Measuring park accessibility for pedestrian in Manhattan, Kansas

by

Ali Alahmary

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Major Professor
Gregory L. Newmark

Abstract

Here in Manhattan, some areas do not qualify for pedestrian users. It implies that the people who live in those areas do not have an equal opportunity to access the parks around them. Most of the park accessibility measurements do not consider the quality of the trip or the walking trip as a major factor for measuring accessibility to public amenities. In this research, we measure the quality of park distribution for pedestrian use in Manhattan, KS. The methodology of the study uses three variables to measure the park distribution: the number of opportunities (Parks) within cut off distance of 800m, the quality of the parks, and the quality of the walking trip to the parks based on the existence of the sidewalk in the city. These variables test the hypotheses: If the people (race, age, and homeownership) of Manhattan, KS have difficulty accessing all parks by walking, then it showed a lack of efficiency of the parks' distribution for pedestrians. The results showed that the difference between the racial groups is very low in terms of accessibility, which indicates a low degree of inequity. For the homeownership groups, the difference between the groups has shown an advantage for the renter group in all the accessibility measurements. For the age groups, the result in all the accessibility measurements favored the age group of 5 to 19 years old. Overall the results show that the differences between groups are statistically significant, but still small in term of equity.

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Dedication

To my best friend, Hamzah Altheeban.

Thanks, Grandad!

Chapter 1 - Introduction

In every community, there are common needs that should be provided by the government such as safety, health, and physical infrastructure. These needs are for all types of people in the community; meaning everyone should be treated equally in being allotted a healthy community (Martin, 2011). Therefore, the planners and the government must use their tools and their experiences to assure that their people will have equal access to the same opportunities.

Accessibility measurements are one of the planner's useful tools that measure the disparity on equity in a particular community. It measures the accessibility to the amenities in a city. The objective is to identify what are the areas that lack equitable access. The variation of both the input and the desired outputs are the main reason for the different types of accessibility measurements (Wee & Geurs, 2011). Two classification techniques used to assess the accessibility to public services include Place-based measures and People-based measures (Neutens, Schwanen, Witlox, & De Maeyer, 2010a). Place-based method is commonly used. They are applied to measure the accessibility through the minimum travel time, the number of services in a particular area, and the network distance (Song, 2012; Talen, 1997). In this research, we will focus on place-based measures to evaluate the social equity of the park distribution.

Few studies researched the social equity of park distribution. In terms of outputs, some of the reviews focused on measuring the accessibility to the park among different socio-economic groups (So, 2016; Talen, 1997). Other focused on how many people, in general, have equitable access to green spaces (Maria, Alice, Stefano, & Matina, 2016; Sotoudehnia & Comber, 2011).

The first study showed that 82% of Amsterdam's Population has access within 750m from the entrance of the park corresponding to a time of 15 minutes walking at 3 Km/h. (Maria et al., 2016). The second study showed that 15% of Leicester's Population has an access within 300 m which determine by GIS-based network analysis (Sotoudehnia & Comber, 2011)

The block group is the most widely used sample in the studies done on cities in the United States. However, there are rare researches based on a small scale assessment, such as an individual's house (Sotoudehnia & Comber, 2011). Most of the studies used the network analysis technique to calculate the distance between the residential areas and the parks (Kaczynski et al., 2016; So, 2016; Talen, 1997). Even though this method seems more likely agreeable to be applied to most of the studies, there are small differences in the standards that it uses. Examples are the average distance of a half of one a mile from the residential areas and the nearest park, and the size of the parks (Nicholls, 2001). Also, there is only one study that used the quality of the park as a significant standard to study the social equity of the park (Kaczynski et al., 2016). The study measured the quality of the park by using Community Park Audit Tool (CPAT) (Besenyi et al., 2016).

In this paper, the accessibility to the park will be evaluated by using an accessibility measurement that calculates the number of opportunities (Parks) within the cut off distance of 800m. The project will contribute to the field by using two standards as significant factors to assess the accessibility to parks, the quality of the parks, and the quality of the walking trip to the parks. To calculate the quality of parks, each park will get a value from one to five, where five indicates a park with full amenities. For the quality of the walking trip, the longer a person spends walking on the street to the park the lower the value of accessibility. Due to the scale of the study area, we use the census blocks as sample study which been hardly used before. The results will then be applied to three different demographic groups race, age, and type of tenure.

Chapter 2 - Literature Review

Equity:

Early in the 20th century and until today, the sustainability term has been essential. It is set as a primary goal, and it influences the governments' orientation around the world. The United Nations World committee on environment and development defined sustainability as "the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs" (“Home—2018—United Nations Sustainable Development,” 2018).

One of the three elements that complete the sustainability triangle besides the economy and ecology is equity (Barbier, 1987; Basiago, 1998). According to the Cambridge Academic Content Dictionary, the meaning of equity is equal treatment and fairness (“EQUITY | meaning in the Cambridge English Dictionary,” 2019). One of the terms prominent under equity is "social equity." In the world of planning, social equity means making sure that every community is given fair treatment and accorded a uniform chance to take part in the formulation of plans and the decision-making process (Martin, 2011). Equity in transportation is defined as the fairness of the distribution of the benefits of movement among different socioeconomic groups (Venter, Jennings, Hidalgo, & Pineda, 2018). Equity in the transportation field is further broken down into two definitions, horizontal equity, and vertical equity. The horizontal equity is the distribution of the transportation benefits between people without favoring one group over others; we focus on the spatial distribution of the services on offer, notwithstanding the social groups (Maliwa, 2019). On the other hand, the vertical equity deals with compensating the disparity if the delivery of the transportation benefits between groups which improve the inability of access for the group with more significant needs (Baas, 2019). There are two aspects of vertical equity, and the first one focuses on the inequalities based on the income class among different social groups, whereas the other one is based on the disparities between the transportation abilities and needs (Litman, 2019).

Accessibility:

Accessibility is one of the four dimensions that complete equity besides affordability, health, and safety (McCahill, 2015). Accessibility is how simple one can reach opportunities such as activities, services, goods, and meaningful locations (Litman, 2019). Also, "the potential of interactions and exchanges can define accessibility" (Miller, 2018). For example, access to food can be provided by the grocery store. The internet and the library can enable information access. The airports, roads, and paths allow access to numerous places. There are various meanings and usage for the word accessibility or access. More commonly, in people's minds, transportation describes physical access to opportunities. But in geography and urban economy, accessibility means the relative distance between an origin and destination (Litman, 2019). Finally, in social planning, accessibility means the ability to reach opportunities among the different social groups (Litman, 2019).

Accessibility components:

According to wan Wee, B. van, Geurs, & Emmanuel, the four elements of accessibility are transportation, land use, individual, and temporal components. The aspect of land-use deals with the spatial distribution of land usage, which is the demand of the opportunities represented as the origin (residential areas) and the supply as the destination (jobs) (Maliwa, 2019; Wee &

Geurs, 2011).The transportation component "expressed as the disutility experienced by an individual when covering the distance between an origin and a destination" (Wee & Geurs, 2011), which disutility represents the travel time, cost, and the level of comfort. The individual components describe the personal socio-economic characteristics that influence the individual access chances such as opportunities (personal travel budget and income), abilities (transport mode availability and physical condition), and needs (depending on the level of education, age and income). Finally, the temporal components reflect the time constraints on the origin and the destination, with the origin represented by the individual schedule and the destination designated by the availability of the opportunities at a different time (Maliwa, 2019). Accessibility measurements combine two or more components that several papers have used before which we will discuss next.

Accessibility Measurements:

Many researchers classified the accessibility measurements using different criteria; each criterion has a special arrangement for the accessibility measurements. There are many similarities and differences between each criterion. Song discusses that accessibility measures extents from "simple proximity measures in mathematically and theoretically complex ways" (Song, 2012). He arranged the accessibility measurements in three groups: Simple proximity measures, Gravity model, and Utility-Based Model and Activity Based Model. First, simple proximity measures include intuitive and straightforward methods to determine closeness to the target points such as minimum distance method, covering objectives method, and minimizing travel cost method (Talen, 1997, 2003). The minimum distance method calculates the minimum distance to the nearest opportunity. The covering objectives method calculates the opportunities in a specific area. The minimizing travel costs method calculates the average distance between the origin and the destination. The second group has one accessibility measurement, which is the gravity model. In Song's criteria, the gravity model represents the middle level in complexity between the three groups and is based on two factors: the destination characteristics (attraction factors) such as the size of the service, and distance (friction factors) (Chang & Liao, 2011; Dalvi & Martin, 1976; Pacione, 1989). The final group includes Activity-Based Model and Utility-Based Model, which consider the personal choice as a significant factor for choosing a destination (Handy & Niemeier, 1997).

Other authors categorize the measures of accessibility into two groups, which are people-based and Place-based measures (Neutens, Schwanen, Witlox, & De Maeyer, 2010b). The Place-based measures deal with the distance between the service location (destination) and the servant location (origin). It contains four methods: gravity model, minimum distance method, objectives covering technique, and minimizing travel cost method. On the other hand, People-based measures focus on the servant activity schedule and the service space-time constraints. There are six methods which are the number of accessible opportunities in DPPA (NUM), the weighted sum of accessible opportunities in DPPA (NUMD), the length of accessible network in DPPA (DUR), Maximum utility of opportunities in DPPA (BMAX), the expected maximum utility of opportunities in DPPA(BTRANS), and Aggregated utility of opportunities in DPPA (BAGG) (Berechman, 1981; Carlstein, Parkes, & Thrift, 1978; Kwan, 1998). DPPA is the daily potential path area.

Furthermore, other researchers suggested four approaches for accessibility measures based and they range from infrastructure-based measures, activity-based measure/location-based measures, utility-based measures, and person-based measures (Maliwa, 2019; Wee & Geurs, 2011)First, infrastructure-based measure analysis the network infrastructure by measuring the travel impedance and travel congestion of the road network. Second, Activity-based measures/location-based measures calculate the accessibility level of a location to the available activity in a certain time, and it includes cumulative/contour opportunity measure, potential measure, and competition-based measure. Cumulative-opportunity calculates the number of opportunities on the specified cost of travel (e.g., time, distance) (Ben-Akiva, 1979). In contrast, the potential measure/gravity measure does not consider all opportunities equal in access, but it depends on its attractiveness. Such as the size of the facility (Geertman & Eck, 1995). Competition-based measures consider the competitive factors between the opportunities in which the origin represents the demand, and the destination represents the supply(Cheng & Bertolini, 2013). Thirdly, utility-based measures analysis the accessibility on the basis of how individuals perceived different travel options (Ben-Akiva, 1979). Finally, Person-based measures/Space-time measures consider the temporal and spatial aspects of individuals. "i.e., the time available for an individual to participate in an activity is considered as a constraint" (Maliwa, 2019)

Jihoon's classification for accessibility measures centers on the complexity of the data (Song, 2012). At the same time, Geurs and van Wee arrangement have the same structure but are divided into four groups. On the other hand, Neutens and Schwanen's classification is based on the existing of the individual behavior data, where they assembled the accessibility measures if it includes individuals' actions or not in two groups.

Accessibility measures classifications depend on the arrangement of the accessibility component, which relies on the researcher's theoretical perspective. Moreover, the selection of accessibility measures is subjective and relies on data availability and research objectives (Maliwa, 2019). In some cases, the differences between the studies are based on the variables of the accessibility measures such as distance, travelling time, the size of the destination, the quality of the service, etc. The research will illustrate these differences based on the studies that measure the accessibility to the parks which the current project focuses on.

Case studies:

Previous studies done in the United States have measured the walkable distance to the nearest park. These studies documented that the reasonable walking distance to the nearest park is from 0.25 miles to 1 mile (Kaczynski et al., 2016; Miyake, Maroko, Grady, Maantay, & Arno, 2010; So, 2016), although in some cases, it reached 2 miles (So, 2016). On the other hand, some other previous studies done outside the United States chose the walkable distance to the nearest park from 0.2 miles to 0.4 miles (Halkia et al., 2016). The big difference between the two standards shows that European countries have higher standards than the United States. There are two techniques used to identify the walking distance from the nearest park. Firstly, Euclidean analysis measures the distance between two points by a straight line ("Understanding Euclidean distance analysis—Help | ArcGIS Desktop," n.d.). One of the previous studies used this technique by GIS by making a buffer of one mile around the place of residence to calculate how many people have access to the green spaces with a buffer of one mile (Kaczynski et al., 2016). Secondly, there is the network analysis which measures access to the green spaces based on the road network around the green space. It calculates the shortest route or the given distance on the road network from the resident's places to the green areas (So, 2016).

Previous research tried to assess the environmental justice implications of access to a park across ethnic and racial groupings. It studied which socioeconomic group has the highest and lowest accessibility to public parks (Miyake et al., 2010). The study used GIS to identify the socioeconomic group on the scale of block, and the network analysis is then used to demonstrate which of the groups has high access to the public parks in their area (Miyake et al., 2010).

One of the studies used new variables, including two of the variables that were mentioned before: the quality of the park and the number of the parks. The study identifies the quality of the park by six composite variables which are park access amenities, park facilities, essential park amenities, park aesthetic features, park quality concerns, and neighborhood quality concerns (Kaczynski et al., 2016). A standardized sub-score 0-100 was created (with the latter two variables reverse-coded) for each one of these variables and then averaged to determine the park quality index for each park (0-100). Each participant's An average park quality index (0-100) was then computed depending on the parks within 1 mile. (Kaczynski et al., 2016)

The vast majority of the research done on the environmental implications of park access did not analyze the quality of the road network. Transportation infrastructure is an essential tool that the urban planner can use to provide a higher standard of social equity to the community. Provision of easily accessible and equitably distributed transportation services that cater to all the urban residents without considering ability, age, or income counts is not equitable. Also, they ensure the equitable distribution of all the park benefits and burdens. The study used the quality of the transportation infrastructure, which is expressed by whether or not the sidewalk exists and, the quality of the parks in conjunction with the other variables to measure the accessibility to the public parks in Manhattan, KS.

Chapter 3 - Methodology

Study Area:

Manhattan, Kansas located in the scenic Flint Hills of northeastern Kansas at the junction of the Big Blue and Kansas rivers, the seat of Riley County. It is famous for its name the "Little Apple". Manhattan is situated 56 miles west of Topeka, 85 miles west of Lawrence, and 120 miles west of Kansas City. The city has two known establishments; Kansas State University and the Fort Riley Army Base. Also, two colleges located here are Manhattan Area Technical College and Manhattan Christian College. The total population of Manhattan is 52,281 people, and it has 26 different public parks (“Manhattan, KS - Official Website | Official Website,” 2019).

Data Collection:

The city of Manhattan provided the data shapefile of the parks and the street network. The study used the park that was classified as a park in data acquired from the city of Manhattan, Kansas. The research also excluded open spaces areas, cemetery, fields for sports use only, and streetscape. The blocks shapefile were downloaded through the TIGER/Line Shapefiles database provided by the U.S. Census Bureau (2010). Three types of socioeconomic groups, race, age, and homeownership were also considered. The race comprised of two groups white and non-whites. For the age, the study classified age into five groups: below five years old, 5-14; 15-20; 21-66, and above 66 years old. Finally, the homeownership groups were divided into two groups: owners and renters. The data for the economic and demographic census blocks of Manhattan KS 2010, were downloaded from the U.S. Census Bureau.

Data Analysis:

The current study focuses on computing the accessibility to the parks in two phases. The first phase will be computed by the use of GIS mapping accessibility scores. The maps do not show any demographic or economic characteristics. In the second phase, the accessibility to the parks for different socioeconomic groups such as race, age, and homeownership will be computed.

The Mapping Accessibility Score:

The study calculated the accessibility to the parks in three phases. First, the number of opportunities within a specified cutoff distance of 800m will be calculated (So, 2016). According to the survey by The Trust for Public Land on the 50 biggest cities in the US, just 14 of them have the aim of maximizing the distance that a resident ought to live from his/her closest park. In all the 14 of them, the standard length ranges from at least one-eighth of a mile to a mile. The most ordinary distance in Cleveland, Colorado Springs, Columbus, Ohio, Nashville, and Phoenix is 800m (Harnik & Simms, 2004). So, we chose the 800m distance to be the maximum distance to the nearest park. The census block centroid will be used as the origin and the entrance of the public park as the destination. Each block gets a value that is based on the number of opportunities (parks) that block can access within 800m on the street network. Also, each park gets a score of 1, and this means that if a block has access to 3 parks, the total scores is 3. Additionally, the study classified access to the parks in five categories (excellent, very good, good, fair, poor), a high score for a given census block indicates greater access. Poor access means no access. Fair means access to 1 park. Good access means access to two parks. Very good access means access to three parks. Excellent access means access to four parks. We used the natural break to categories access to five classifications.

The second phase uses the quality of the parks variable to calculate the accessibility. To begin with, the research weighed the quality of the parks by assessing the park services. Five park facilities that were measured include restrooms, playgrounds, shelters, path trail, and pedestrian entrance. The weight of each facility, if it existed in the park, was assigned 1 point, and if it did not exist, it was awarded 0 points, as shown in figure 1. So, the highest rating park gets five points, and the lowest gets zero. The accessibility was measured by calculating the number of weighted opportunities within the specified cutoff distance of 800m. If the census blocks have accessibility to two parks, it got two points. However, in the second accessibility measure, the park's quality was considered. It means that if the census block has access to two parks and the first park rating is four and the second park rating was three, the census block gets seven points. Additionally, the study classified access to the parks in five categories (excellent, very good, good, fair, poor), a high score for a given census block indicates greater access. Poor access means no access. Fair Access means the bloke's access value starts from 1 to 3 . Good access means the bloke's access value starts from 4 to 6. Very good access means the bloke's access value starts from 7 to 9. Excellent access means the bloke's access value starts from 10 to 13.

In the third phase, the quality of the walking trip for each block that got access to the park calculated. The quality evaluated based on the existing sidewalk. Then we are going to identify the road for the walking trip by the minimum distance approach, which is used to calculate the minimum distance from the centroid census block to the nearest park entrance(Song, 2012; Talen, 2003). After identifying the walk trip -route, we will value the quality of each block by how much a person spends walking on the street. In other words, the longer a person spends walking on the street to the park, the lower the value of accessibility will be. In this phase, we are not going to conclude the number of opportunities and the quality of the park.

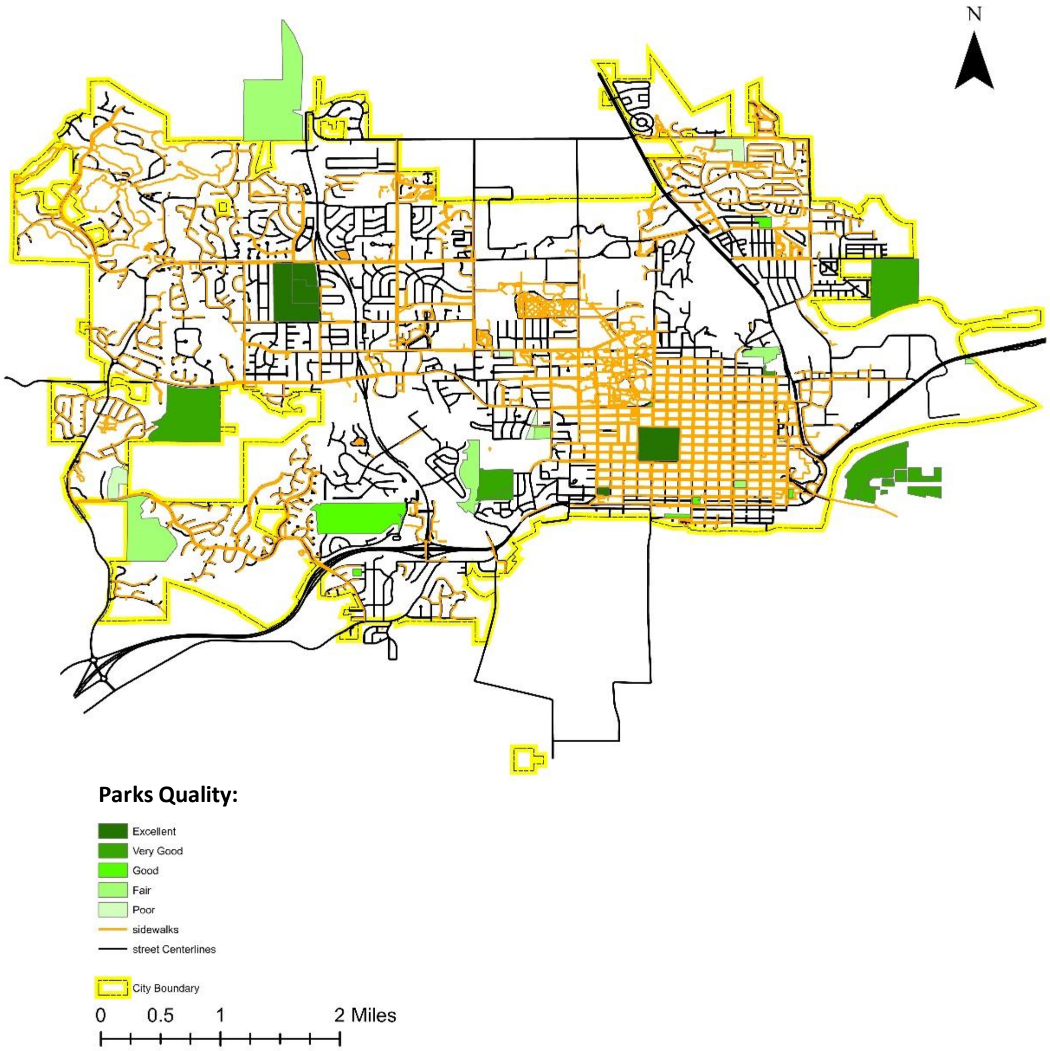

Figure 1 Street Networks & Parks Quality

Demographic Data Analysis:

The study used the results of the quality of park accessibility map, the quality of park accessibility like the park quality, and the quality of the walking trip to the nearest park map to compare three categories of socioeconomic groups race, age, and homeownership. In relation to the quality of park accessibility, the socioeconomic characteristics will be compared by giving each person a score. The lowest score is 0, and it implies that there is no access while the highest is four, and it means that the person can access four parks. Then we use data sets of people and their scores to calculate the averages for each socioeconomic group in order to compare them. The same process applies to the quality of park accessibility, including the quality of the park map. The only difference is the score of people. The lowest score is 0, and the highest is 13, and this shows that the total number of the park quality that a person can access. Finally, for the quality of the walking trip, the longer a person spends walking on the street to the park indicates lower access. The value is based on the amount of distance on the street. Then, the data sets of people and their amount of distance on the street are used to calculate the average distance for each socioeconomic group and in comparing them.

Chapter 4 - Findings

The Mapping Accessibility Score:

The Quality of Accessibility:

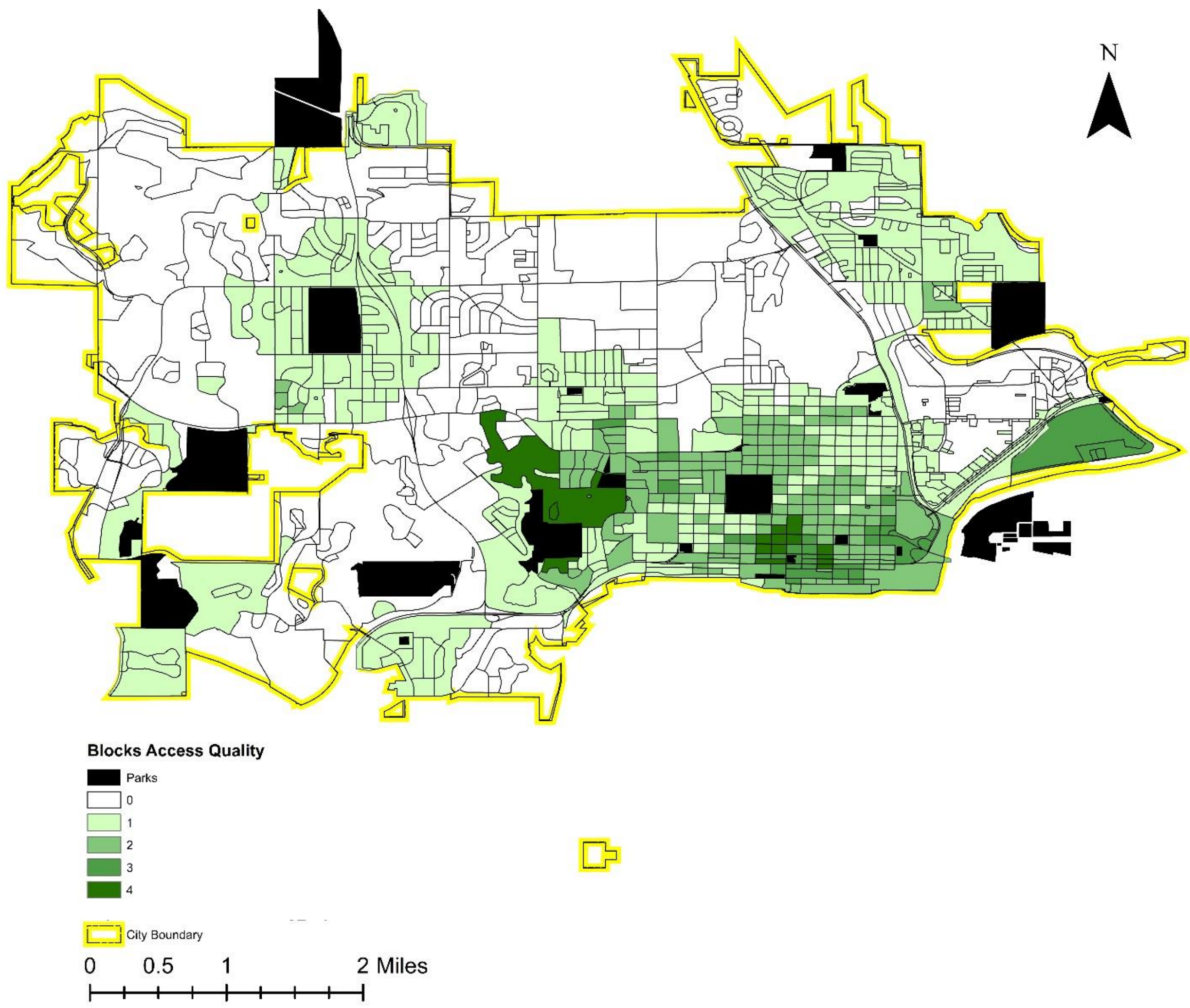

Figure 2 Blocks Access Quality

The figure shows the accessibility score to the park for each census block that got access to at least one park in the study area. The ratings started from 0 to 4. 0 represented the blocks with no access and 4 the highest block accessibility to the parks. The darkest color represents the blocks with the highest accessibility on the map. Each number represents the number of parks that are accessible for each block in a specified cutoff distance of 800m. This means that the census blocks that got a score of 3 had access to three parks, as shown in Figure 2. The map doesn't show any demographic or economic characteristics.

The Quality of Accessibility Including the Parks Quality Factor:

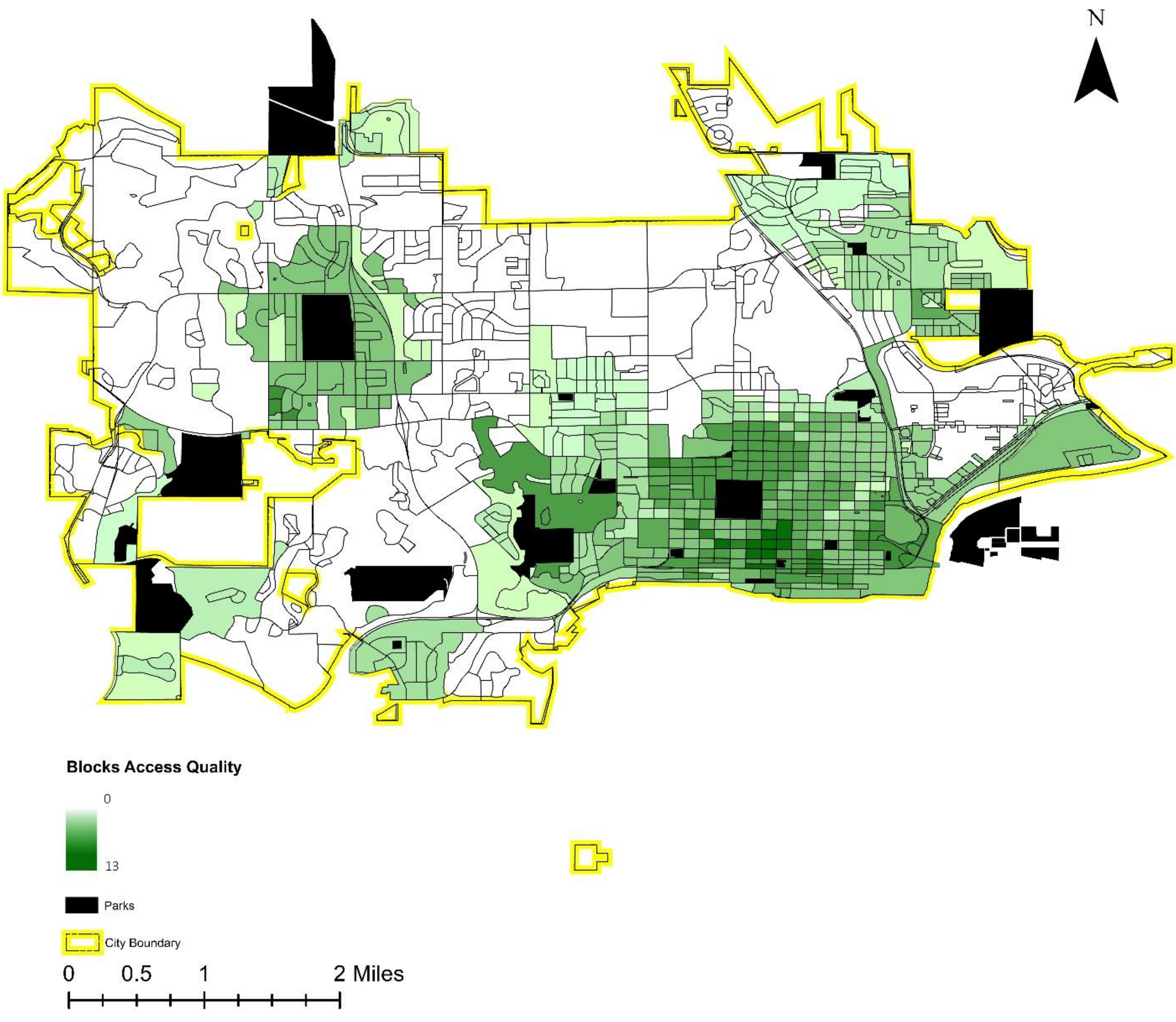

Figure 3 Blocks Accessibility Including Parks Quality

The second map shows the accessibility score for each census block after including the park quality. The ratings started from 0 to 13. 0 represented the blocks with no access and 13 the highest block accessibility to the parks. The scores represent the sum of the park quality that is accessible within a specified cutoff distance of 800m from each census block. For example, if the census block has access to two parks and the first park rating is 4 and the second park rating is 3, the census block will get 7 points shown in Figure 3.

The Quality of the Walking Trip:

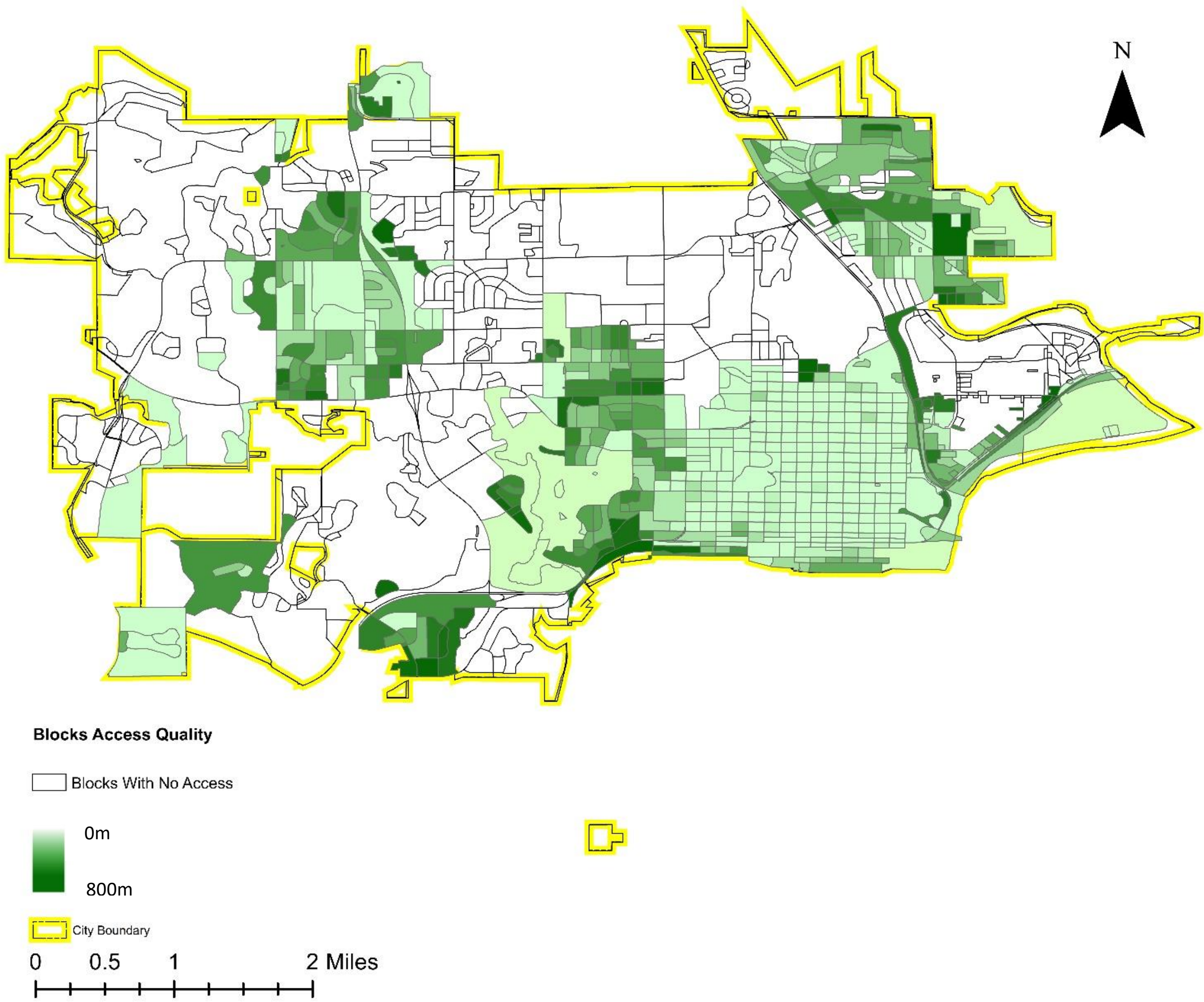

Figure 4 The Quality of the Walking Trip

In the third map, we computed the quality of the walking trip for all blocks that got access to the parks. The longer a person spends walking on the street to the park indicates lower access. The value is based on the amount of distance on the street. The light-colored blocks represent a low amount of walking on the street, and the dark-colored blocks represent the highest amount of walking on the street shown in Figure 4.

Demographic Data Analysis:

Total Population Analysis:

TABLE 1 Blocks Access Quality for Total Population

	Excellent	Very Good	Good	Fair	Poor
Blocks Access Quality					
Number of people	754	672	8557	23098	20698
percentage	1%	1%	16%	43%	38%
Blocks Access Quality Including Parks Quality					
Number of people	530	6363	9886	16302	20698
percentage	1%	12%	18%	30%	38%

Generally, the maps show a large number of blocks don't have any accessible park, but that didn't reflect in the demographic data. The majority of people have access to the parks within 800m shown in Figure 5. In table 1, 38% of Manhattan's people don't have access to the park within walking distance of 800m. 43% have access to one park, and 16% have access to two parks, while 2% have access to three parks or more, as shown in Table 1. The results of measuring the accessibility, including the park quality, show little changes in the results. 38% percent of people have poor quality access to the park, and this means they don't have access. 30% have fair quality access, which means that their access value is 1 while 3.18% have good quality access, which means they got access value ranging from 4 to 6. 12% have very good access, which means they got access value ranging from 7 to 9. Finally, the last 3% have an excellent access quality, which means they got access value ranging from 10 to 13shown in Table 1. The next Table will show the differences between different socioeconomic groups.

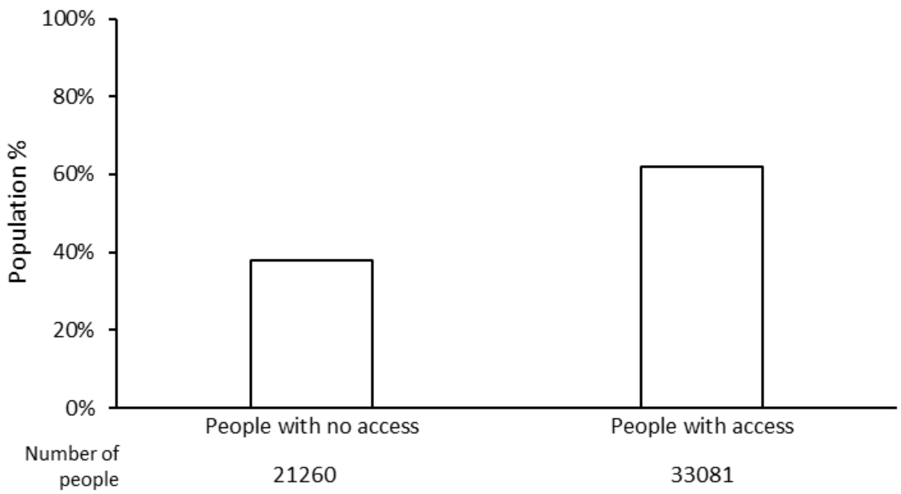

FIGURE 5 Blocks Access to the Parks (Total Population)

Socioeconomic Groups Analysis:

TABLE 2 The Average Score for Accessibility Measurements

		Blocks Access Quality		
		Average Score	Standard Deviation	n=
Race	White alone	0.852	0.822	44993
	Non-White	0.769	0.835	8786
Tenure in Occupied Units	Owner occupied	0.734	0.783	20297
	Renter occupied	0. 945	0. 859	27255
Age	Under 5	0.724	0.765	3021
	Age from 5-17	0.699	0.757	5349
	Age from 18-24	0.944	0.836	20559
	Age from 25-66	0.816	0.815	21260
	Age above 66	0.673	0.885	3590

		Blocks Access Quality Including Parks Quality		
		Average Score	Standard Deviation	n=
Race	White alone	2.594	2.769	44993
	Non-White	2.407	2.843	8786
Tenure in Occupied Units	Owner-occupied	2.308	2.527	20297
	Renter occupied	3.039	3.068	27255
Age	Under 5	2.200	2.200	3021
	Age from 5-17	2.216	2.216	5349
	Age from 18-24	2.730	2.730	20559
	Age from 25-66	2.618	2.618	21260
	Age above 66	2.105	2.105	3590
		Blocks Access Quality (Walking Trip)		
		Average by Meter	Standard Deviation	n=
Race	White alone	184	200.732	44993
	Non-White	193	197.822	8786
Tenure in Occupied Units	Owner-occupied	205	197.366	20297
	Renter occupied	167	209.801	27255
Age	Under 5	222	209.812	3021
	Age from 5-17	117	186.277	5349
	Age from 18-24	111	174.134	20559
	Age from 25-66	118	186.323	21260
	Age above 66	179	201.519	3590

Race:

Blocks Access Quality Results:

We had two groups for the race: White and Non-White. The average score for access to the parks for the white race is 0.852 and the average score for the Non-white is 0.769 shown in Table 2. The difference between the groups is very low, and it shows a low degree of inequity between the two groups. The error bars show that data is significantly different between the two groups shown in Figure 6.

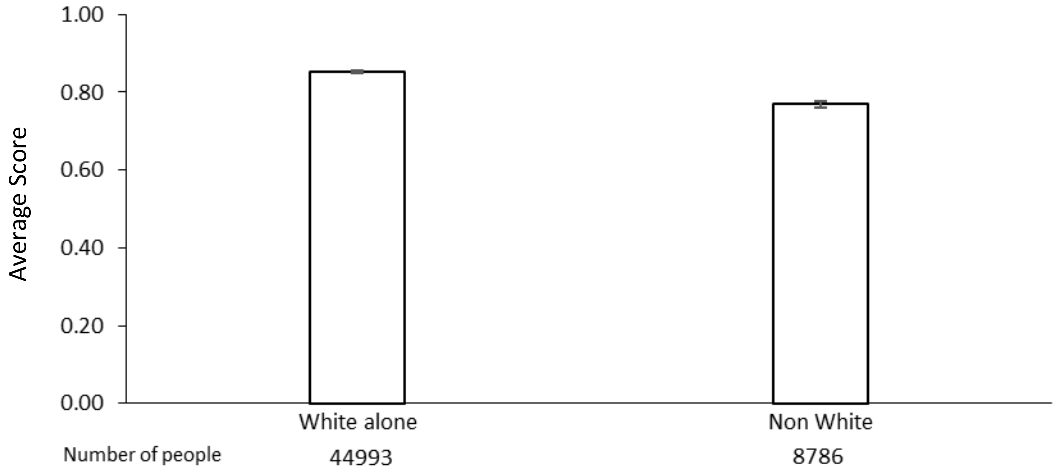

Figure 6 Blocks Access Quality (Race)

Blocks Access Quality Including Parks Quality results:

In relation to the accessibility to the parks the average score for the white race is 2.594, and the average score for the Non-white is 2.407 as shown in Table 2. The difference between the groups is very low, and it shows a low degree of inequity between the two groups. Also, the average score scores are low, and the two groups got a score below three, which indicates poor access. The error bars show that data is significantly different between the two groups shown in Figure 7.

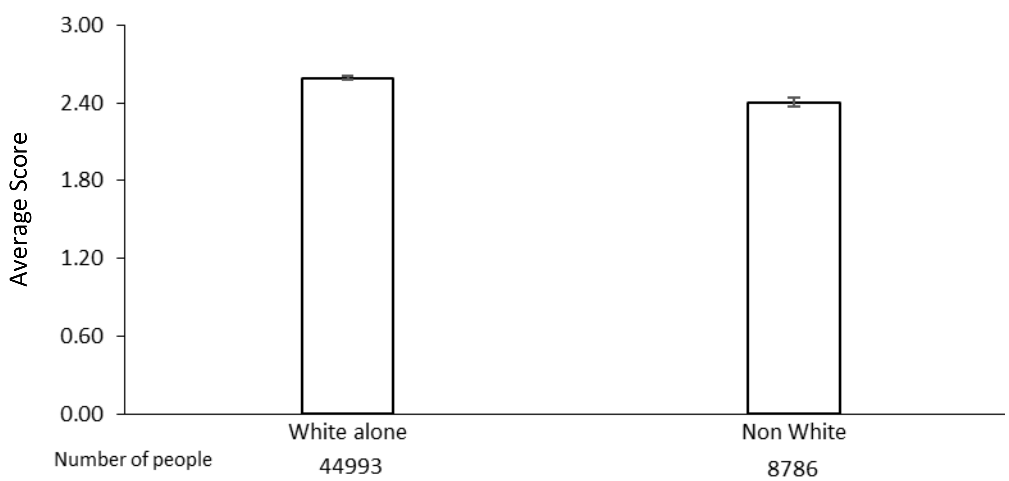

Figure 7 Blocks Access Quality Including Parks Quality (Race)

The Walking Trip Quality:

The average distance of the walking trip on the street to the nearest parks for the white racial group is 184m, and for the Non-white group is 193m, as it is shown in Table 2. The difference between the groups is very low, and it shows a low degree of inequity between the two groups. The error bars show that data is significantly different between the two groups shown in Figure 8.

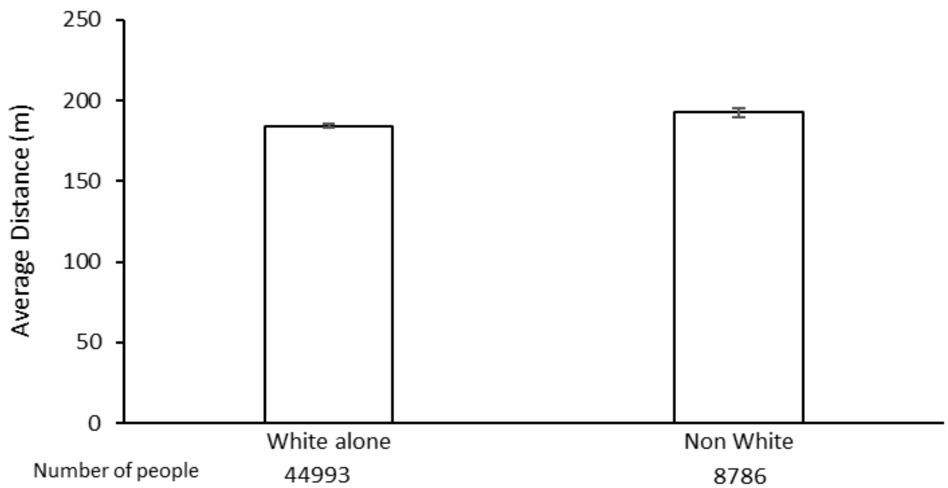

FIGURE 8 The Walking Trip Quality (Race)

Homeownership:

Blocks Access Quality Results:

We had two groups for Homeownership: Renter and Owner. The average score for access to the parks for the renter group is 0. 945, and the average score for the owner is 0.734, as shown in Table 2. The difference between the groups shows an advantage for the renter group, and it indicates a low degree of inequity between the two groups. The error bars show that data is significantly different between the two groups shown in Figure 9.

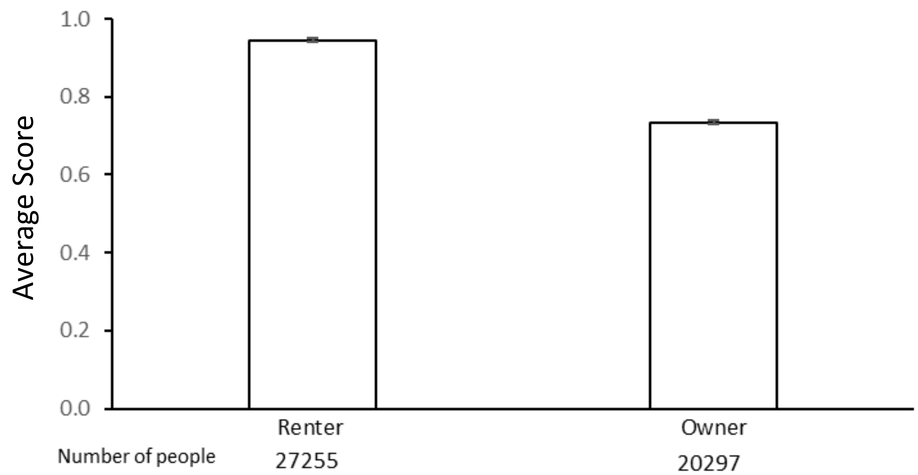

FIGURE 9 Blocks Access Quality (Homeownership)

Blocks Access Quality Including Parks Quality results:

For the accessibility to the parks, including the quality of the parks, the average score for the renter group is 3.039, and the average score for the owner is 2.308, shown in Table 2. The difference between the groups shows an advantage for the renter group, and it indicates a degree of inequity between the two groups. The error bars show that data is significantly different between the two groups shown in Figure 10.

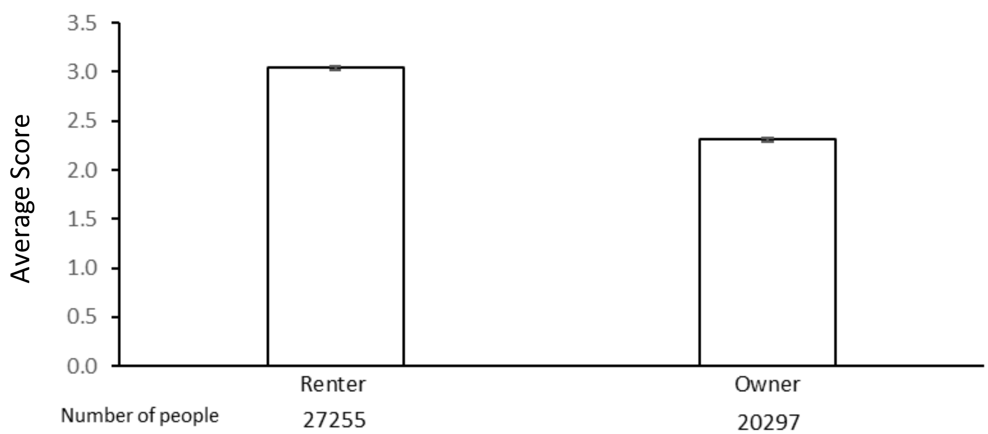

FIGURE 10 Blocks Access Quality Including Parks Quality (Homeownership)

The Walking Trip Quality:

The average distance for the walking trip on the street to the nearest parks for the owner group is 205m, and the renter group is 167m, as shown in Table 2. The difference between the groups shows an advantage for the renter group, and it indicates a degree of inequity between the two groups. The error bars show that data is significantly different between the two groups shown in Figure 11.

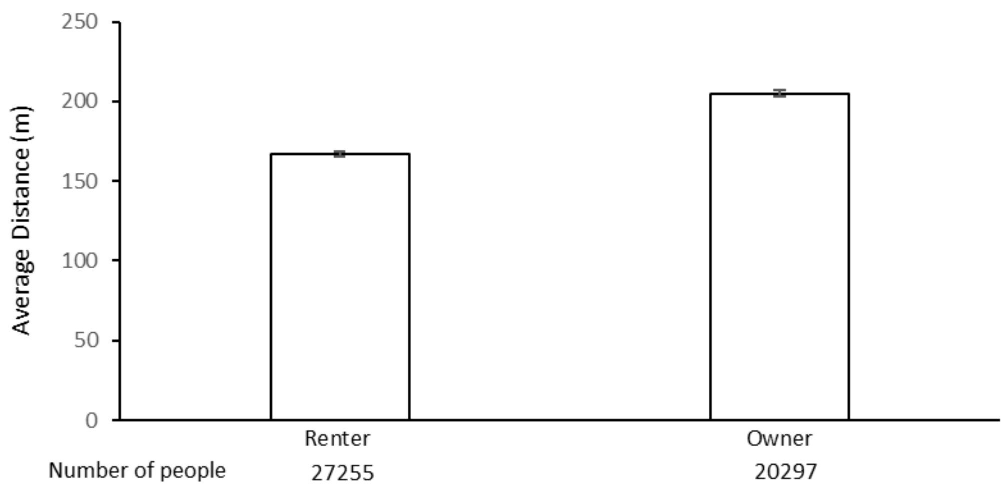

FIGURE 11 The Walking Trip Quality (Homeownership)

Age:

Blocks Access Quality Results:

The average score of the quality of park accessibility for age groups shows that the three groups of (under 5, from 5 to 17, and above 66 years old) got the lowest average scores that ranged from of 0.673 to 0.724. On the other hand, the group of 25 to 66 years old got 0.816, and the highest average score of 0.944 was the group of 18 to 24 years old shown in Table 2. The results show a disadvantage for elderly people and children. The error bars show that data is significantly different between the age groups shown in Figure 12.

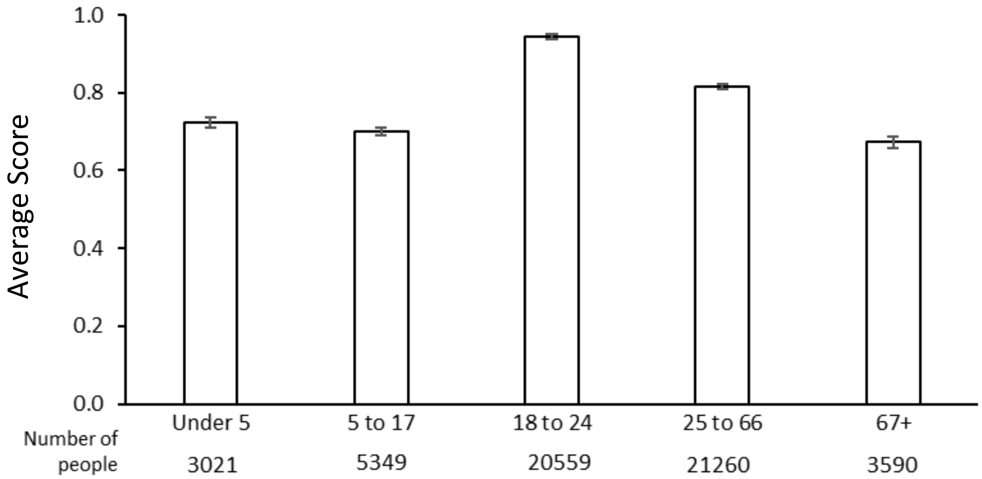

FIGURE 12 Blocks Access Quality (Age)

Blocks Access Quality Including Parks Quality Results:

For the accessibility to the parks, including the quality of the parks, the average score for age groups shows that the average scores for three groups (under 5, 5-17, and above 66 years old) ranged from 2.105 to 2.216. On the other hand, the group with the highest average score of 2.730 was the group that comprised of individuals between the age of 18 to 24 years old, as shown in Table 2. The results show an advantage for the group from 20 to 39 in relation to access to high-quality parks. The error bars show that data is significantly different between the age groups shown in Figure 13.

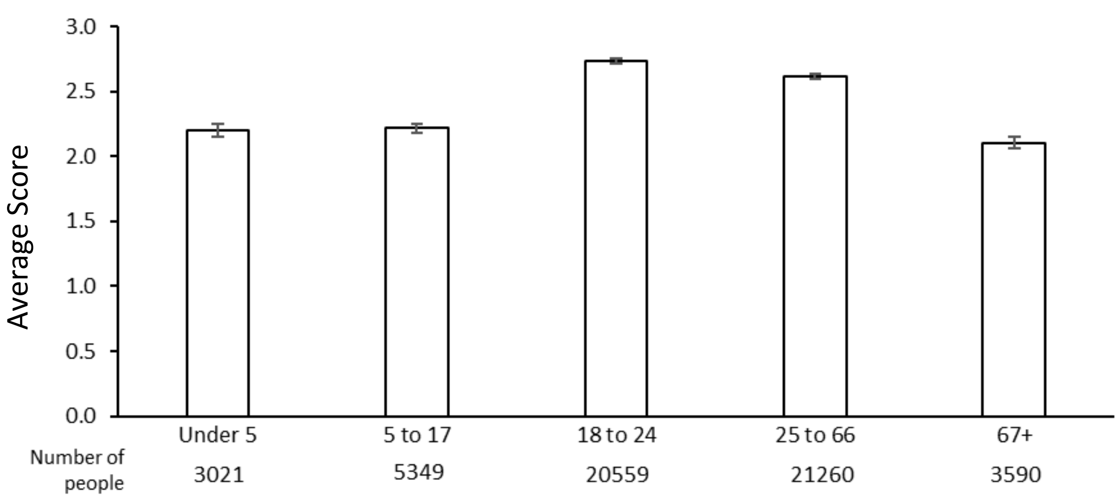

FIGURE 13 Blocks Access Quality Including Parks Quality (Age)

The Walking Trip Quality:

The average distance for the walking trip on the street to the nearest parks for people under 5 years old is 222m, which is the highest average among the other group. Then, the average distance decline to 179 m for the people above age 66 years old. The averages score for age groups shows that the scores for three groups (5-17, 18 to 24, and 25 to 66 years old) ranged from 111m to 118m. The results show a disadvantage for those under 5 years old, and an indication of inequity between children and adults. The error bars show that data is significantly different between the age groups shown in Figure 14.

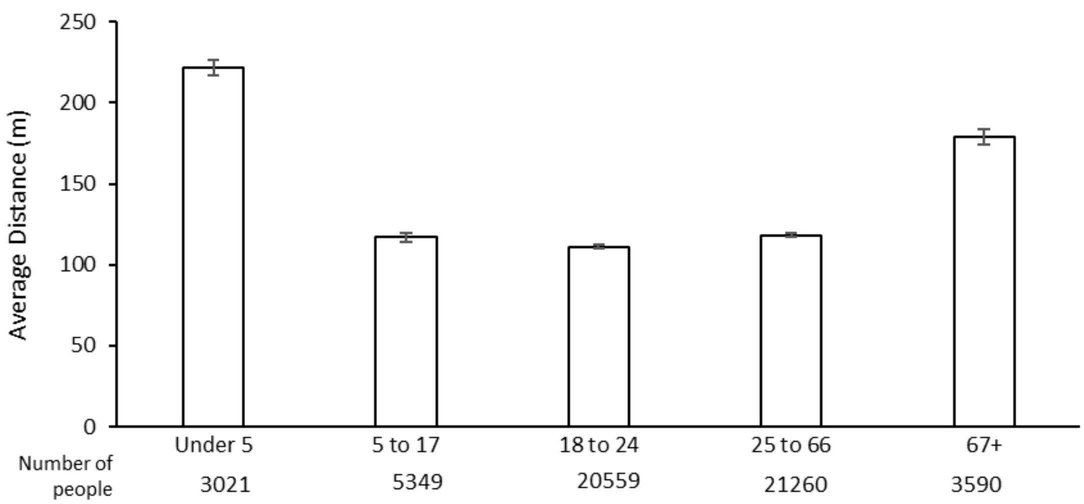

FIGURE 14 The Walking Trip Quality (Age)

Chapter 5 - Conclusion and Limitation

Conclusion:

In Manhattan, KS there are many areas that don't have sidewalks, which will affect walking experience to the daily amenities needs. So, the study considered the quality of the trip or the walking trip as a major factor for measuring accessibility to public amenities. The current study has measured the accessibility to the parks by using accessibility measurements that calculate the number and the quality of opportunities (Parks) within cut off distance of 800m. Then, it has used the existence of the sidewalk as an indicator to value the quality of the walking trip for blocks that got access. We used the average score to indicate the equity differences between three groups (race, age, and homeownership). The results showed that the difference between the race groups is very low in terms of accessibility, which indicates a low degree of inequity. For the homeownership groups, the difference between the groups has shown an advantage for the renter group in all the accessibility measurements. For the age groups, the result in all the accessibility measurements favored the age group of 18 to 24 years old. Overall the results show that the differences between groups are statistically significant, but still small in term of equity.

Limitation:

Firstly, the data we got from the census bureau for Manhattan, Kansas doesn't have a variety of information, especially for census blocks. So, we couldn't study the equity differences between income classes and other socio-economic groups characteristics. Secondly, for the quality of the trip, we couldn't measure the walkability by studying the quality of the sidewalk. We wanted to have many factors instead of using one factor which is the existence of the sidewalk. Because of the lack of time and resources we could not achieve that.

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