HIGH SCHOOL EDITION
Journal of Student Research
Volume 12 Issue 3 (2023)

The Association Between Walkability, Zoning Codes, and Neighborhood Wealth in Bergen County, NJ

Matthew Song

Bergen County Technical High School

ABSTRACT

Walkability is the measure of how friendly an area is to walking, and is important due to the multiple economic, social, environmental, and health-related benefits of walkable communities. A wealth of literature exists on its impacts; however, a gap remains in its association with income levels and the zoning laws which affect it. A correlational analysis of multiple factors of towns in Bergen County, NJ, using Pearson's correlation coefficient, found that towns of higher income tended to be less walkable, due to low land use diversity, suggesting that these towns could increase their walkability through the incorporation of different types of land use, most notably, commercial zones. The results of this study could be used to advise the government of Bergen County on future redevelopment and provide valuable information for the creation of zoning laws for new developments in the U.S.

Introduction

Context

Since 1945, Americans have migrated en masse to the suburbs, from suburbs holding 13% of the population before World War II, to over 50% in 2010. Suburban development brought along lifestyle changes such as commuting to work in the city, car dependency, and the single-family homes of the "American Dream" (Nicolaides & Wiese, 2017). While suburbanization brought on benefits such as more affordable housing, and cleaner and quieter communities, it also brought on negative effects such as increased energy consumption, car dependency, and a significant decrease in walkability (National Museum of American History, n.d.). American cities generally developed before 1950 tend to be significantly more walkable than cities developed afterward, due to the rise of the automobile (Steuteville, 2017).

Benefits of Walkability

Walkability is defined as the extent to which the built environment is friendly to people who walk, and it benefits the health of residents and increases the liveability of cities, (Tobin, et al. 2022, p. 2). It is important due to its aid in societal prosperity in multiple areas, including social, economic, environmental, and health benefits. Cities designed for walkability are conducive to "incidental meetings" and "building neighborliness", due to the increase of people out walking on the streets rather than traveling by car. Increased face-to-face interaction reduces social exclusion and fosters a sense of community, as people living near each other are likely to see their neighbors more often, increasing the chances of forming meaningful social connections (Boyce, 2010). Walkable cities experience economic benefits such as accessibility, consumer cost savings, increased local property values, increased employment and tax revenue, compared to areas without walkability improvements. Social and physical mobility is also increased for economically disadvantaged people who cannot afford cars, as this barrier to accessing employment opportunities is reduced (Litman, 2003). Additionally, cars produce pollution, which has both local and global implications. First, air quality in local areas is compromised due to car traffic, as shown by a study in which concentrations of different pollutants and

volume of traffic were measured in different locations, finding that vehicular movement was the major source of pollution in all of the areas studied (Savio, et al., 2022). Pollution emitted by cars in the form of fossil fuels also contributes to the greenhouse gas effect that causes climate change and the warming of the atmosphere, which has a multitude of serious negative environmental impacts around the world (EPA, 2022).

Walkable areas decrease the need to travel and the distance required to drive by car, due to increased proximity, therefore decreasing the amount of pollution created by the people living in these areas. Finally, walkable cities foster improved public health, as a meta-analysis examining ten different scientific papers, including cross-sectional and longitudinal studies, found that most of the results supported the notion that neighborhoods and cities with low walkability are related to higher levels of obesity, and vice versa (Paulo, et al., 2019). The effects of physical inactivity in combination with the issues posed by pollution and compromised air quality point to the significant health issues related to car-centrism. Car-centrism and low walkability is shown to be a problem in the U.S. by a report by the Institute for Transportation and Development Policy. It found that cities in the U.S. tend to be less walkable than other cities around the world, most notably in Europe, with only one American city making the top 25 of any of the three categories used to measure walkability (ITDP, 2020). Therefore, due to the harm caused by car-centrism and the United States' low levels of walkability, it is important that this issue is addressed, and research is conducted on how to improve walkability.

Literature Review

Measurement of Walkability

There is no standard measure for walkability, as it is simply a concept, rather than a strict science. A multitude of walkability studies have determined and examined different indicators, including a 2009 study which was able to operationalize five factors for walkability on the street level: imageability, enclosure, human scale, transparency, complexity. (Ewing & Handy, 2009). These results influenced an empirical study in an urban village in India, in which these factors, along with indices determined by other previous studies, including building orientation and setback, block length, building height and street enclosure, and building scale and variety, were examined. A major result of this study, found through observations, survey questions, and activity mapping, was that shorter block length resulted in people perceiving distances as shorter in a directly proportional relationship, increasing the activity of people on those streets (Singh, 2016). Some additional indices used in a systematic review of observational studies were land-use mix, street connectivity, and residential density. This paper identified a gap in urban planning literature, in that factors such as food access, physical activity facilities, sidewalks, and safety and crime prevention also need to be studied further (Paulo, et. al, 2019).

One final meta-analysis concluded that land use diversity, intersection density (road intersections per sq. km), and the number of destinations within walking distance, including food access, were the factors most strongly related to the rate of walking within communities (Ewing & Cervero, 2010). The methods of measurement that Walk Score® uses to determine walkability include many of the aforementioned indices such as average block length, intersection density, land use diversity, and proximity to destinations such as grocery stores, parks, schools, and restaurants, which are factored, using a patented formula to output a final score on a scale of 0 - 100 (Walk Score®, 2023). The use of factors in the Walk Score®, justified through existing literature, in combination with its widespread use in the field of research and professional real estate, demonstrates the method's credibility, justifying it as an acceptable source of data in this analysis.

Economic Factors

Some popular sources express that walkable areas come with a premium cost of living, with one article from *The Washington Post* stating that walkable areas are higher in rent and purchase price (Starrs, 2014). A different article

from *Vox* describes that walkable cities are often criticized for their high cost of living, and that they risk becoming "playgrounds for wealthy professionals," (Roberts, 2018). The idea of walkable neighborhoods having reduced affordability can be supported by evidence from a study examining 13 American cities along with Toronto, Canada, which found that homes in these cities located within walking distance of amenities such as schools and parks sell for an average of 23.5% more than comparable homes in car-dependent neighborhoods. However, this premium varied greatly on a city-to-city basis, ranging from 30.2% in Atlanta, GA to -.013% in Oakland, CA, demonstrating the importance of evaluating walkability and affordability in a local scope (Katz, 2020).

Other sources disagree with the notion that walkability comes at a premium. One article from the *Congress of New Urbanism* criticizes the common standard of measuring affordability, which only takes into account the percentage of income spent on housing, supporting a more holistic view on affordability, taking transportation costs into account in combination with housing. Through an analysis of the *Center of Neighborhood Technology's* Housing + Transportation Affordability Index, "traditional cities", defined as cities in which the 1950 population was at least 75% of the 2010 population (average Walk Score®: 75, considered "very walkable"), had a cost of living 19% lower than "sprawling cities", defined as cities in which the 1950 population was less than 50% of the 2010 population, (average Walk Score®: 40, considered "car-dependent"). These results suggest that in terms of housing and transportation costs, walkable cities are more affordable (Steuteville, 2017).

The notion of walkable neighborhoods being more affordable is further supported by a 2021 study, which found that geographic units with high income levels generally tended to be less walkable, with the reverse being true for units with lower income levels. It also found that these associations varied considerably by location, further pointing to the importance of evaluation on a local basis. Finally, the conclusion stated that future studies should analyze walkability measures within small geographic areas, and that zoning codes could be one of the most valuable ways to improve walkability in areas that are already developed (Conderino, et al., 2021). These studies demonstrate that the relationship between income, affordability, and walkability is currently contended, representing a need for further research and clarification on this issue.

Zoning Codes

Zoning laws refer to a set of rules and regulations that divide land and dictate how specific areas can be used, and are an integral part of how a neighborhood is designed, and whether it is walkable or not (National Association of Realtors, n.d.). According to a report by the *Institute for Health Research and Policy,* the prioritization of car-movement, which came with the rise of the automobile, has caused widespread single-use zoning, which has contributed to suburban sprawl. Sprawl limits walkability, as single-use zoning often causes different amenities to be too far from each other, exceeding a reasonable walking distance (Chriqui, 2018).

These laws have the ability to make a profound impact on communities, as observed in one study conducted in Los Angeles. In this analysis, 205 blocks were observed in eight neighborhoods with relatively high crime rates, with significant variation in zoning codes between each neighborhood. It was found that mixed commercial and residential zoned areas are associated with lower rates of crime than areas zoned only for commercial use (Anderson, et al., 2013). A possible explanation for this trend is that these types of zones make neighborhoods more walkable, in turn reducing crime rates, however literature on the connection between zoning laws and walkability remains limited.

One of the few studies examining this connection found that mixed use, commercial, multifamily residential, and pedestrian-friendly residential zones increase walkability, while single-family residential zoning decreases it. However, it is described that relatively few studies have addressed the relationship between zoning and walkability, presenting a clear gap in the field of urban planning (Koschinsky, 2018).

Based on the gaps presented, Bergen County, NJ serves as a prime location for analysis. Due to its small geographical area of 638.4 square kilometers, its population of 954,879, and location directly northwest of Manhattan, this analysis could be significantly impactful, due to the importance of examining walkability on a smaller scale, Bergen County's large population, and its proximity to a major city. Additionally, the county is incredibly diverse in

terms of land use, including its airport, state forest, multiple malls, and historical downtown areas, and population, in terms of income. (U.S. Census, 2020). Analyses have been conducted on sidewalk conditions in northern New Jersey (Plascak, et al., 2019) and walking and bicycle routes in central Bergen County (Bergen County Department of Planning & Engineering, 2015), however no critical analysis has been conducted regarding its zoning laws. Despite holding a population of nearly one million people (U.S. Census, 2020), limited walkability research has been done on the county, meaning that a study examining the area could have a substantial impact on a large population. Based on the information gathered and gaps remaining in existing literature, this paper aims to establish the relationship between neighborhood wealth and walkability, using patterns in zoning codes, to explain the existing trends within towns in Bergen County, NJ.

Methods

Data Collection

This study focused on three different factors in relation to each other: median household income, the total area of different zones, and Walk Score®. The data representing these indices was gathered and sorted for each town in Bergen County, using Google Sheets. Median household income data was obtained from the 2020 U.S. Census, as the U.S. Census is a well-known and reputable organization, which directly collects data from each household, yielding accurate data to be used (U.S. Census, 2020). The area of each zone was obtained from the ArcGIS database (ArcGIS Hub, 2023), which was the only existing dataset representing zones in terms of area in a table. Each town had its own zoning map, but it was simply a visual image and did not contain the data regarding the exact area of each zone. The categorizations, locations, and shapes of each zone in this database corresponded accurately with the official zoning maps of the towns, proving its reliability as a dataset. Walkability scores were gathered from the official Walk Score® website, due to the widespread use and reliability of the Walk Score®, as previously mentioned. The methodology used in the scoring is heavily based on the proximity of amenities, which is determined by zones, rendering it an appropriate dataset to examine in this inquiry.

Diversity Index

Land use diversity was one of the major factors of walkability discussed by previous studies, so it was applied to the area of examination in this study, in order to determine its local importance. It was quantified using Simpson's Diversity Index, which was originally created for the purpose of measuring biodiversity of animal species, and has been widely used in scientific literature since its creation in 1949.

The formula for the diversity index is as follows: $D = 1 - (\Sigma n(n-1) \div (N(N-1))$, where n represents the number of individuals of a single species, N represents the number of individuals in the total population, and D represents the value of the diversity index, and $0 \leq D \leq 1$. In this index, 0 represents the maximum level of diversity and 1 represents the minimum level of diversity. This formula can be used to effectively measure the diversity level of land use, as it has been used multiple times to measure land use diversity in past literature. One study used Simpson's Diversity Index to identify patterns within Oklahoma City, and analyzed the results alongside the demographic patterns in the city (Comer & Greene, 2015). A different study used the index to measure the spatiotemporal patterns of land fragmentation in Phoenix and combined the data with social and ecological factors in the area in order to better understand the process of urbanization (Shrestha, et al., 2011).

The Land Use Diversity Index was calculated with the same formula as Simpson's Diversity Index, but replaced n with the percentage of total land area in a town of a single category, and replaced N with the total land area of the town, as a whole.

Zoning Categorization

The land use categories used within the aforementioned application of the Land Use Diversity Index (Comer & Greene, 2015) were as follows: Agricultural/Vacant, Agricultural, Airport, Church, Commercial, Cultural, Education, Entertainment, Exempt, Government, Hospital, Hospitality, Industrial, Mixed Use, OUHSC, Office, Parking, Passive Open Space, Recreation, Residential, Retail, Right-of-way, Rural Residential, Tinker AFB, Utility, Vacant, Other/Unknown.

Category Omission

The following categories were excluded from this analysis: Agricultural/Vacant and Agricultural: there is very limited agricultural activity present in Bergen County, and no single zone dedicated to it; Church: no single town in the county had a zoning category dedicated to churches, as churches are generally included in commercial zones; OUHSC: this zoning category is exclusive to Oklahoma City; Parking: land dedicated to parking was not designated on zoning maps, so all parking space in the county was assigned to the zone it was located in; Right-of-way: this land use was not present as a zoning classification in the dataset; Rural Residential: Bergen County is a relatively urban landscape and does not contain rural residential zoning, and the dataset did not include this as a category; Tinker AFB: this zoning category is exclusive to Oklahoma City; Utility: this was classified in the industrial category, as small areas are generally dedicated to this land use, and did not appear commonly; Vacant: a limited amount of land in Bergen County is vacant, and there was no vacant category included within the dataset.

Zoning Standardization

Zoning laws varied from municipality to municipality, and there was no single standard for zoning categories within the county, so a specific process was used in order to sort the hundreds of different zoning classifications into the 17 listed categories. Each zone has a specific title, so keywords were used as the first step in the sorting process. For example, any zone with a title containing the word “residential” was placed in the “residential category” (i.e. “Multi-family Residential”, “7,500 SF Residential). For zones without explicit keywords, examination was done on what the land was used for in the specific location, then the zones were categorized appropriately (i.e. “Cemetery” → “Passive Open Space”; “Three to Six Family” → “Residential”). Finally, for zones that remained ambiguous, an examination of the specific location using Google Maps GIS data and Google Street View was conducted, in order to determine what the land was being used for, and which category would be most appropriate (i.e. “Tradesman District” → “Commercial”, “GT Zone” → “Mixed Use”). This method was able to successfully categorize 99.2% (904/911) of the zones in the county. Of the seven zones that remained unaccounted for, two were located in Park Ridge, and remained unidentifiable due to the low quality and indecipherability of the town’s official zoning map. One of these zones was located in Haworth, which encompassed many different uses over a large area, meaning that it could not be placed into a single category, and would have also led to an inaccurate figure of the town’s diversity as a whole. The remaining four zones were located in Emerson, which were all unnamed, and caused the same issue as the ambiguous zone in Haworth. Due to the uncertainty and possible inaccurate representation of land use diversity, the data from these three towns was omitted from the study.

Walk Score® Calculations

When a coordinate is input to the Walk Score® website, a score on a scale of 0 (least walkable) to 100 (most walkable) is provided. In order to estimate the average Walk Score® of each town as a whole, nine different coordinates were calculated, to potentially be input to the program. Using the coordinates of the northernmost, southernmost, easternmost, and westernmost points of a town, nine sections were created, with the central point of each section representing

the nine coordinates. Each of the points located within the town's border was input to Walk Score®, and the average score of the points represented the average walkability score of the town as a whole. A visualization of this process is demonstrated in Fig. 1 below, a smaller scale of the same process the Walk Score® uses itself to calculate the walkability of a large area. For example, the dots shown in Fig. 2 represent each specific coordinate that is factored into the Walk Score® of Washington D.C. as a whole.

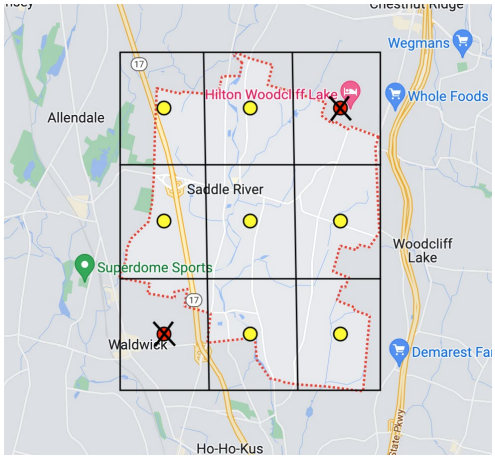

Figure 1. Method of Coordinate Selection for Walk Score®

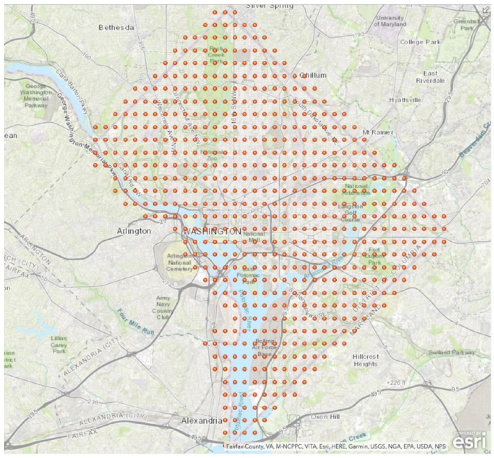

Figure 2. Coordinates Selected for total Walk Score® of Washington D.C. from Official Walk Score® Website

Data Analysis

First, the relationships between the income level and Walk Score® of each town was determined, using the Pearson correlation coefficient. Next, the correlation between the Walk Score® and Diversity Index and the correlation between the Diversity Index and median household income was found, using the same method. Finally, Walk Score® was correlated with the proportion of each category of zoning, in order to determine which category had the most significant effect on walkability. The strength of each correlation was determined using the r value, where an r of 0 indicates no correlation and an r of 1 indicates a perfect correlation.

Results

Walkability vs. Income

The correlation between median household income and Walk Score® had an r value of r(65) = -.72, p < .00001, indicating a strong and statistically significant relationship between the two factors (Fig. 3). Towns with a higher median household income tended to have a lower Walk Score® than towns of lower income levels. The correlation had a p value of <.00001, well below the maximum p value for statistical significance of .05 typically used in social sciences (Vidgen & Yasseri, 2016), indicating that the result was statistically significant. This association can be seen through a comparison of maps of Bergen County's average Walk Score® and median household income by town (Fig. 4).

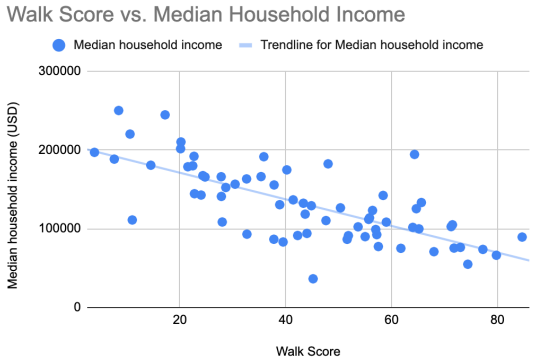

Figure 3. Correlation between Walk Score® and Median Household Income

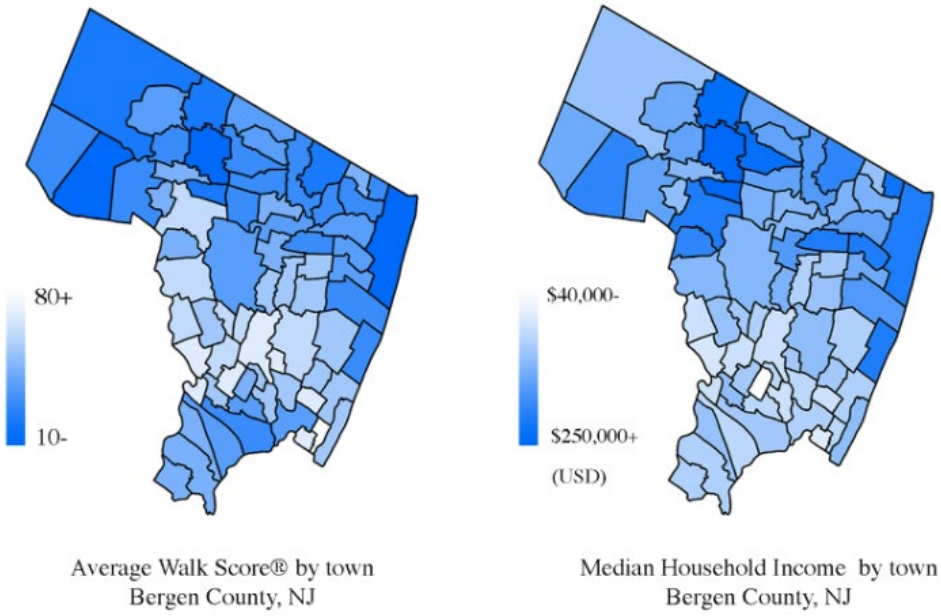

Figure 4. A Comparison Between Maps of Average Walk Score® and Median Household Income of Bergen County

Land Use Diversity vs. Income and Walkability

Next, it was found that wealthier neighborhoods tend to have less diverse land use, with an r value of r(65) = -.51, p = .000013 (Fig. 5). In order to determine whether the trends in walkability as a result of income could be a result of higher-income towns having lower land use diversity, a third correlation was calculated, between the Diversity Index and Walk Score®. It was found that towns with more diverse land use zoning tended to be more walkable, with an r value of r(65) = .29, p = .017 (Fig. 5), indicating a weak-to-moderate correlation. Therefore, the trend of walkability and income can be somewhat explained by land use diversity, however many other factors remain to be accounted for.

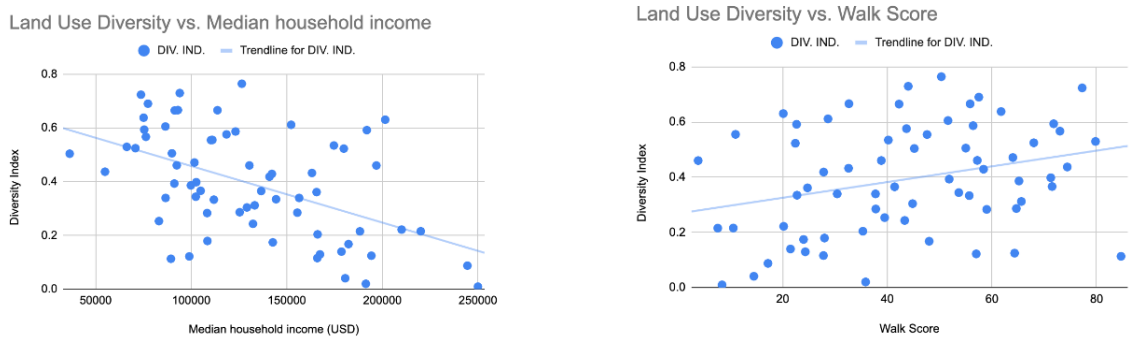

Figure 5. Correlation Between Land Use Diversity and Median Household Income (left) and Correlation Between Land Use Diversity and Walk Score® (right)

Analysis of Zoning Categories

Of the relationships between the proportion of each category of land use and Walk Score®, land use with the greatest association with walkability was commercial zoning. The correlation of r(65) = .38, p = .0018 indicated that commercial zoning had a greater effect on walkability, when compared to all the other categories, with towns containing a greater proportion of commercial zoning, tending to have a higher walkability score (Fig. 6). Of all the different types of land use, the "Other" category indicated the weakest correlation, with a value of r(65) = -.0086, p = .95. However, due to the nature of this land-use category, it was discounted due to the fact that it encompasses multiple land uses. The next-weakest correlation was that between the proportion of land use in the "Airport" category, with a value of r(65) = -.0092, p = .99, which was also discounted, due to the fact that this land use was only present in 1 of the 70 towns.

Therefore, the land use that affected walkability the least on a large-scale was residential zoning, with an r value of r(65) = -.013, p = .92 (Fig. 6). The high p-value is a result of the lack of correlation, demonstrating that there is no statistically significant association. Despite results from previous studies indicating that an increase in residential zoning decreases walkability (Koschinsky, 2018), these results suggest that the percentage of land dedicated to residential has little to no effect on it. However, the previous study indicated that single-use-only residential zoning had a significant impact, while this study simply focused on residential-only zoning as a whole, meaning that those results could still hold true. Overall, this study indicated that it is important to examine the specific type of residential zoning used (i.e. single family, two family, multifamily) and that zoning codes must be examined on a deeper level than simple proportions.

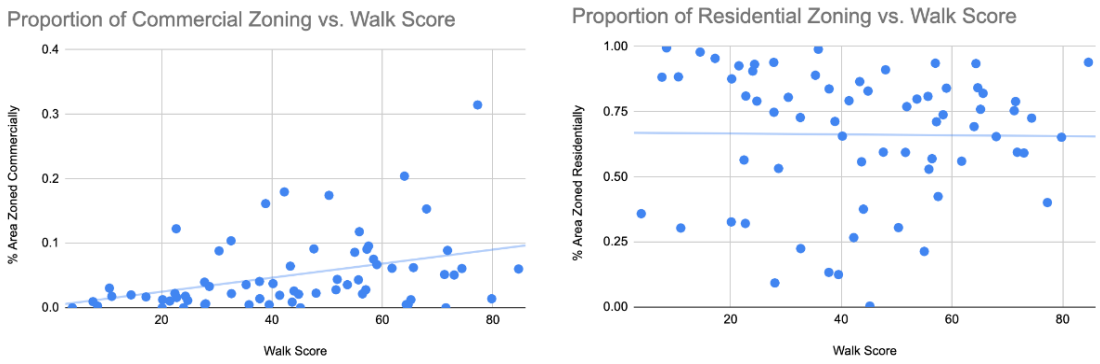

Figure 6. Correlation Between Proportion of Commercial Zoning and Walk Score® (left) and Correlation Between Proportion of Residential Zoning and Walk Score® (right)

Discussion

A similar analysis of the diversity score of different tracts of Oklahoma City was conducted in 2015, which identified areas in which to modify public service planning and transportation. This study also used the Diversity Score, with more of a focus on the zoning aspect of urban planning rather than the factors considered in the Oklahoma City analysis, such as race, age, and family size. The study used a similar method of examination, but in Bergen County, where the impact of zoning laws has not been extensively researched, rather than Oklahoma City. Both studies worked toward the ultimate goal of using statistical analysis to make decisions on public policy. In the examination of Oklahoma City, analyses found results such as high carpooling rates in low-income areas, representing a need for improved public transportation (Comer & Greene 2015).

In this instance, it was found that walkable towns tend to have more diverse land use, especially in the form of increased commercial zoning. Therefore, implementing commercial zones in areas of low walkability could help to increase it. A lack of these zones tend to occur in higher-income neighborhoods, where large residential areas exist, with a lack of close by commercial amenities, such as in the boroughs of Franklin Lakes and Woodcliff Lake. These results could help to inform policy decisions in these towns. For example, southwest Paramus (area circled in green) has a significant portion of land with low walkability, with its zoning map revealing that the area is low in land use diversity, made up of mostly single-family residential zoning (Fig. 7). Both circled areas in the zoning map of Fig. 7 experience a high volume of car traffic from the three main roads that run through the area (N. Fairview Ave, Forest Ave, & Spring Valley Road), with the circled area on the right additionally experiencing high levels of pedestrian traffic from Van Saun County Park (zone marked in green). Therefore, businesses placed in commercial zones in this area could thrive from interaction with the high volume of population movement, and the surrounding neighborhoods could thrive from the benefits of increased walkability.

Significant areas in northern Bergen County are made up of unwalkable neighborhoods with moderate population density, which could also benefit from zoning code modifications, in terms of walkability. However, there are possible reasons these areas would not be zoned commercially, such as an increase in traffic, a reduction of privacy perception, change in neighborhood character, and the fact that the area is already fully developed. Nevertheless, if a town, such as Paramus, were to have a board meeting on redevelopment, walkability should be considered as a factor regarding which changes should be made. This study, along with other statistical analyses of walkability, should be used in conjunction with other considerations such as traffic studies and public surveys, to provide a holistic view in informing policy makers on the best decisions for zoning code modifications and redevelopment.

Figure 7. Area of southwest Paramus with Low Walkability (left) and Zoning Map of Paramus with Areas for Potential Redevelopment Circled (right)

Conclusion

The results also indicated that living in a walkable neighborhood is not necessarily unaffordable, as many of the lower-income towns in the county were highly walkable, suggesting that anyone has the opportunity to live in a walkable neighborhood, regardless of income level. It also means that effective planning, rather than wealth, is required in order to create walkable neighborhoods. While these results apply specifically to Bergen County, NJ, they suggest this trend could be more widespread, additionally supporting previous literature suggesting that low-income neighborhoods tend to be more walkable than those of higher income (Conderino, et al., 2021). Citizens living in wealthier neighborhoods are more likely to be able to afford a car, eliminating the issue of accessibility, yet may suffer from the effects of social isolation that are associated with living in an unwalkable neighborhood (Boyce, 2010), a possible area for future research.

Limitations

One major limitation of this study was that walkability varies within towns. For example, Cresskill's western side is made up of a walkable downtown, while its eastern side is made up of an unwalkable neighborhood with a Walk Score® ranging from 0-20. Within this study, simple proportions of areas of land use were measured, rather than where zones existed in relationship to each other, another concept for potential future research. Additionally, the Walk Score® is not perfect, as it only takes factors such as destination proximity and block length into account, while failing to consider factors such as the existence of sidewalks and visual appeal of an area. While the Walk Score® serves as a foundation for determining walkability, a more in-depth examination of an area is required in order to acquire a more complete picture of how land is used and how land should be used.

Finally, the results of this study only represent the trends that exist within Bergen County, NJ. While they could be applied to different areas, as principles of walkability remain the same in all locations, geographic and cultural patterns vary significantly from place to place, meaning that it is important to analyze walkability on a more local basis, in order to effectively make informed decisions.

Future Research

These specific results may not apply to different counties, which opens up the opportunity for similar studies to be conducted elsewhere. For example, Georgetown, TX is the fastest-growing city in the U.S., which experienced a growth rate of 10.5% between 2020 and 2021 (U.S. Census, 2022). An identical study could be conducted in the areas of the city that are already developed and the results can be used to help inform policy makers on how to zone future developments to be more walkable. Walkability is a broad and complex topic with many factors, rendering it impossible for a single study to cover all of them. Future studies should also incorporate other measures of walkability, such as visual appeal of neighborhoods, and not just their Walk Score®. However, research such as this can help provide specific insights, contributing to an overall body of knowledge to help urban planners create more walkable and livable communities.

References

Anderson, J. M., MacDonald, J., Bluthenthal, R., & Ashwood, J. (2013, February 13). *Reducing crime by shaping the built environment with zoning: An empirical study of Los Angeles*. SSRN. Retrieved April 24, 2023, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2216842

Baobeid, A., Koç, M., & Al-Ghamdi, S. G. (2021, August 26). *Walkability and its relationships with health, sustainability, and livability: Elements of physical environment and evaluation frameworks*. Frontiers. Retrieved April 23, 2023, from https://www.frontiersin.org/articles/10.3389/fbuil.2021.721218/full#:~:text=Building%20walkable%20communities%20contributes%20to%20reducing%20automobile%2Dbased%20transportation.

Bergen County Department of Planning & Engineering. The Central Bergen Bicycle & Pedestrian Plans. (2015, May). Retrieved April 25, 2023, from https://www.co.bergen.nj.us/images/Departments__Services/Planning__Engineering/2015-Central-Bergen-Bicycle-and-Pedestrian-Plan---Final-Report.pdf

Boyce, C. (2010). *Walkability, social inclusion and social isolation and street redesign*. ResearchGate. Retrieved April 25, 2023, from https://www.researchgate.net/profile/Carmel-Boyce/publication/263145395_Walkability_Social_Inclusion_and_Social_Isolation_and_Street_Redesign/links/596d993e0f7e9b8144414605/Walkability-Social-Inclusion-and-Social-Isolation-and-Street-Redesign.pdf

Chriqui, J. F. (2018, January). *Components of Local Land Development and Related Zoning Policies Associated with Increased Walking*. Institute for Health Research and Policy | University of Illinois Chicago. Retrieved April 25, 2023, from https://ihrp.uic.edu/wp-content/uploads/sites/530/2021/07/Zoning_primer_508v4_Apr2.pdf

City and Suburb. National Museum of American History. (2019, April 15). Retrieved April 24, 2023, from https://americanhistory.si.edu/america-on-the-move/city-and-suburb

Comer, D., a, b, AbstractCharacteristics of land use and land use diversity play an integral part in determining how a city develops, Havard, S., Griffith, J. A., Antipova, A., Arrington, G. B., Ashby, D. T., Bartholomew, K., Byrne, J., Duany, A., Ewing, R., & Hutcheson, G. D. (2015, April 3). *The development and application of a land use diversity index for Oklahoma City, OK*. Applied Geography. Retrieved April 24, 2023, from https://reader.elsevier.com/reader/sd/pii/S0143622815000466?token=82A10DCC0F5FDDDCE0EDE3823167DB567A2158AF4C59B57F89D4BF7ECCE6205ADF83088D407A83741305723571E68EEE&originRegion=us-east-1&originCreation=20230127184846

Conderino, S. E. (2021, June 6). *Social and economic differences in neighborhood walkability across 500 U.S. cities*. American Journal of Preventive Medicine. Retrieved April 24, 2023, from https://www.sciencedirect.com/science/article/pii/S0749379721002270#:~:text=Evidence%20suggests%20that%20people%20whose,the%20costs%20of%20car%20ownership

Environmental Protection Agency. (2022). *Carbon Pollution from Transportation*. EPA. Retrieved April 24, 2023, from https://www.epa.gov/transportation-air-pollution-and-climate-change/carbon-pollution-transportation

Ewing, R., & Cervero, R. (2010). *Travel and the built environment*. Taylor & Francis. Retrieved April 23, 2023, from https://www.tandfonline.com/doi/abs/10.1080/01944361003766766

Ewing, R., & Handy, S. (2009). *Journal of Urban Design Measuring the unmeasurable: Urban design ...* Journal of Urban Design. Retrieved April 25, 2023, from https://edisciplinas.usp.br/pluginfile.php/5068336/mod_resource/content/0/EwingHandy2009%20Measuring%20the%20Unmeasurable%20-%20Urban%20Design%20Qualities%20Related%20to.pdf

Institute for Transportation and Development Policy. (2020). *View City Measurements*. Pedestrians First. Retrieved April 24, 2023, from https://pedestriansfirst.itdp.org/city

Katz, L. (2020, October 14). *How much does walkability increase the value of a home?* Redfin Real Estate News. Retrieved April 24, 2023, from https://www.redfin.com/news/how-much-does-walkability-increase-home-values/

Koschinsky, J. (2018). *Planning tools for walkable neighborhoods: Zoning, land use, and urban form*. Retrieved April 24, 2023, from https://www.researchgate.net/publication/333035094_Planning_tools_for_walkable_neighborhoods_Zoning_land_use_and_Urban_form

Litman, T. (2012). *Economic value of walkability - vtpi.org*. Retrieved April 24, 2023, from https://www.vtpi.org/walkability.pdf?source=post_page----------

National Association of Realtors. (2017, March 6). *Zoning*. www.nar.realtor. Retrieved April 24, 2023, from https://www.nar.realtor/zoning#:~:text=Zoning%20is%20a%20set%20of,cities%20racially%20and%20economically%20divided

Nicolaides, B., & Wiese, A. (2017, April 26). *Suburbanization in the United States after 1945*. Oxford Research Encyclopedia of American History. Retrieved April 24, 2023, from https://oxfordre.com/americanhistory/display/10.1093/acrefore/9780199329175.001.0001/acrefore-9780199329175-e-64

NJTPA. (2023, January 27). Bergen County Zoning [Geographic Information System]. Retrieved January 27, 2023, from ArcGIS Hub.

Paulo Dos Anjos Souza Barbosa, J., Henrique Guerra, P., de Oliveira Santos, C., de Oliveira Barbosa Nunes, A. P., Turrell, G., & Antonio Florindo, A. (2019, August 28). *Walkability, overweight, and obesity in adults: A systematic review of Observational Studies*. International journal of environmental research and public health. Retrieved April 23, 2023, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6747269/

Plascak, J. J., Llanos, A., & Chavali, L. (2019, May 16). *Sidewalk conditions in northern New Jersey: Using google street view imagery and ordinary Kriging to assess infrastructure for walking*. Centers for Disease Control and Prevention. Retrieved April 24, 2023, from https://www.cdc.gov/pcd/issues/2019/18_0480.htm

Savio, N., Lone, F. A., Bhat, J. I. A., Kirmani, N. A., & Nazir, N. (2022, April 28). *Study on the effect of vehicular pollution on the ambient concentrations of particulate matter and carbon dioxide in Srinagar City*. Environmental monitoring and assessment. Retrieved April 24, 2023, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9047626/#CR26

Shrestha, M. K., Yu, X. J., Thapa, R. B., Stehman, S. V., Munroe, D. K., Díaz-Caravantes, R. E., Clark, J. K., Carsjens, G. J., Buyantuyev, A., Bhatta, B., Batisani, N., Alberti, M., Batty, M., Bolin, B., Burchell, R. W., Burchfield, M., Congalton, R. G., Cushman, S. A., Dale, V., … Gober, P. (2011, July 24). *Land fragmentation due to rapid urbanization in the Phoenix Metropolitan Area: Analyzing the spatiotemporal patterns and drivers*. Applied Geography. Retrieved April 24, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S0143622811000658

Singh, R. (2016, January 21). *Factors affecting walkability of neighborhoods*. Procedia - Social and Behavioral Sciences. Retrieved April 23, 2023, from https://www.sciencedirect.com/science/article/pii/S187704281506228X#!

Starrs, N. S. (2021, December 5). *Walkability vs. affordability*. The Washington Post. Retrieved April 24, 2023, from https://www.washingtonpost.com/news/where-we-live/wp/2014/12/01/walkability-vs-affordability/

Steuteville, R. (2022, June 1). *Why walkability is not a luxury*. CNU. Retrieved April 23, 2023, from https://www.cnu.org/publicsquare/2017/09/28/why-walkability-not-luxury

TD;, K. A. T. G. (n.d.). *Talking the talk, walking the walk: Examining the effect of neighbourhood walkability and social connectedness on physical activity*. Journal of public health (Oxford, England). Retrieved April 23, 2023, from https://pubmed.ncbi.nlm.nih.gov/22378942/

Tobin, M., Hajna, S., Orychock, K., Ross, N., DeVries, M., Villeneuve, P. J., Frank, L. D., McCormack, G. R., Wasfi, R., Steinmetz-Wood, M., Gilliland, J., Booth, G. L., Winters, M., Kestens, Y., Manaugh, K., Rainham, D., Gauvin, L., Widener, M. J., Muhajarine, N., … Fuller, D. (2022, March 7). *Rethinking walkability and developing a conceptual definition of active living environments to guide research and Practice - BMC Public Health*. BioMed Central. Retrieved April 23, 2023, from https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-022-12747-3#:~:text=Wikipedia%20defines%20walkability%20as%20%E2%80%9Ca,increases%20the%20liveability%20of%20cities

United States Government. (April 1, 2020). QuickFacts: Bergen County, New Jersey [American Community Survey]. Retrieved March 8, 2023, from U.S. Census Bureau.

Vidgen, B., & Yasseri, T. (2016, February 19). *P-values: Misunderstood and misused*. Frontiers. Retrieved April 24, 2023, from https://www.frontiersin.org/articles/10.3389/fphy.2016.00006/full#:~:text=If%20the%20reported%20p%2Dvalue,levels%20are%200.01%20and%200.001

Walk Score®. (2023). Walkability, Real Estate, and Public Health Data [Data Services]. Retrieved February 6, 2023, from Walk Score®.