S. Census Bureau. Therefore, the Latino demographics were analyzed using the Census Data Downloader Python program in order to identify population statistics for the nine census tracts. The comparative figures can be viewed below (see Table 1).

Census Tract	Total Population	Not Hispanic or Latino	Hispanic or Latino
Census Tract 7312.03, Worcester County, Massachusetts	5781	3781	2000
Census Tract 7313, Worcester County, Massachusetts	3657	1978	1679
Census Tract 7314, Worcester County, Massachusetts	4204	1882	2322
Census Tract 7315, Worcester County, Massachusetts	4648	2740	1908
Census Tract 7318, Worcester County, Massachusetts	7048	4854	2194
Census Tract 7319, Worcester County, Massachusetts	4905	3277	1628
Census Tract 7320.01, Worcester County, Massachusetts	3795	1318	2477
Census Tract 7324, Worcester County, Massachusetts	6953	3314	3639
Census Tract 7330, Worcester County, Massachusetts	3709	2592	1117
Grand Total	44700	25736	18964

Table 1. Population demographics of the Latino community in nine census tracts

The results demonstrate that the average Latino-to-non-Latino population ratio is quite high. Many of the health and economic challenges faced by Latinos elsewhere are more highly concentrated in the nine census tracts with a 42% Latino population, whereas the non-Latino

population comprises 58%. To better convey what scale this ratio might adversely affect Latinos economically, the results of the Python program were re-configured to extract education level, Latino vs. non-Latino white income, and language barriers, all of which inhibit adequate access to nutritional resources.
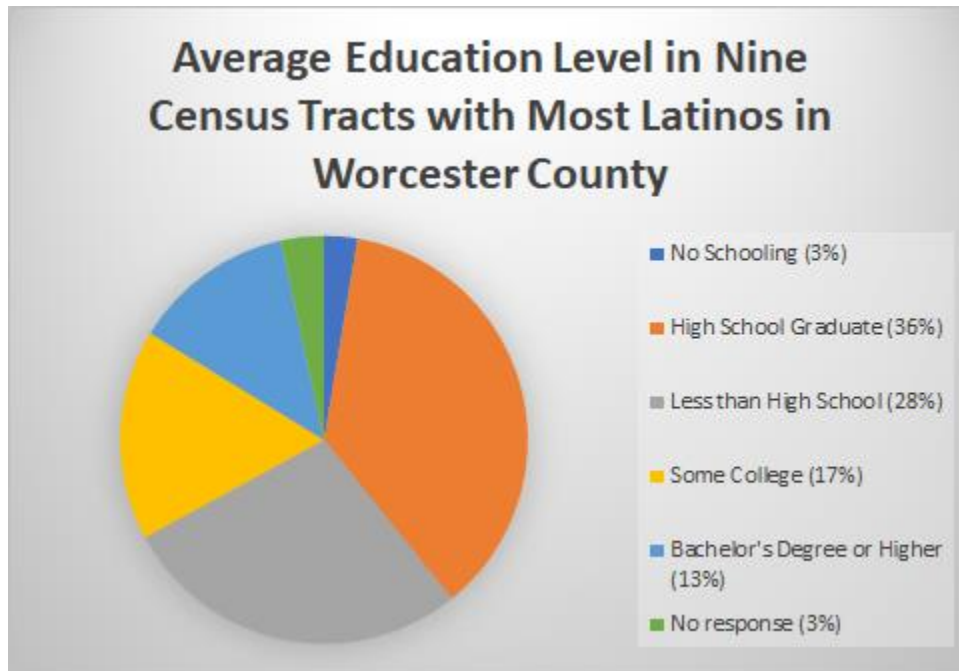
Figure 7. A pie chart compiled using the education data output from the program.

As shown in the graph above, while most individuals in these areas graduated high school, only 30% had some level of college education. Approximately 28% were reported to have not finished high school as well. Subsequent research revealed that nearly half of all new jobs in the local Greater Boston region require a college degree or higher, thus presenting a substantial barrier to Latino employment (Lima et al., 2019). Most of the occupations projected to see significant growth are those of high-wage fields such as technical management and computer occupations. While these fields' wages average around $90,000 per year, fields with less education requirements such as food preparation and personal care jobs are within the range of only $30,000 per year (Lima et al., 2019). The Latino population is overrepresented in low-wage occupations such as construction, grounds maintenance, and food preparation services. For example, Latinos comprise 33% of food preparation jobs, with median wages of $31,000 for year-round, full-time work (Lima et al., 2019). This research coincides with the results of the Latino vs. non-Latino white income findings below:
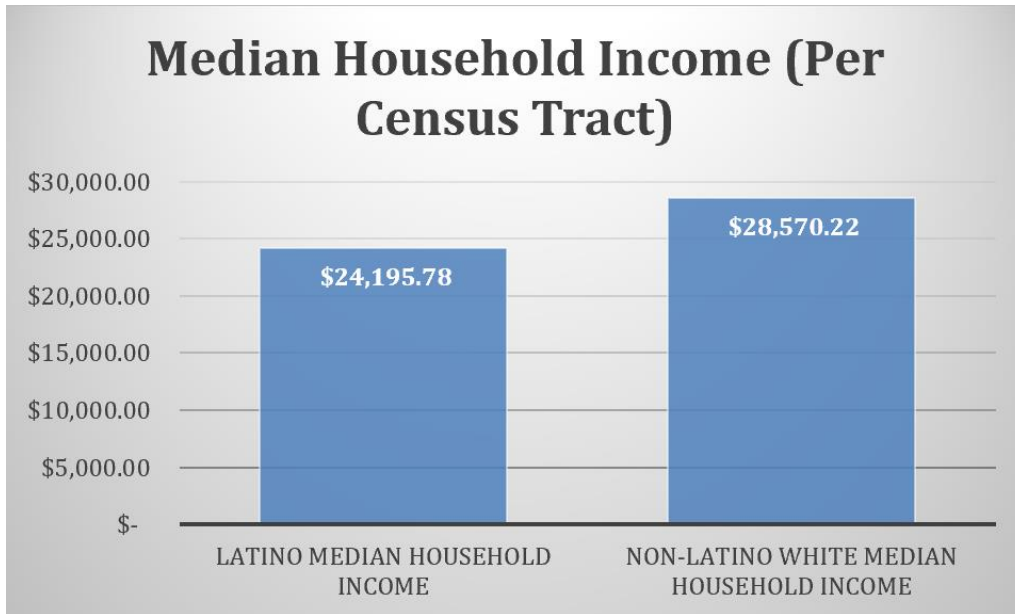
Figure 8. Median Household Income by Ethnicity for Nine Census Tracts with Highest Latino Population of Worcester
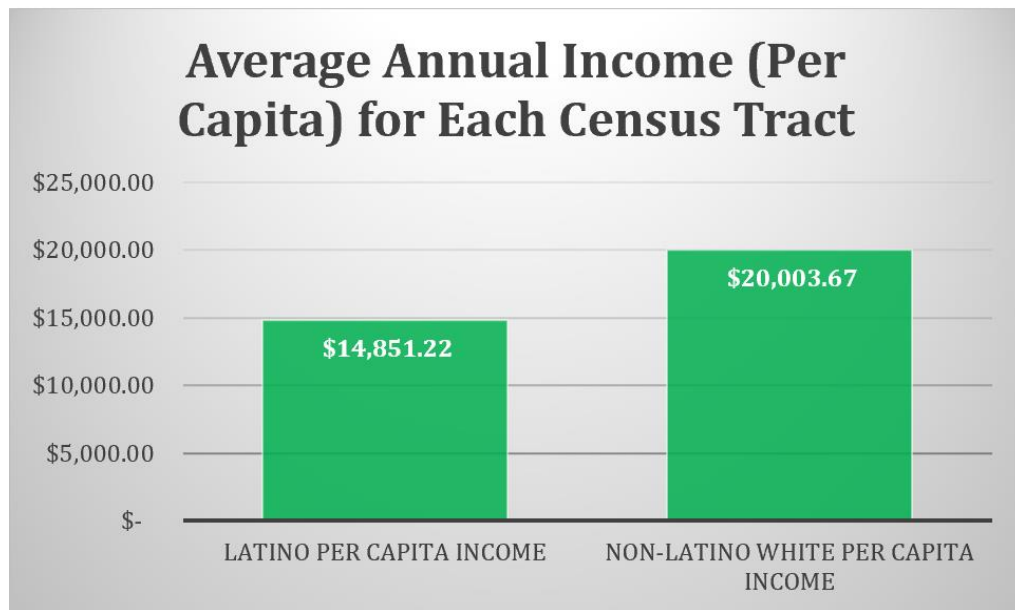

Figure 9. Average Annual Income Per Capita for Nine Census Tracts with Highest Latino Population of Worcester

Both graphs detail significant economic disparities for Latinos living in the same areas as non-Latino whites for these nine Worcester census tracts. It is evident by these figures that the

non-Latino white population in these nine census tracts earns approximately 25.7% more than the respective Latino population on an average per capita basis. Increased opportunities for educational attainment as well as a corresponding increase in skilled labor positions within Latino communities will offset income disparities resulting in lack of nutritional access on the basis of higher cost for higher quality food. However, the availability of these opportunities largely depends on advancement through higher education. The inability to speak English further limits educational opportunities and therefore limits higher income opportunities for the Latino communities. Improving English language skills will be necessary in order to ensure higher educational attainment and therefore higher income for the Latino community.

66% of Worcester residents speak English at home and as their primary language. Concerning the 34% that do not speak English at home, 14.9% of Worcester residents speak Spanish (World Population Review, 2018). However, it is estimated in Massachusetts that 41.1% of those who speak Spanish do not speak English well (Statistical Atlas, 2018). In a region with a majority English-speaking population, the lack of Spanish-speaking job opportunities present severe limitations for the large portion of Latino residents that speak only Spanish. This is evident by viewing English proficiency in correlation with income earned as shown below.
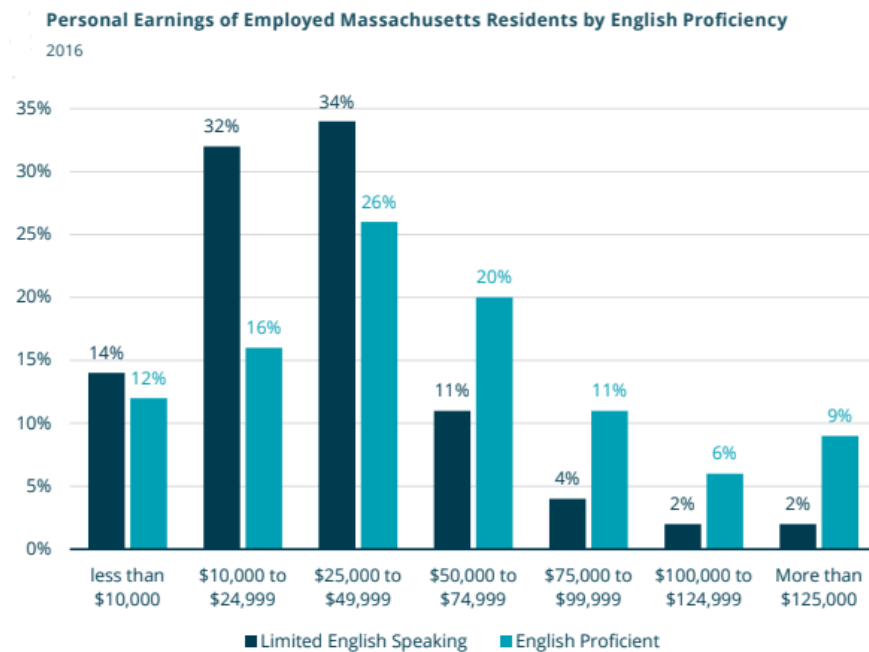
Figure 10. Personal Earnings of Massachusetts Residents by English Proficiency

80% of limited English speakers earn under $49,999 each year, with 46% earning less than $24,999 each year, indicating severe limitations to income and thus quality of food resources. In order to better compare these statistics to the accessibility of nutritional resources, three density maps were created on the basis of the Latino population rate, poverty rate, and per capita income within the nine census tracts with the highest percentage Latino populations. These statistics were then overlaid with Worcester food pantries, stores that accept SNAP assistance while also providing fresh produce, and stores that accept Women, Infants, and Children (WIC) assistance. The results are demonstrated below with areas of concern circled in red (see Figure 11, 12 and 13):
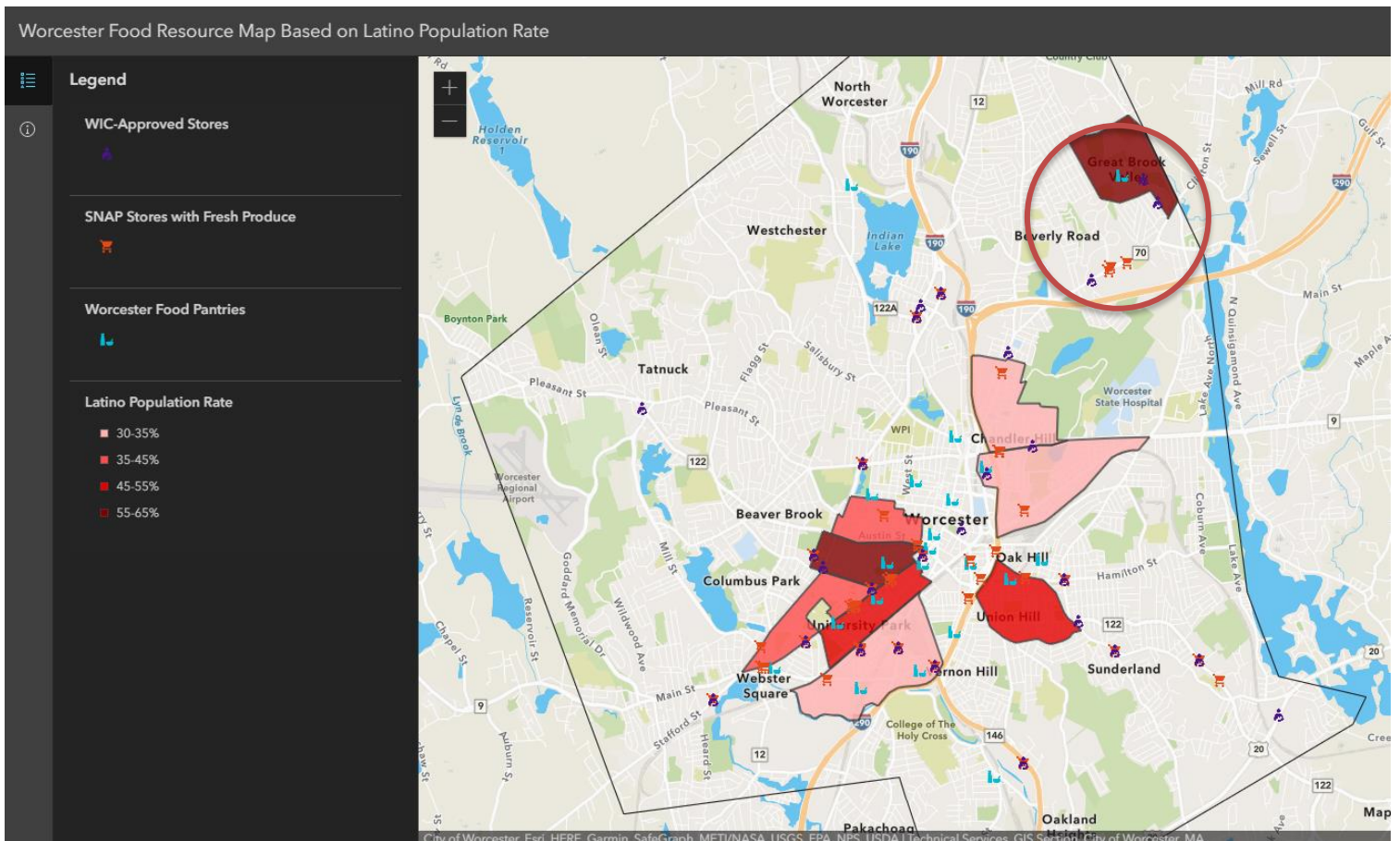
Figure 11. Worcester Census Tracts by % Latino Population (Web App Screenshot)
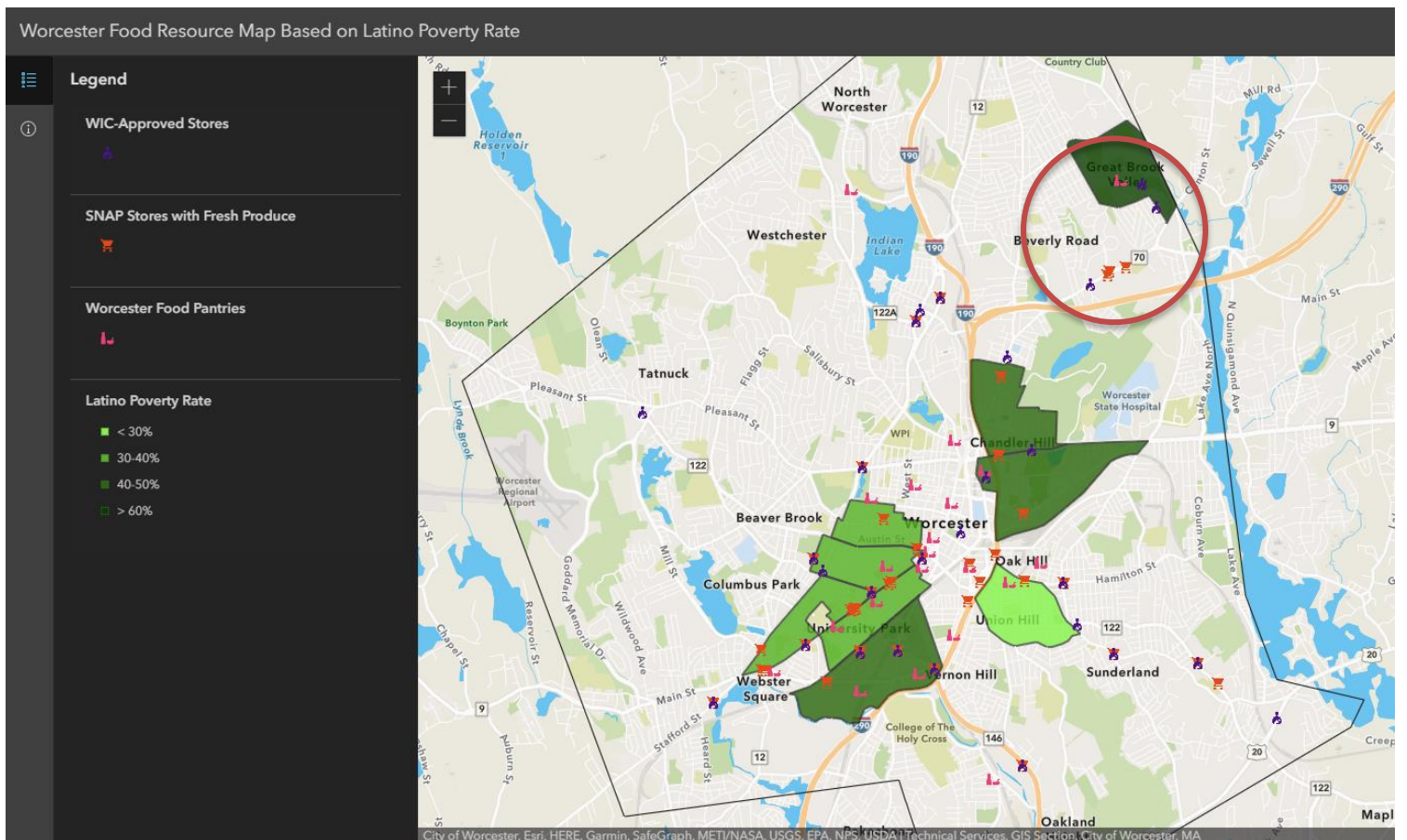
Figure 12. Worcester Census Tracts by Latino Poverty Rate (Web App Screenshot)
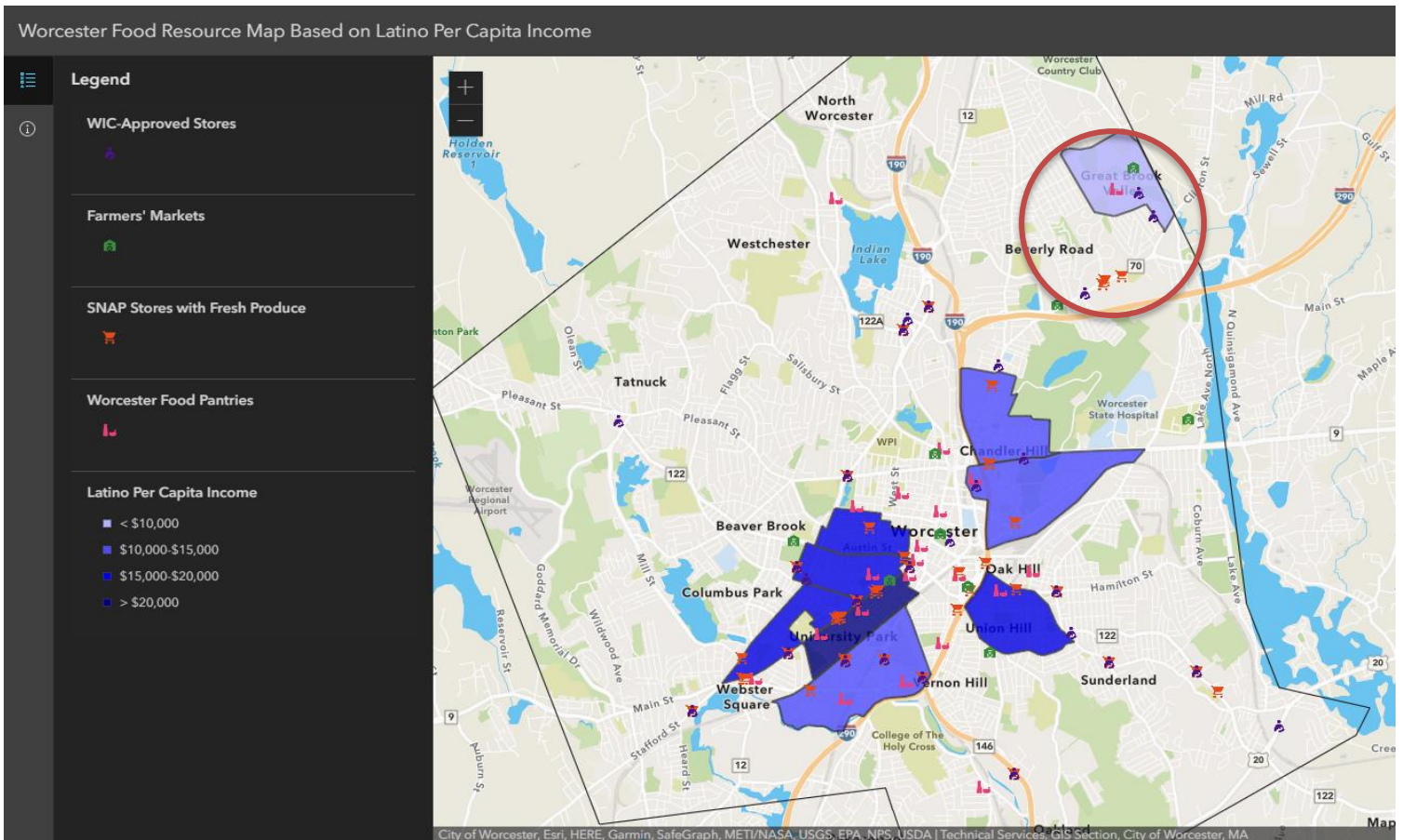
Figure 13. Worcester Census Tracts by Latino Per Capita Income (Web App Screenshot)

As shown in the density maps above, there are several regions of concern, but the Great Brook Valley census tract (to the farthest northeast circled in red) stood out the most. These three maps indicate that the Latino per capita income is below $10,000 annually, with a poverty rate greater than 60% in the Great Brook Valley census tract. This indicates economic difficulty not only for the working population with smaller incomes, but also the conditions of the non-working class of children and the elderly living in poverty as shown on each map. The Latino population rate is also nearly 60% of the total population, indicating a substantial challenge for the Latinos that constitute most of this census tract. Based on the maps' visuals, it is evident that this census tract also has the least amount of direct access to SNAP stores with fresh produce compared to the other Latino census tracts. None of these stores are within the same proximity to the Great Brook Valley tract as they are to any of the other eight Latino census tracts.

4.2 Identifying Nutrional and Physical Activity Resources in Worcester

Many of the resources are concentrated within the urban centers of the city, but few of the resources appear to be within the bounds of the census tracts alone. To better determine the access to resources, a heatmap was created detailing the allocation and concentration of food resources throughout the city of Worcester. This was created via a layer-editor tool utilized by ArcGIS Online by modifying the area of interest color gradient surrounding each feature (food resource/activity center) of the layer. Blue details a low concentration of food resources, while "warmer" colors such as red and then yellow indicate higher concentrations. The green regions indicate the nine Latino census tracts of focus.
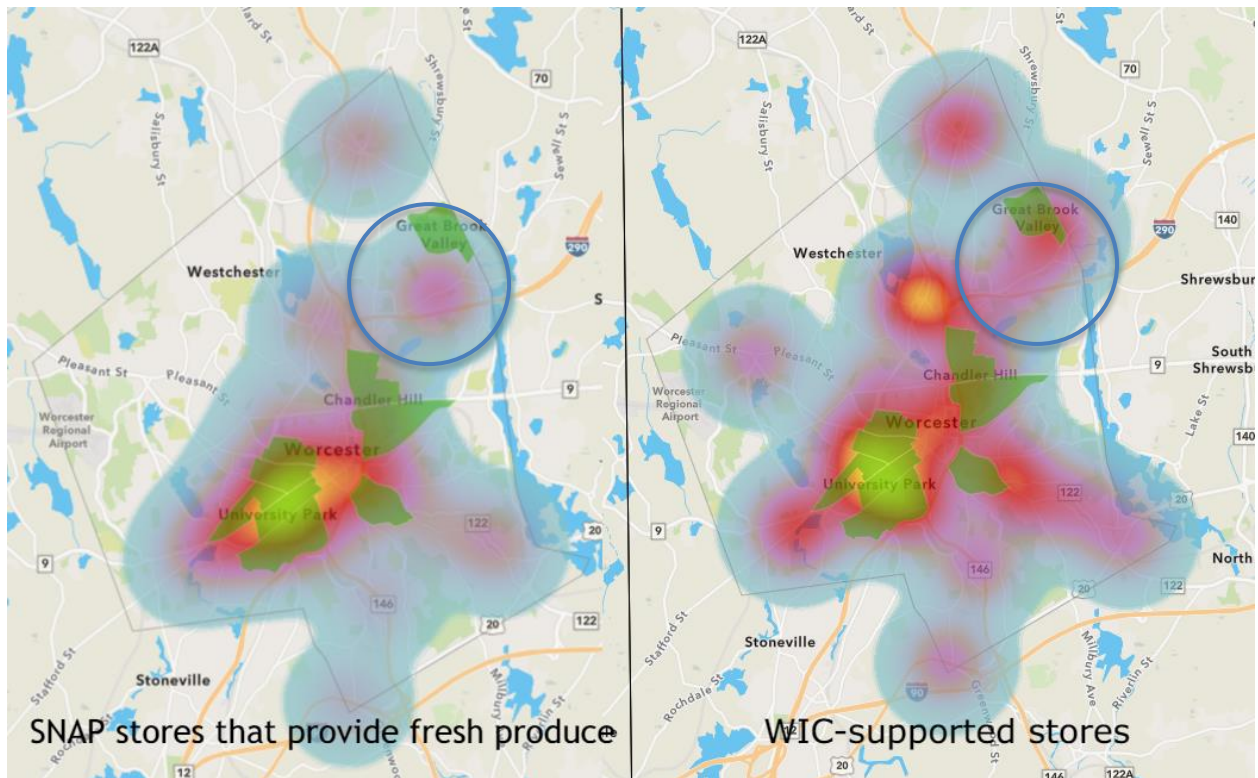
Figure 14. Heatmap of SNAP stores that provide fresh produce and WIC-supported stores (cooler region of concern is circled in blue)
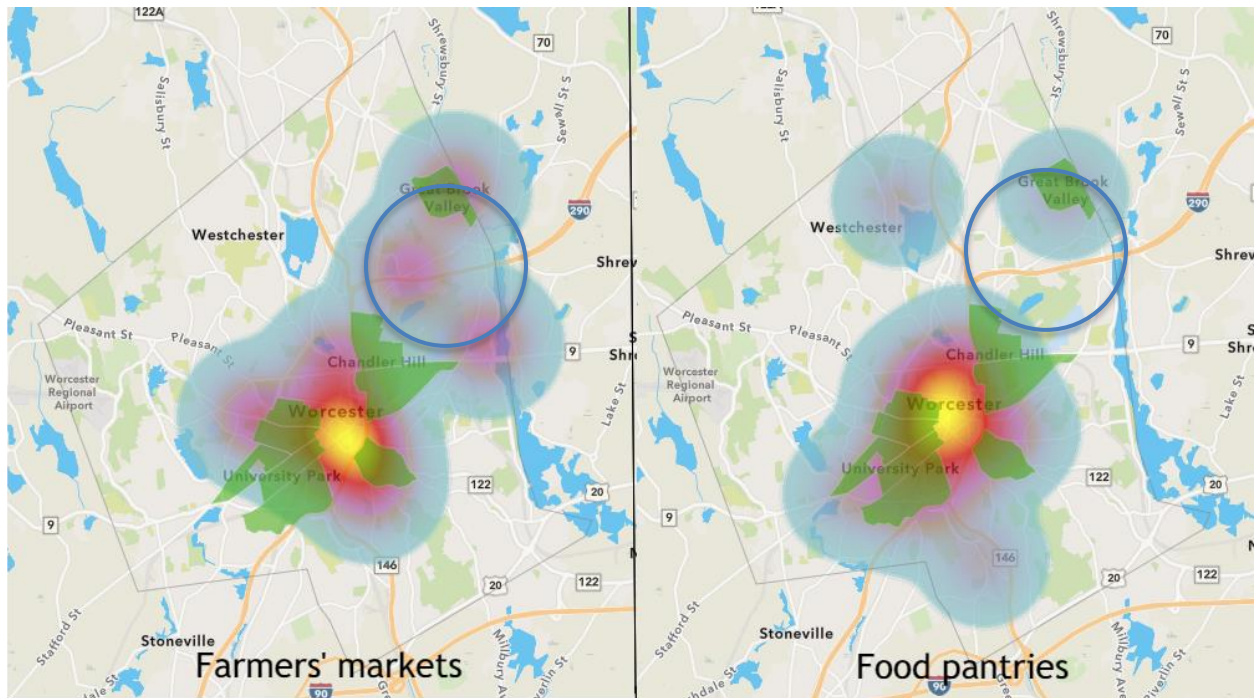
Figure 15. Heatmap of farmers' markets and food pantries (cooler region of concern is circled in blue)
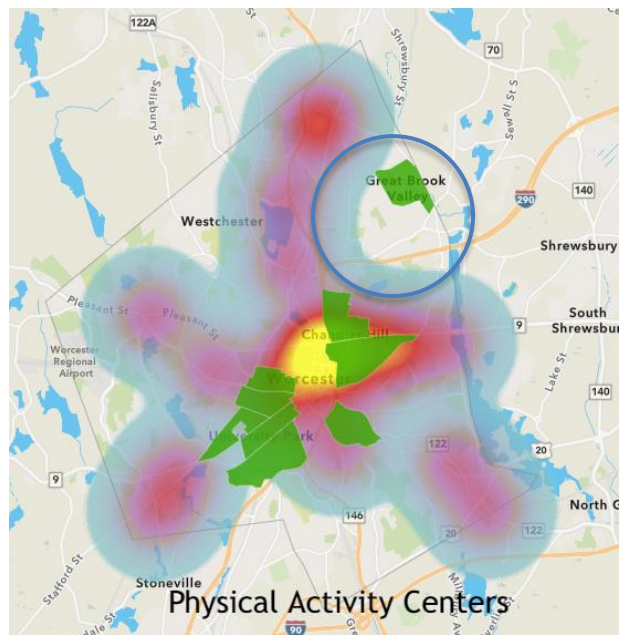

Figure 16. Heatmap of physical activity resources (cooler region of concern is circled in blue)

The results of the heat-mapping demonstrate a "cooler" region with less resources in both the far west of the city as well as the northeast surrounding Great Brook Valley. The far west has a smaller population than that of the central and eastern portions of Worcester. This allocation of resources toward the urban center is indicative of a lack of nutritional resources available to the three most northeastern census tracts and their surrounding regions. Regions with higher concentrations of people in the urban heart of Worcester contain a significantly larger number of resources disproportional to the outer-lying regions. Each census tract has approximately the same number of individuals (around 4,000-6,000 people; see Table 1), yet, the accumulated resources toward the center does not reflect distribution of resources to meet the needs of each census tract equally. Some resources, such as physical activity centers including gyms, yoga studios, and YMCAs, are widespread, although they are concentrated farther to the north than the food resources. Due to the wide heatmap areas surrounding each resource, a more precise tool of measurement is required to ascertain physical access to resources. This involves a more definitive approach to demonstrating physical access via a walkability map, which details the time it takes to walk to food resources within a specific area represented by a colored boundary. These maps take road conditions, sidewalk conditions, traffic statistics, and even seasonal climate conditions to demonstrate how long it takes to walk to each resource. Walking distances were used to map universal access to all resources within a short time, so as to not disproportionally serve only those with vehicles. They are broken into 5 and 10 minute walk-time regions for each type of nutritional resource as demonstrated here:
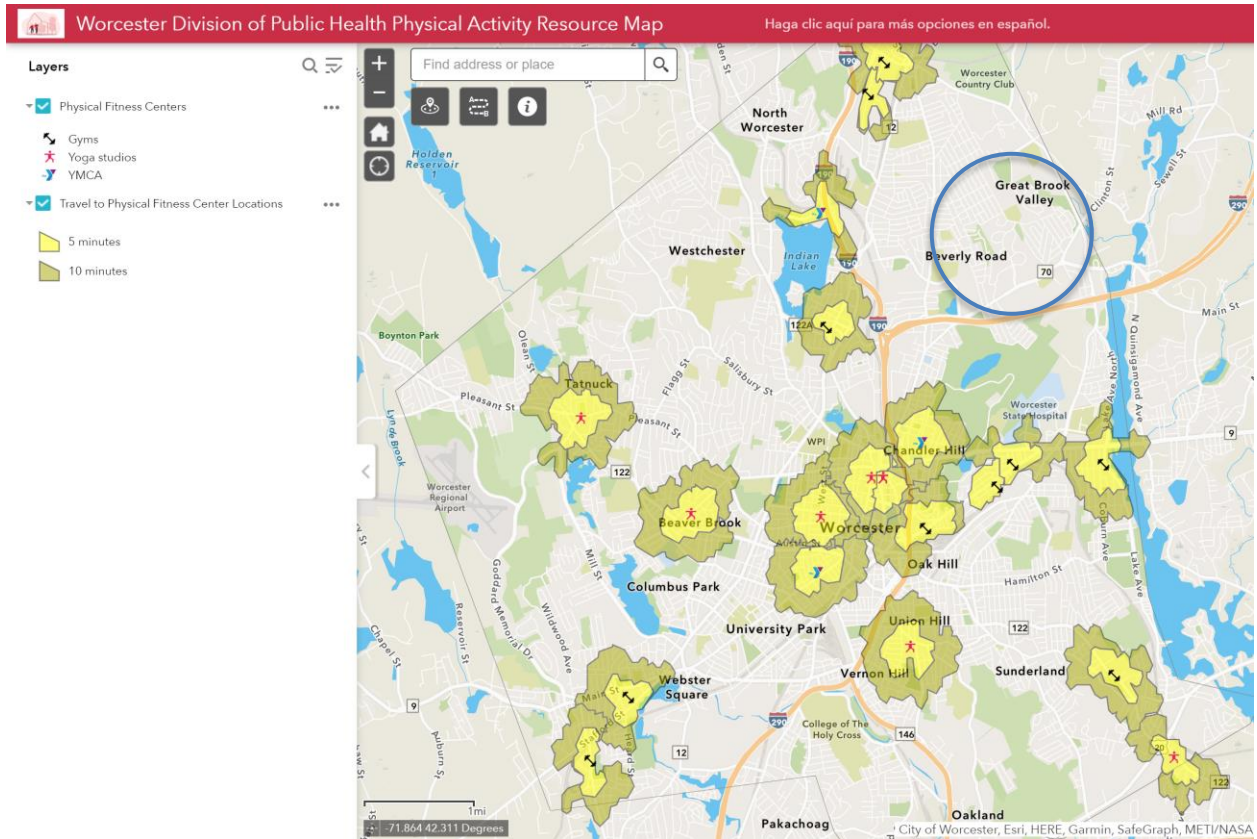
Figure 17. Physical activity locations with walkability times via web application (light colors = 5 minutes, darker colors = 10 minutes walking time)
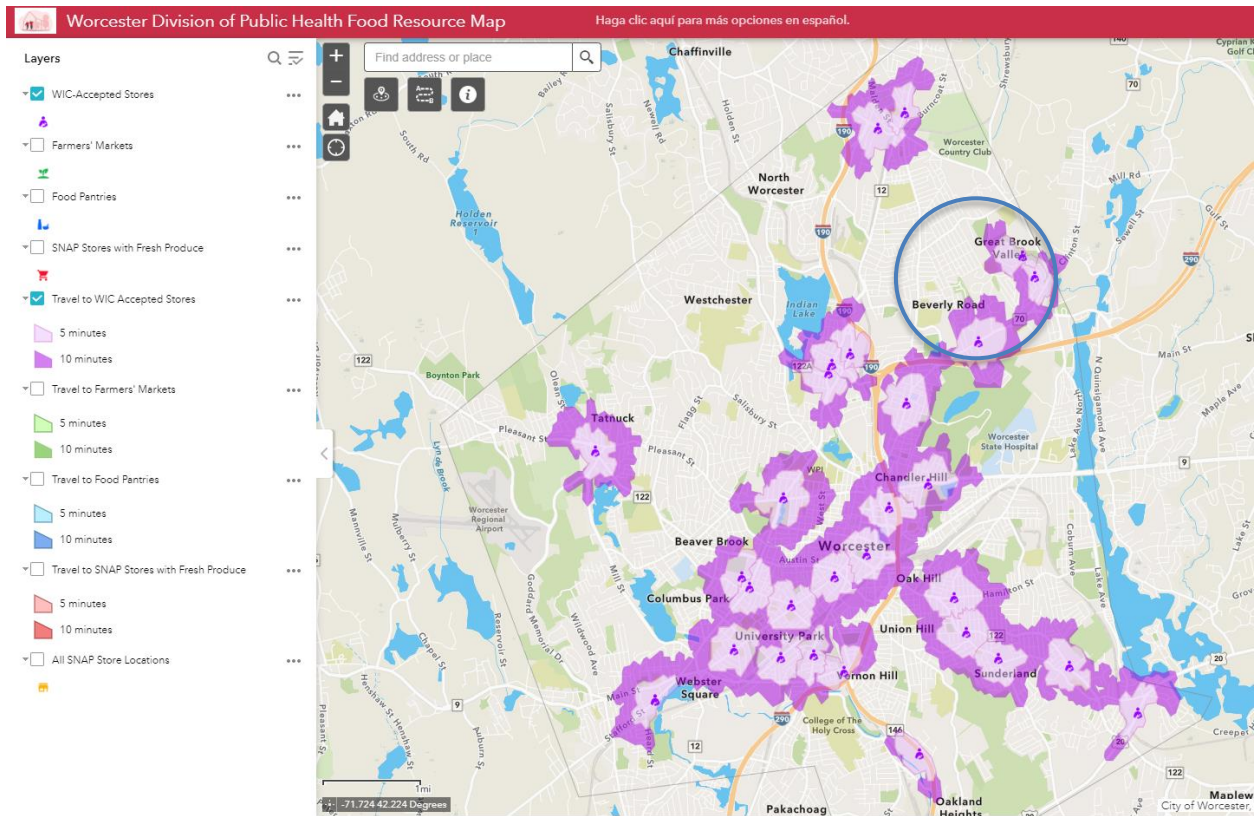
Figure 18. WIC-approved locations with walkability times via web application
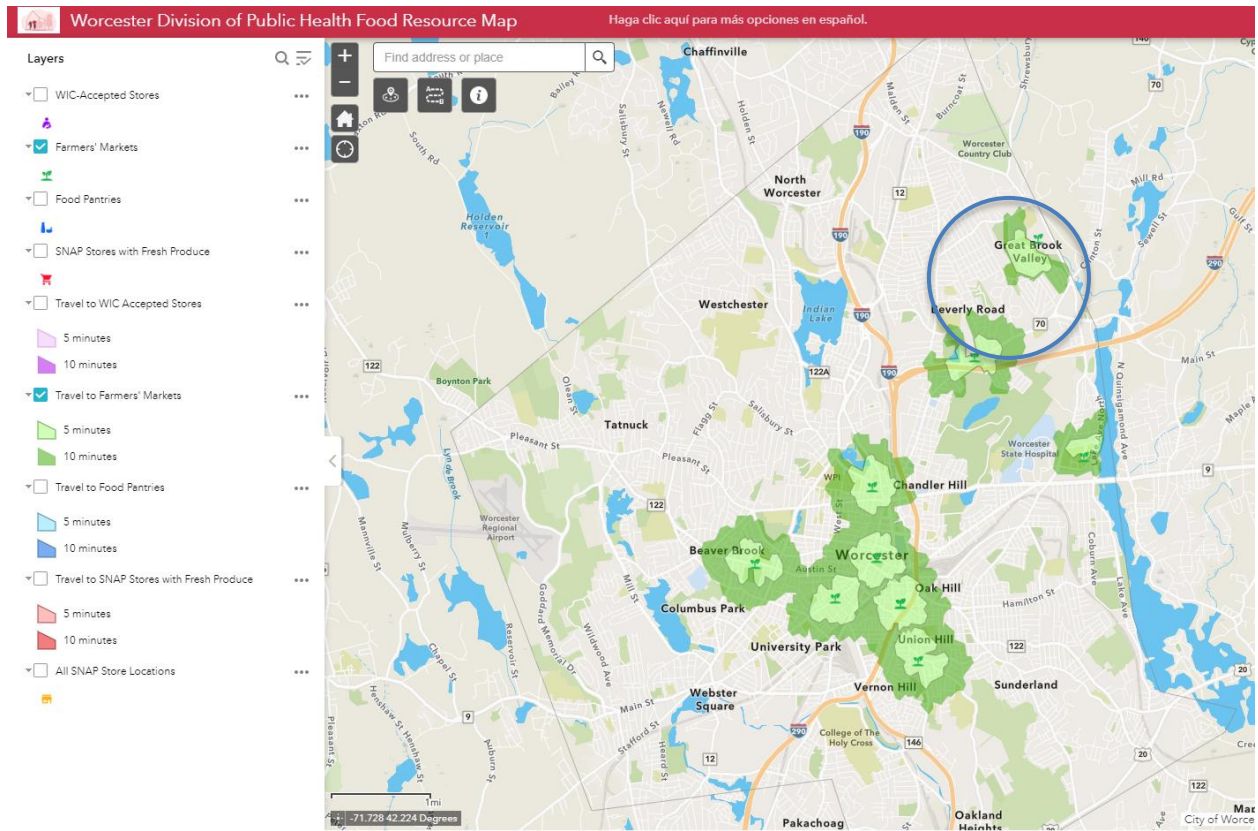
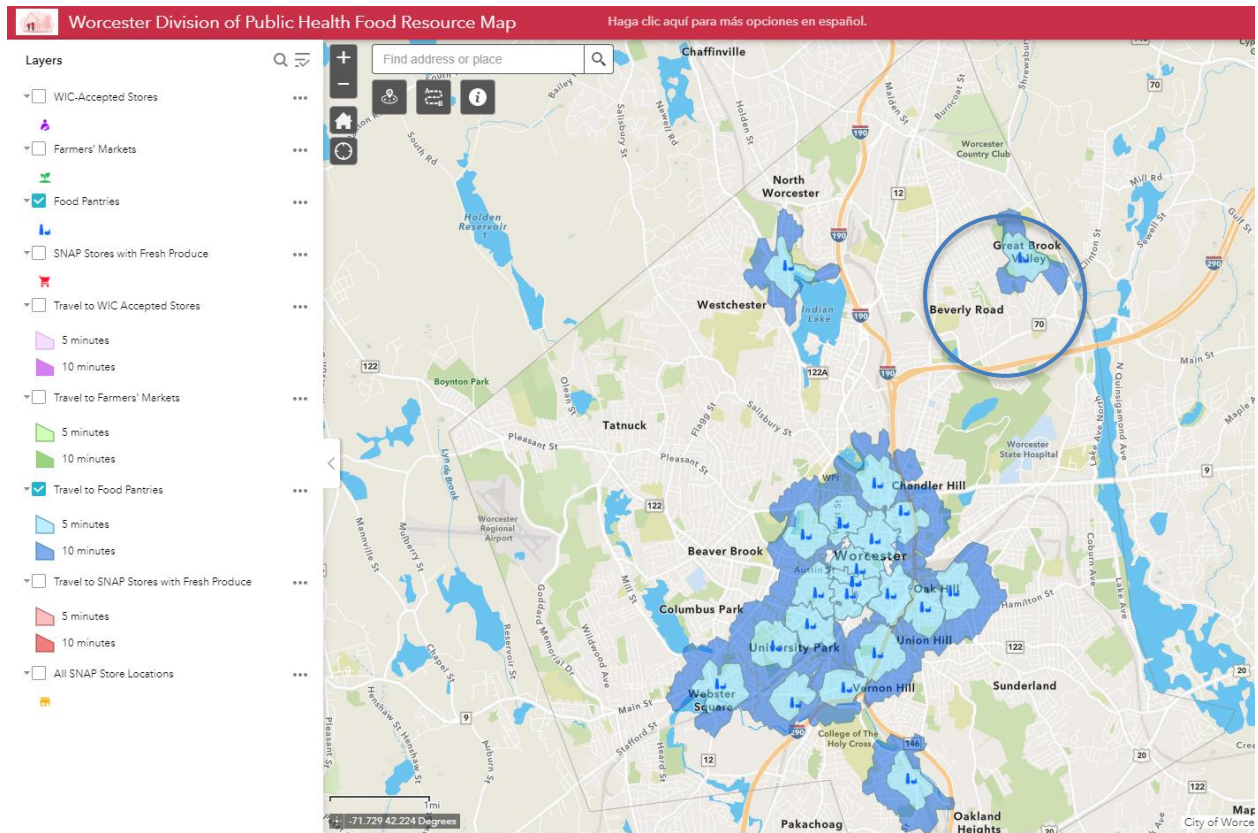Figure 19. Farmers' market locations with walkability times via web application

Figure 20. Food pantry locations with walkability times via web application
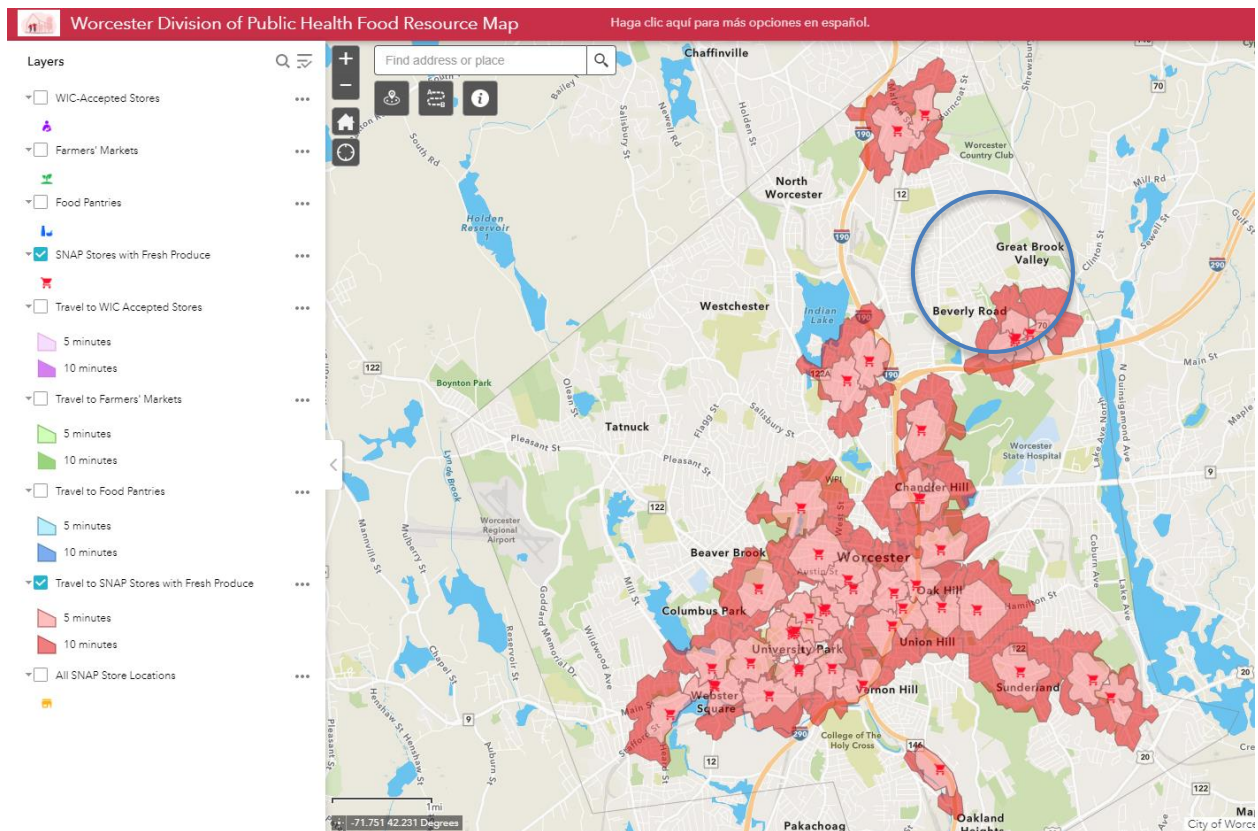
Figure 21. SNAP store with fresh produce locations with walkability times via web application

These walkability maps provide useful information for the general public as well as the Worcester DPH regarding which nutritional and physical resources are within 5- and 10-minute walking times closest to them. A web application with all these resources was also created to make these findings more intuitive for the general population. This application uses real-time traffic information and demonstrates how this affects walk-time to healthy food choices for those census tracts farthest from the urban center. There is also an option for the user of the web service to find their location on the map automatically and use the directions widget to find directions to nearby resources by driving or walking. This web application informs the public of resources close to them and allows them to quickly and easily take advantage of those in proximity.

4.3 Testing the Nutrition Web Application by Members of the Worcester Community

The user-friendliness of the web application was analyzed through public testing. This resulted in 7 individuals completing the survey and 1 of these individuals meeting with the team

over Zoom to give additional feedback. There were two main difficulties the group faced with testing including, a high no response rate and small sample size. The no response rate was 96.5%. This high no response rate is likely due to the current crisis situation because of COVID-19. As well, the small sample size made it so that the results did not accurately represent the population and, therefore, no generalizations or assumptions could be made. The sample population ended up being 71% Latino individuals, with a variety of ages ranging from 13-60, two parents participated and 5 of the 7 different regions in Worcester were represented by the population. This variety in individuals was a good representation of the target audience for the application.

The majority of the tasks which were asked of the test participants were able to be completed. The first task of locating a SNAP resource and its address had a 100% success rate with 43% of the individuals being able to complete this task in under 2 minutes. The next task used the find my location feature to locate a food pantry near you had a 71% sucess rate, with two individuals unable to complete this task. The average time it took individuals to complete this was 2-5 minutes. The third task was to use the walkability feature and figure out if they resided within 10 minutes' walk time of a farmers market. This task, similar to that of the previous question, had a 71% success rate. With this task, however, the average time was not as obvious and spread out from under 2 minutes to 7 minutes. The final task was to use the directions feature to get directions from your current location to a WIC location. This task had an 86% success rate and had the most diversity between the time it took individuals to complete the task. For this activity, each time to complete the task was represented by at least one individual making this the most unpredictable of the tasks. All of the graphs and specific results for this testing can be seen below in Figure 22.
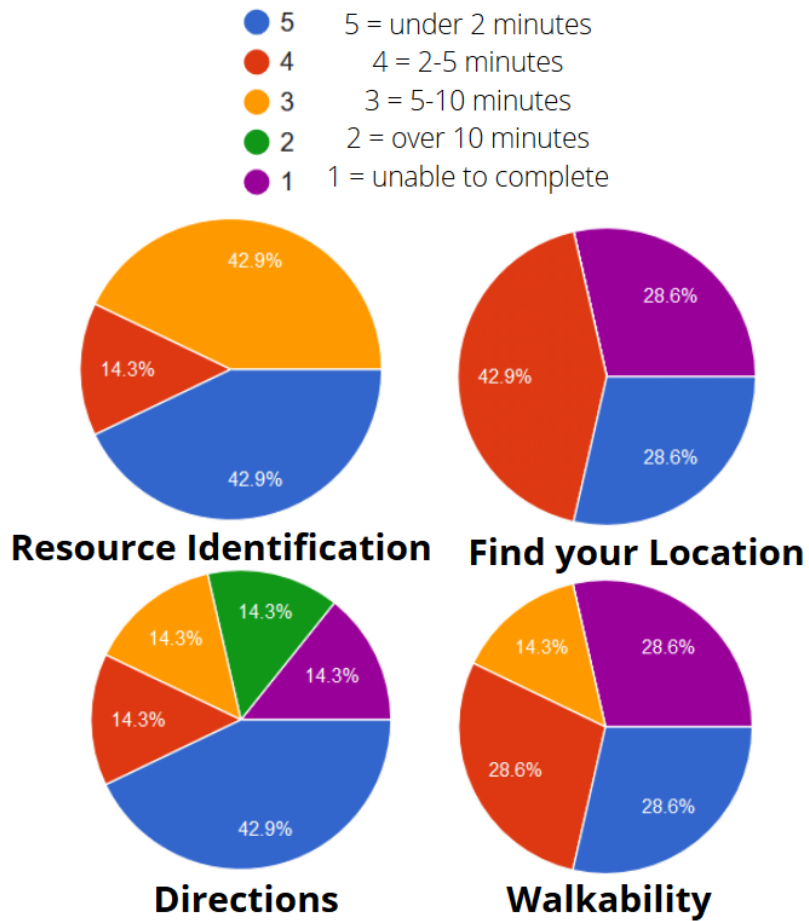
Figure 22. The results from testing the Nutrition Website Application throughout the Worcester Community

In addition to collecting these results, the team was also able to receive generalized open response feedback. Some of the feedback included positive visual appearance, difficulty to use, language barrier issues, slow performance and overall usefulness of application. Through the Zoom calls, we were able to get more information and insight from individuals on their experience using the application. This feedback was that the application was not intuitive, adding a tutorial video would benefit the users and adding the layers to the side bar would help with accessibility. Based on this feedback, it is evident that more work needs to be done to the application to reach its full potential, but it is a step in the right direction for improving access to all individuals.

5.0 Conclusions and Recommendations

The findings reveal that Latino communities of Worcester do not have equal access to the necessary healthy food and physical activity resources. The purpose of our project was to demonstrate where Latino populations in Worcester lack resources and provide the required information in order to implement change in the future. To combat these health disparities, we worked with the city of Worcester's DPH to identify where these gaps are located. Our first method was to create interactive resource maps detailing the locations of all physical activity and nutrition resources within Worcester. Our second method was to map economic and ethnic demographics of Worcester as well as the location of nutrition and physical activity resources to identify key areas of least access. The main takeaway from our project was that the most disadvantaged community had the highest number of Latinos and the least number of resources. The findings reveal that the problem within the downtown Latino census tracts is socioeconomic inaccessibility and a lack of community awareness of public resources present in the area. However, in the northeastern census tract in Great Brook Valley shows that in isolated areas outside of urban centers, there is an obvious scarcity of resources in the area.

Based on these findings, we advise that our sponsors recommend the expansion of the number of grocery stores that sell fresh produce, accept SNAP, and are within a comfortable walking distance of Worcester's isolated Latino communities including the Great Brook Valley census tract. We also recommend that after subsequent testing and revision, our web applications be used by the Worcester DPH to promote public awareness of stores available through public service announcements, events, and community outreach. An increased number of nutrition and physical activity resources within walking distance should be implemented to promote healthy and active lifestyles. In the future, further research should be conducted to expand on the web application by introducing other mapping for other public resources such as schools and transportation. Additionally, future research can expand the extent of community surveying in order to better assess the accuracy of the application as the demographics of Worcester shift over time. These different research methods will prove invaluable to diminishing health disparities experienced by the Latino communities of Worcester.

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Appendices

Appendix A: Google Survey for Testing Nutrition Web Application

The Google survey for testing of nutrition website application to be completed by individuals in the Worcester community. Below is a screenshot of the survey as well as a link to the full Google survey.

https://docs.google.com/forms/d/e/1FAIpQLSfbjz9XYHeP3YP0iUy5xmJKJgVty1P-4eeuhmiA8CoytbID_Q/viewform

Appendix B: Keywords for Latino Identification

Encoded keywords used to identify "Latino" populace of Worcester census tracts:

"mexican   puerto_rican   cuban   dominican   central_american   costa_rican   guatemalan
honduran   nicaraguan   panamanian   salvadoran   other_central_american   south_american
argentinean   bolivian   chilean   colombian   ecuadorian   paraguayan   peruvian   uruguayan
venezuelan   brazilian   other_south_american   other_hispanic_or_latino   spaniard   spanish
spanish_american   all_other_hispanic_or_latino"

Appendix C: Latino Population Rate Density Map Web Application

https://w-p-i.maps.arcgis.com/apps/EmbedMinimal/index.html?appid=255e2031df514c219e34de442ff3fb6a
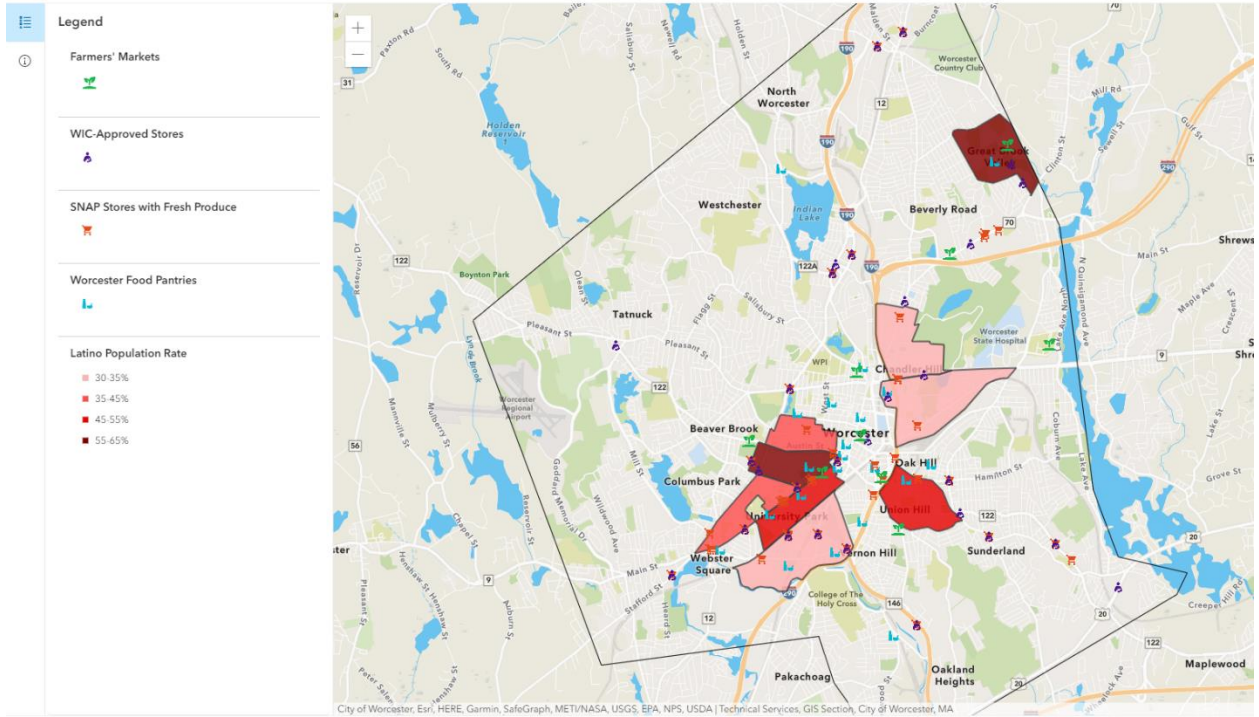
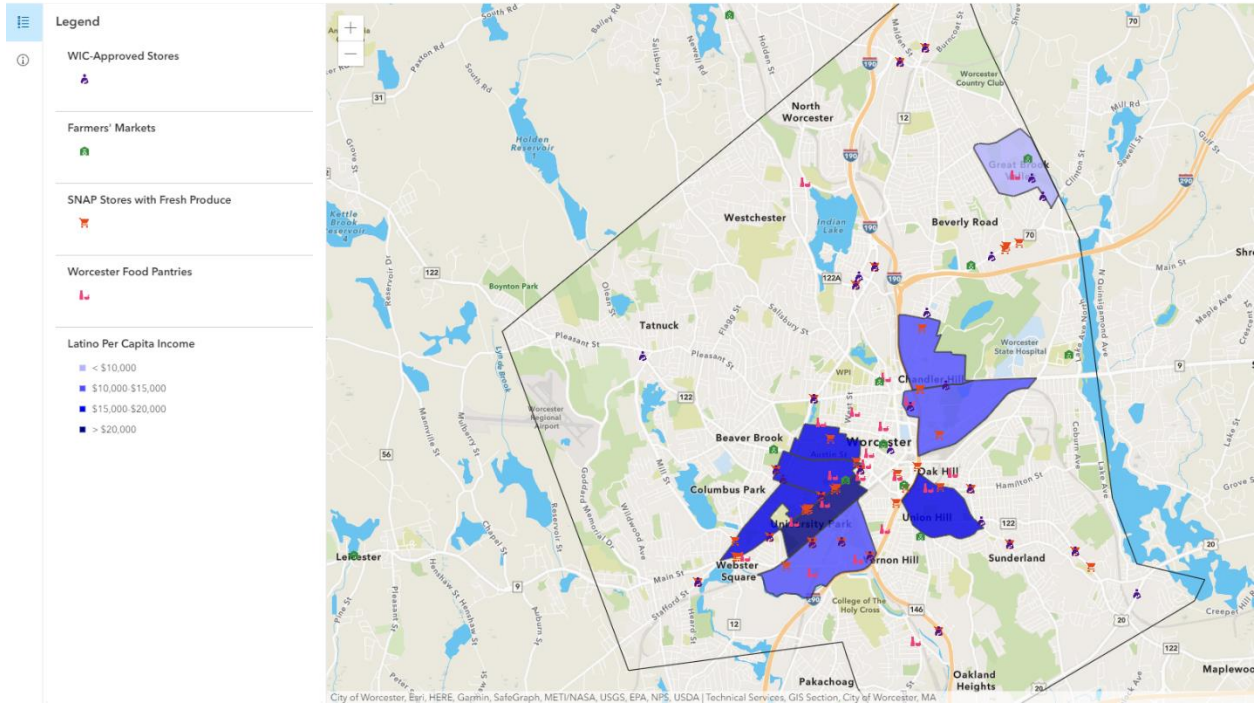# Appendix D: Latino Poverty Rate Density Map Web Application

Worcester Food Resource Map Based on Latino Poverty Rate (Map Only)

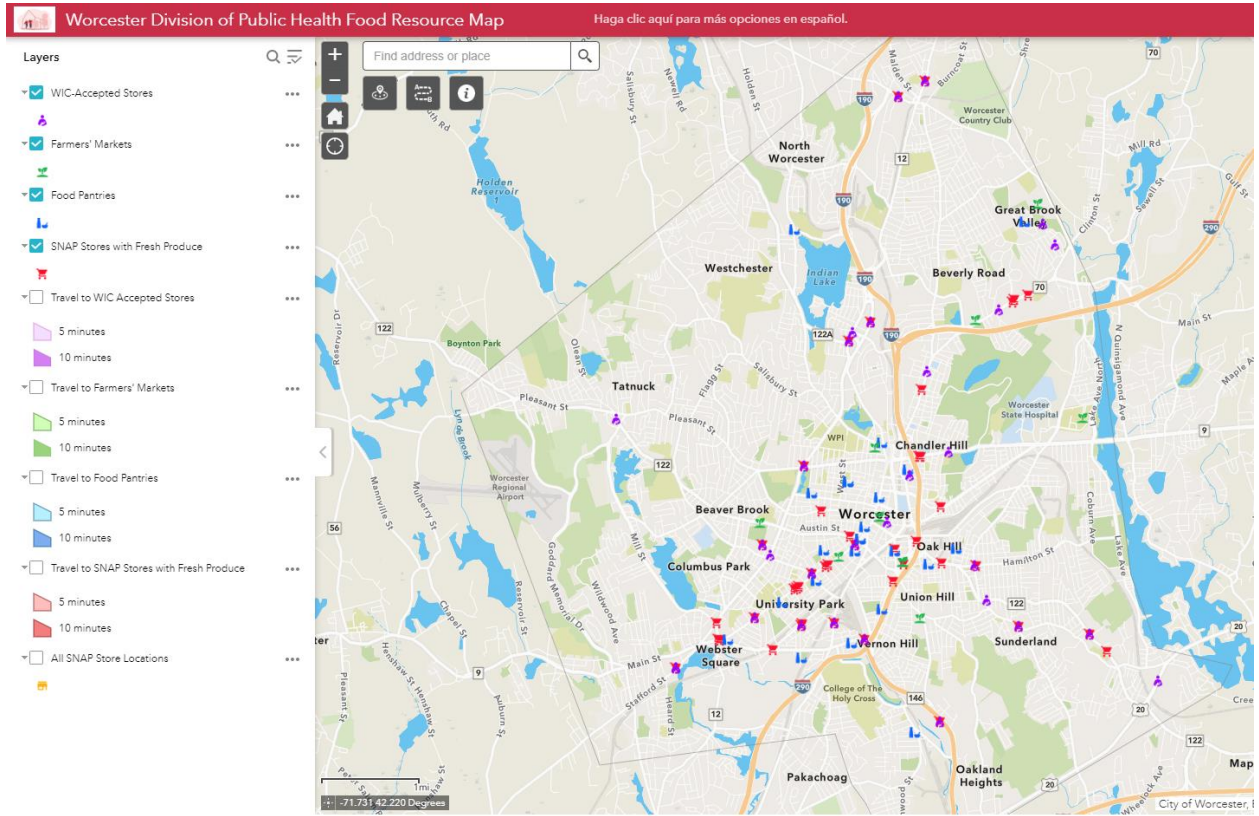https://w-p-i.maps.arcgis.com/apps/EmbedMinimal/index.html?appid=d7e1dd7d30a447999e533320e9a91ccf
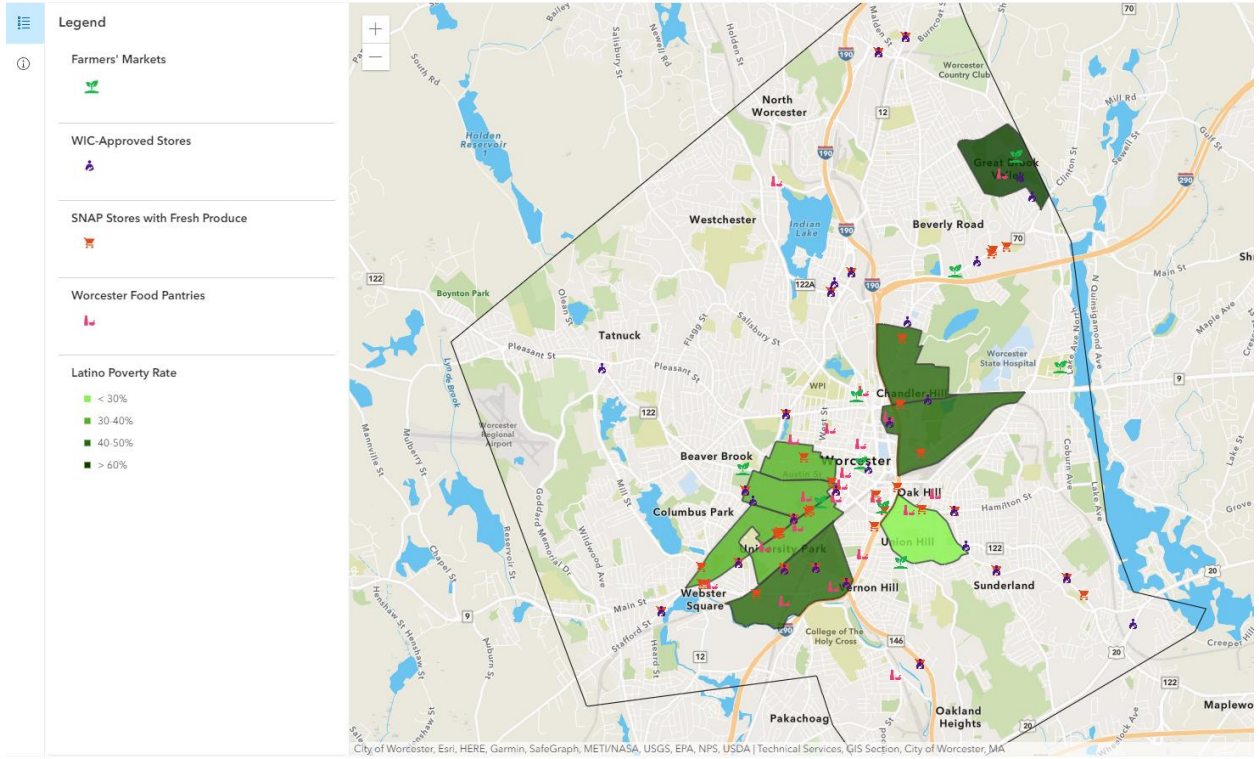
Appendix E: Latino Per Capita Income Density Map Web Application

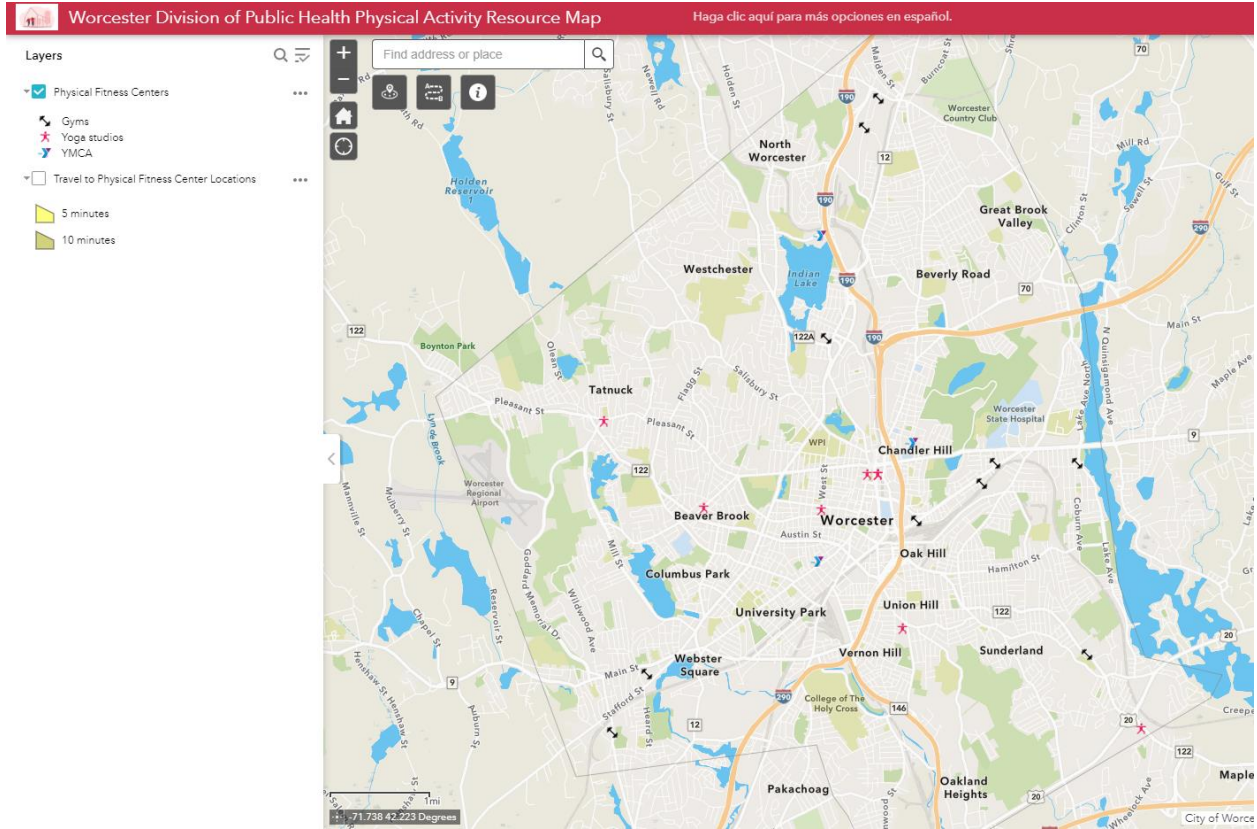Worcester Food Resource Map Based on Latino Per Capita Income

https://w-p-i.maps.arcgis.com/apps/EmbedMinimal/index.html?appid=88521058438f4df3bf45e7ae324d559e

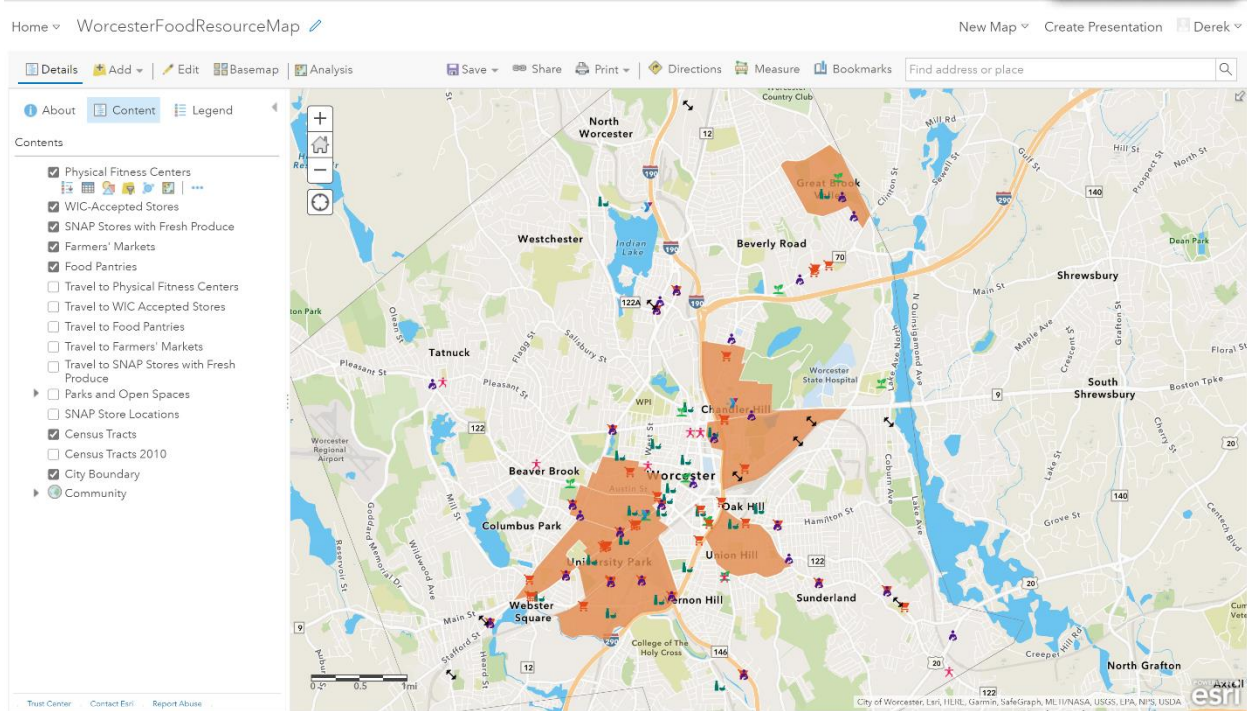**Appendix F: Worcester Nutritional Resource Web Application**

https://w-p-i.maps.arcgis.com/apps/webappviewer/index.html?id=cf8c140c4a7248b5a7a5f8029033caae

Appendix G: Worcester Physical Activity Center Web Application

https://w-p-i.maps.arcgis.com/apps/webappviewer/index.html?id=42feb9bc8ca44273b8301a2d2b8877fc

Appendix H: DPH Internal-facing map

https://w-p-

i.maps.arcgis.com/home/webmap/viewer.html?webmap=9383153bfc7a491086d262595578112a