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Accessibility of Walking and Biking as Forms of Exercise in Harris County, Texas, USAJoseph Hudson¹, Wycliffe W. Njororai Simiyu²**ARTICLE INFORMATION**

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Volume: 3, No: 2**Pages:** 77-89**ABSTRACT**

The prevalence of obesity in Texas, specifically Harris County, is a growing health concern. 26.7% of Texan adults reported no leisure time activity, which is significantly higher than the national average (24.4%). This study aimed at collecting walkability and bike-ability scores for 115 zip codes covering the greater City of Houston in Harris County, Texas, USA. The walkability and bike-ability scores are objective representations of the ability one completes their daily errands. Walkscore.com was used to collect the data from 115 zip codes found inside Harris County. It ranks walkability and bike-ability on a scale of 0 to 100 depending on the availability of walking and biking infrastructure in an area. Thirty-three (28.4%) zip codes had walkability scores between 0 and 24, thirty-nine (33.6%) had scores between 25 and 49, thirty (25.9%) had scores between 50 and 69, eleven (9.5%) had scores between 70 and 89, and only two zip codes scored above 90 (1.7%). Only thirty-five counties have a reported bike-ability score. Zero (0%) are within 0-24, thirty (83.3%) are within 25 to 49, two (5.6%) are within 50 to 69, three (8.33%) are within 70 to 89, and zero (0%) are within 90-100. The majority (72, 62.1%) required vehicle transportation while only thirteen (11.2%) had walkability scores over 70. Only 5 (4.3%) of the total zip codes within Harris County have adequate biking infrastructure.

Keywords: Built Environment, Healthy Lifestyles, New Urbanism, Physical Activity, Walkability Score

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INTRODUCTION

Public health in most developed countries has seen a significant downturn in recent decades with a steady increase in body mass index (BMI) and subsequent increases in both morbid obesity and cardiovascular disease (Sadiva & Khan, 2018; Sturm & Hattori, 2012). These changes to public wellness are seen across the world, with the United States having an extreme increase in those with clinically severe, or morbid, obesity. People with morbid obesity are proven to have elevated rates of cardiac arrest, and thus at an increased risk of sudden death at young ages (Duflou et al., 2004; Sadiva & Khan, 2018). This widespread change in health is largely preventable with an appropriate amount of moderate physical activity, such as walking or biking.

General physical activity is one of the recommended methods to improve general health and aid in the prevention of chronic diseases such as cardiovascular disease (Anderson & Durstein, 2019; Lee & Buchner, 2008). The activity recommended for adults is a minimum of 30 minutes of moderate-intensity exercise, in at least 10-minute intervals, 5 days a week. Walking is the most commonly reported moderate-intensity physical activity by adults and teenagers in the USA (Collins & Fulton, 2015; Rodriguez-Hernandez & Wadsworth, 2019). Walking, though commonly viewed as a non-vigorous exercise, when maintained at a brisk pace can generate energy expenditures up to those seen when jogging (Das Gupta et al., 2019; Greiwe & Kohrt, 2000; Kipp et al., 2018). Conversely, health education is similarly important in promoting healthy lifestyles. Those more knowledgeable about the benefits of physical activity are less likely to be physically inactive (Chen & Gu, 2018).

However, physical inactivity and subsequent obesity are growing health concerns in Texas, USA as well as the whole world. According to the Center for Disease Control, more than 60% of adults do not engage in the recommended 30 minutes of exercise a day. Furthermore, physical inactivity varies greatly among USA states and territories. Inactivity levels range from 17.3% of adults in Colorado to 47.7% in Puerto Rico. Texas specifically has an above-average inactivity rate of 27.9% (CDC, 2020). Marginalized communities in low-income regions are most at risk for physical inactivity due to differences in social environment and local infrastructure compared to high-income regions (Bauman, 2012; Josey & Moore, 2018). Overall, these issues can be fixed by bringing attention to the large disparities in access to healthy foods, public transportation, lack of physical activity facilities, job strain, higher prevalence of fast-food restaurants and high-calorie foods with low nutritional value at their supermarkets (Bauman, 2012; Institute of medicine, 1970; Josey & Moore, 2018). The local environment can impact physical activity in children as well. Areas with higher walkability scores, access to recreation facilities, and more friendly land use have higher levels of activity among adolescents (Bauman, 2012; Josey & Moore, 2018). Studies show that the physical and social environments in which we live can make it difficult to obtain optimal levels of activity and maintain normal weight (Ahlport, et al., 2008; Ewing et al., 2003; Gordon-Larsen et al., 2000). The lack of appropriate physical activity-friendly environments predisposes communities to depend on automobiles as a predominant means of transportation for most families, which results in even more sedentary behavior (Ewing et al., 2003).

Recent studies on physical activity have focused on promoting walking as a health-enhancing endeavor. In 2019 the proportion of Texas adults who reported no participation in the leisure-time activity (26.7%) was significantly higher than the national average (24.4%). Similarly, the overall prevalence of obesity among Texans (34.8%) is significantly greater than the national obesity rate (30.9%) (CDC, 2019). According to the Center for Disease Control, adults are not the only group suffering from obesity. The obesity rate among high school students is around 15.5% (CDC, 2019). Although the obesity rate among adolescents is lower

than the national average for adults, the prevalence of early-life unhealthy habits is concerning for the future of public health.

If unhealthy habits begin at such a young age, chronic diseases are much more likely to occur later in life. Those with obesity are at an increased risk for cardiovascular disease and diabetes, but many other chronic diseases stem from obesity as well. Obese adults have higher rates of fatty liver disease, cancer, sleep apnea, and many others (Demakakos et al., 2010; Kyrou, 2018; Pi-Sunyer, 2009). All these chronic diseases are strongly related to overall BMI and fat distribution. As BMI increases over 29.9, the mortality risk increases even further, which overall poses more risk to men than women (Kyrou, 2018). Furthermore, according to the Center for Disease Control, the prevalence of obesity in the United States was 42.4% between 2017-2018. Of this percentage, 40.3% of adult men and 39.7% of adult women were considered obese (CDC, 2020). Men have higher mortality at a higher BMI than women, and also have a higher obesity rate than women, posing an increased risk for premature death. However, with proper intervention, these health conditions can be managed, and the metrics improved. Promoting physical activity from a young age can moderately improve adult activity levels, nonetheless, promotion of an active lifestyle must continue into adulthood if the risk of health-related disease is to truly be mitigated (Hallal et al., 2006).

Local governments must promote healthy lifestyles and provide access to exercise for their citizens. Policy designated by local municipalities can have a big impact on the health of cities around the nation, and specifically, Texas. In Houston specifically, socio-economically disadvantaged communities, as well as minority groups are most likely to be affected (Health behaviors n.d). To reduce the occurrence of inactivity, city planners can aid in the determination of street design, public transportation, the establishment of walking and biking paths for citizens, and the creation of recreational facilities (Irvani & Rao, 2019; Librett et al., 2003). Proper funding and legislation can have a significant impact on local communities. Having available parks and recreation facilities within one mile of home, or an increase in investment of \$10 per resident can significantly increase physical activity (Godbey & Mowen, 2010). Due to trends in increasing obesity among the general population, exercise accessibility may be the most important factor in increasing overall public health. To actively promote exercise, infrastructure must be in place to support ease of movement as well as specialized physical activities. Studies have shown that urban design promotes overall community wellness. Community-scale Street planning can increase the overall physical activity of a community when used in conjunction with local policy (Heath et al., 2006; Irvani & Rao, 2019).

This study researched the walkability and bike-ability of Houston, Texas, and the surrounding cities within Harris County using the different zip codes. Harris County was chosen specifically as it is the largest county in Texas and the 3rd largest county in the United States by population (World Population Review, n.d). Walkability and bike-ability are valid measures in determining the overall physical activity of a locality. Assessing walkability and bike-ability scores and comparing them from one area to the next, allows one to get the scope of physical activity profile of the community in question. The scores for each zip code were derived from www.walkscore.com, an online resource that promotes walking and biking as a healthy lifestyle in urban communities. This study analyzes the varying walk and biking scores for 115 zip codes selected from the greater Houston area in Harris County, Texas, USA.

METHODS AND MATERIALS

Harris County zip codes were abstracted from www.walkscore.com and the City of Houston was used as the framework for data collection and analysis. Walk Score was developed by Front Seat Management (www.frontseat.org), a software development company based in Seattle, WA, which focuses on software with civic applications. Walk Score uses publicly available data to assign a score to a location based on the distance to and variety of nearby commercial and public frequently visited facilities. Data sources used by Walk Score include Google, Education.com, Open Street Map, and Localize. Facilities are divided into five categories: educational (e.g., schools), retail (e.g., grocery, drug, convenience, and bookstores), food (e.g., restaurants), recreational (e.g., parks and gyms), and entertainment (e.g., movie theaters).

The Walk Score algorithm calculates the distance to the closest of each of the five facilities, using straight-line distances, and calculates a linear combination of these distances weighted both by facility type priority and a distance decay function (Duncan et al., 2011). The Walk Score data has previously been validated by Carr et al., (2010), Carr et al., (2011) and Duncan et al., (2011) as viable for establishing the physical activity profile of a community. The walk score helps one to find a walkable place to live depending on preference on accessing certain utilities including physical activity, grocery stores, supermarkets, restaurants, apartments, etc. The Walk Score is a number between 0 and 100 that measures the walkability of any address. The scoring between 90 and 100 is a walker's/biking paradise where daily errands do not require a car; 70 to 89, is very walkable/bike-able as most errands can be accomplished on foot or bike; 50 to 69 is somewhat walkable/bike-able as some errands can be accomplished on foot/bike; 25 to 49 is car-dependent as most errands require a car and 0 to 24 is car-dependent as almost all errands require using a car. The data were descriptively analyzed and presented in figures.

Bike score, like the walk score, analyzes the infrastructure in place to allow for safe and accessible travel by bike. The bike score measures bike lanes road connectivity, trails, hills, and distance to local destinations. While the walk scores are determined based on time, the bike scores are based on distance. If any of the five local amenities stated previously are outside of one Kilometer from the origin marker, then they are not calculated into the bike score. In comparison, the walk scores are only calculated by these locations that are within a 30-minute walk. Each of the different measures is graded differently. For example, bike paths, bike lanes, and shared infrastructure have different weighted scores in descending order, respectively. The "hilliness" of an area is only measured within 200 meters of the origin and depending on the grade of the slope a different score is given.

The bike score is graded on the same scaling as the walk score. 90-100 is the "Biker's Paradise" where all daily errands can be accomplished on a bike. A score of 70-89 is "Very Bikeable" where biking is convenient for most trips. 50-69 is "Bikeable" where there is some bike infrastructure, and 0-49 is "Somewhat Bikeable" where there is minimal bike infrastructure. However, unlike the walk score, not every location has a calculated bike score, thus the data related to biking is less inclusive than the walk score.

Sampling

Greater Houston in Harris County, Texas was the setting of the study. Harris County is in Texas, USA. As of the 2020 census, the population was 4,731,145, making it the most populous county in Texas and the third most populous county in the United States of America. Its county seat is Houston, the largest city in Texas and fourth largest city in the United States (<https://www.visithoustontexas.com/about-houston/nearby-towns-and-cities/harris-county/>).

There are 138 Zip Codes for the City of Houston. Out of the 138 Zip Codes for the City of Houston, 115 (83 percent) of them that fall under Harris County with pertinent walkability scores, were purposely selected for the study.

FINDINGS

The findings for walkability and bike-ability levels in Harris County, Texas are presented below. Figures one and two represent the findings on walkability and bike-ability in the selected zip codes within Harris County respectively.

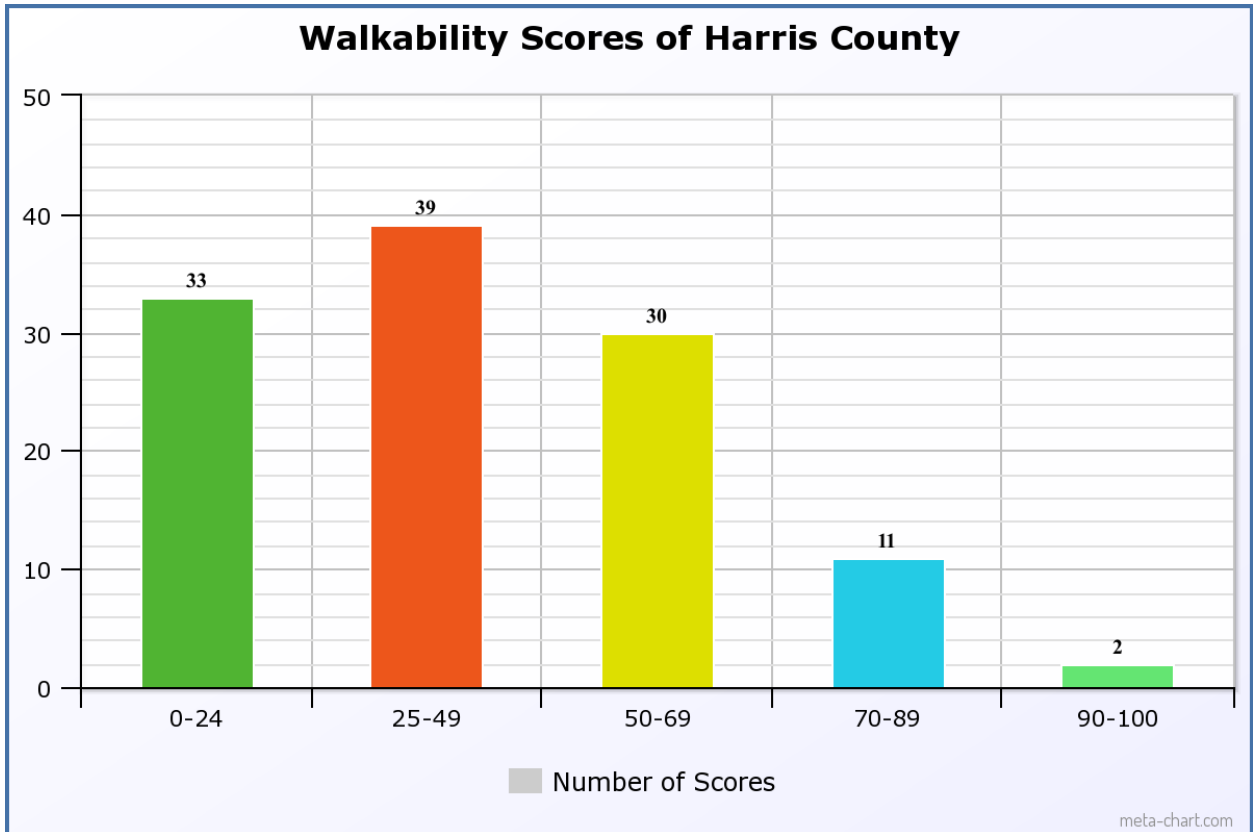


Figure 1. Frequency of occurrence of Walkability scores (Y-axis), separated into ranges of 0-24, 25-49, 50-69, 70-89, and 90-100

As data in figure one shows, the 115 zip codes located within Harris County, were, on average, dependent on vehicle transport. The data shows that thirty-three (28.4%) zip codes had walkability scores between 0 and 24, thirty-nine (33.6%) had scores between 25 and 49, thirty (25.9%) had scores between 50 and 69, eleven (9.5%) had scores between 70 and 89, and only two zip codes scored above 90 (1.7%) on the walkability score.

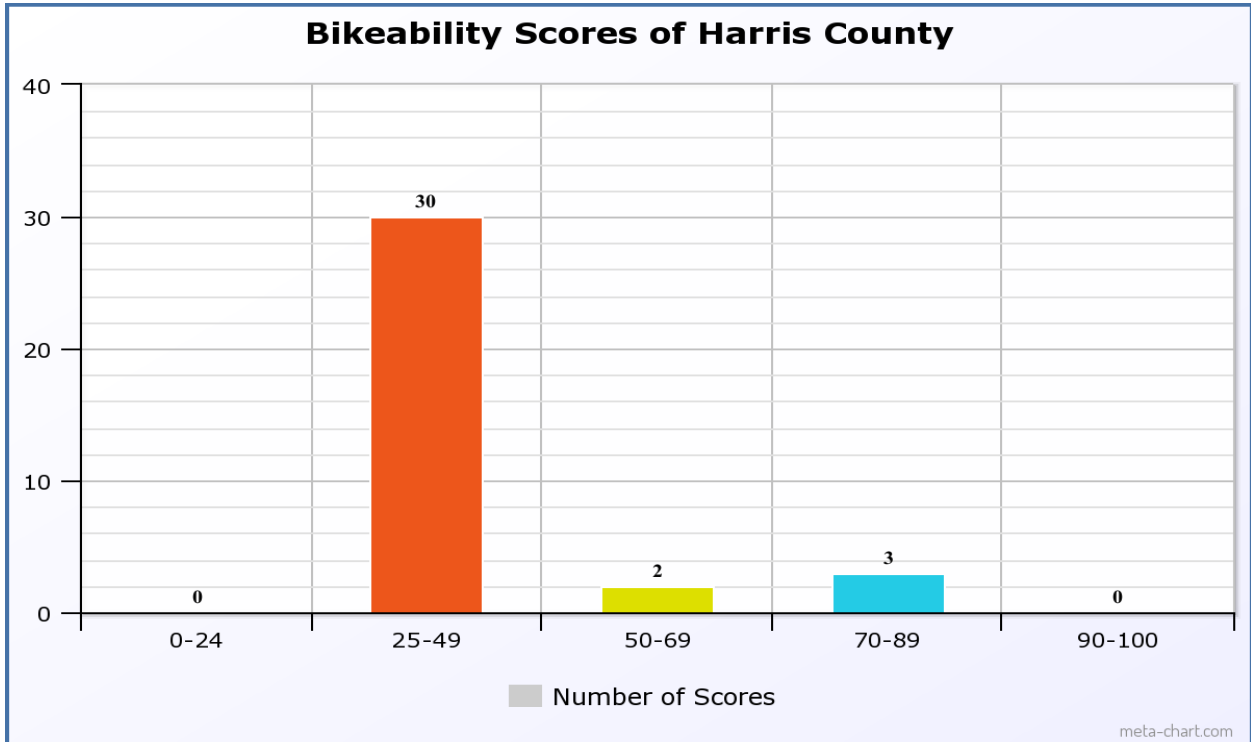


Figure 2. Frequency of occurrence of the 35 reported Bike-ability scores (Y-axis), separated into ranges of 0-24, 25-49, 50-69, 70-89, and 90-100.

Only 35 zip codes have reported bike-ability scores. Figure 2 represents the 35 reported bike-ability scores. These values ranged from twenty-five to eighty-nine, where on average, the zip codes with reported scores were highly car-dependent with minimal biking infrastructure. The data shows that zero (0%) of the reported zip codes range between 0-24, thirty (85.7%) range between 25-49, two (5.7%) range between 50-69, and three (8.6%) range between 70-89, and finally zero (0%) are between 90-100.

According to figure 2, twenty-three of the thirty-five (66%) reported bike-ability values were higher than the walkability score. 7 zip codes of those recorded had walkability scores of 0-2. Including 77049, 77082, 77044, 77032, 77377, 77375, and 77336. Each of these zip codes surrounds the northernmost area of Houston city limits which may impact development and accessibility. Contrarily, there are only two reported scores over 90: 77051 (97), and 77202 (94). 77202 is related to the center of downtown Houston, while 77051 is several miles south, in a well-developed region. The thirty-five zip codes with reported bike-ability scores had a much smaller range in comparison to walkability, with thirty (83%) scoring less than 50, which is very car-dependent.

DISCUSSION AND RESULTS

Regarding walkability, the majority (72, 62.1%) of zip codes within Harris County are dependent on vehicle transportation. Only thirteen (11.2%) zip codes had walkability scores above 70, where one can walk almost everywhere for services. These results are like the data reported in east Texas where walkability is low (Njororai et al., 2015; 2016). Simply living in

a neighborhood that has a higher walkability score has been shown to provide health benefits. In a population-based study by Chiu et al. (2015), those living in neighborhoods with walkability scores >90 had less than half the incidence of hypertension in comparison to their lower walkability counterparts. Walking is also correlated with positive mental health. In a study involving those in cognitive behavioral therapy, adding walking into their daily routines resulted in improvements in anxiety, depression, and phobias (Cooley et al., 2021). Environments with higher walkability scores can improve the holistic health of those within the community.

Regarding bike-ability, the majority (33, 91.7%) of the total zip codes studied do not have adequate biking infrastructure and scored less than 70 with only three (8.3%) of the reported bike-ability scores above 70. Bike-ability has been shown to have a direct association with an increased incidence of biking in a region, with each additional mile of bike lanes per square mile having a 1% increase in workers commuting by bicycle (Porter et al. 2019). With bike-ability showing a direct increase in those incorporating daily cycling, it is important to stress the health benefits of biking in a community. Cycle commuting is associated with decreased risk of cardiovascular disease and cancer (Celis-Moralis et al., 2017). Furthermore, there are many community benefits associated with cycling when accounting for reduced private vehicle use. Bicycle road infrastructure is approximately 50 times cheaper than cars, eight bicycles can be stored in a single parking space, and 28% of the world's CO2 admissions stem from transportation (Nematchoua et al., 2019).

The local built environment can have a major impact on the overall activity level of a community. Having a substantial infrastructure in place allows for communities to lead safe and healthy lifestyles. A term for sustainable land development that focuses on these factors is New Urbanism. New urbanism is the way of developing a densely populated community that allows for non-vehicular transportation. By creating mixed-use neighborhoods, communities can have access to most of their daily necessities to create sustainable living spaces (Stanislov & Chin, 2019). New Urbanism communities tend to have higher walkability scores than traditionally modeled communities and thus allow for a greater focus on public health (Irvani & Rao, 2019).

The biggest factor as to why New Urbanism-focused communities have higher walking scores is the idea that they are a “complete community.” A complete community contains mixed-use zoning so citizens can have places to live, work, and play. However, these communities are generally only located in suburbs outside of the city and are reserved for high-income families. Future zoning needs to account for low-income housing in complete communities so anyone, regardless of socioeconomic status can have access to safe, inclusive environments (Irvani and Rao, 2019). This data is congruent with the findings in Harris County. Zip code 77010 has a walkability score of 89 and an average salary of over USD 250,000 a year while zip code 77048 has a median income of just over USD 31,000 a year (US Census Bureau 2021). This trend can be seen across Harris County where the average walkability and bike-ability scores are both 40 and Harris County has a median income of just over USD 31,000 (US Census Bureau 2021). Zip codes such as 77010, 77202, 77098, 77052, and 77006 all have Walkability scores in the high 80's or above and have average salaries several times larger than the Harris County Average. While zip codes such as 77011, 77029, 77032, 77064, and 77082 all have walkability scores of 10 or less and have average salaries well below the Harris County average. Although this comparison is not perfect and there are several outliers such as 77005 with an average income of over \$192,000 and a walkability score of 62, there is a positive correlation between the income of a region and the walkability score (US Census Bureau, 2021).

When examining areas with high bike-ability, the only regions that have bike-ability scores >70 are 77201, 77051, and 77010 with scores of 70, 79, and 89, respectively. 77010 has a reported median income of USD 250,000 and is located directly in downtown Houston. However, directly beside it 77051 and 77201 have much lower median incomes of approximately USD 32,000 and USD 50,000, respectively (US Census Bureau 2021). The four lowest bike-ability scores are within zip codes 77043, 77046, 77081, and 77052, all with scores of 25. The median incomes of these four zip codes are approximately USD \$66,000, \$130,000, \$35,000, and N/A. These incomes are all higher than the median income of Harris County, except for 77052 which does not have a listed median income. These findings could suggest a general lack of development of bike-friendly infrastructure across the entire region. This lack of bike infrastructure has been seen in other regions as well. For example, a study from Virginia cited the barriers to the increase of bike infrastructure as lack of funding and lack of public support (Robarte et al., 2021).

The built environment has an impact on the health of the entire community no matter the age. Having safe environments for children to play in can help create social networks throughout the neighborhoods and promote healthy behavior. Having these environments in place, especially in densely populated regions, can help the entire family, and the greater community, lead healthier lives (Josey & Moore, 2018). Many of the most densely populated regions of Harris County not only have some of the lowest walkability scores but also have the lowest average incomes in the area (Zip Atlas Team, n.d). These most densely populated, or highest populated regions such as 77081, 77099, and 77036 all contain some of the lowest average incomes and walkability scores (US Census Bureau 2021). These regions that contain large proportions of working people need to be better developed to ensure the continued health of the greater population of those within Harris County

CONCLUSION

The results in this study show that most zip codes in the greater City of Houston area within Harris County have walkability and bike-ability scores under 69% meaning they are very car-dependent. This is an indicator of the need to actively pursue an agenda that promotes infrastructural investments that can bring about ease of walking and accessibility of community services at close range (Njororai et al., 2015; 2016). The lack of opportunities to walk predisposes the local population to engage more in driving than walking. This limits the opportunities to maintain an active physical lifestyle. There is a need to promote active lifestyles as well as a policy shift to invest in the appropriate physical activity-friendly infrastructure such as sidewalks, biking routes, walking trails, and walkable school routes, among others.

Limitations and Recommendations

The study focused on assessing walkability and bike-ability in only 115 Zip Codes in Harris County that are within the greater Houston area. For a broader and more comprehensive picture of Harris County, there is need to assess the walkability as well as bike-ability in all zip codes in the county. Such a comprehensive assessment would inform policy decisions to promote walkability and bike-ability as healthy lifestyles in the whole county rather than just a portion as per the current study.

Walkability for the local communities needs to be prioritized as the leadership and planning authorities at the city level consider the future expansion of administrative boundaries. Including mixed-use zoning with high-density housing units could allow for greater access to

walking as a form of exercise and transportation. Building high-density housing in such communities would allow more lower-income families to have access to safe and efficient ways to travel by foot for exercise or transportation. This would aid in reducing the prices of road maintenance, road noise, local pollution, and space required to accommodate personal vehicles. If such changes are implemented this would hopefully allow for safer communities in which one is able to walk to complete most, if not all daily errands. If these communities are successful, one could hopefully see a significant drop in hypertension, obesity, and CVD rates in the Harris County area in and around the City of Houston.

Regarding bike-ability, it is recommended that infrastructure be implemented city-wide, while at the same time carrying out a public-health campaign to help gain support for such a project (Josey & Moore, 2018). With a general increase of 1% of employees commuting to work per additional 1 mile/square mile of bike lanes added, a significant increase in those biking to perform their daily errands would hopefully be seen. This addition of bike lanes would likely require greater public support to achieve funding and the right-of-way laws to implement bike lanes throughout the city. This will be especially important in regions that have disadvantaged populations ((Braun et al., 2019; Robartes et al., 2021).

There are many regions in the greater Houston area that could be greatly revitalized by rezoning and rethinking the local infrastructure. For example, one of the most densely populated areas in Harris County is Gulfton, zip code 77081. 77081 has a walkability score of 62 and a median income of USD 33,500. As one of the most densely populated communities in the Houston area with 14,600 people per square mile, the community must fit its people (Shelton n.d). With such density and low walkability scores, people must use vehicular transportation to fulfill their daily needs. If mixed-use zoning is implemented to create these complete neighborhoods, it could help raise the walkability scores and provide cleaner, safer areas for families to live. Gulfton is not an isolated region either, as there are several regions in Harris County all with population densities over 10,000 people per square mile (Shelton, n.d.). As Harris County continues to grow and develop, the local legislature needs to ensure that these densely populated communities are not isolated, and regions with lower incomes can still have access to the amenities they require within a reasonable distance.

It is recommended that policymakers strive to provide physical activity-friendly environments to accommodate safe walking and biking if the physical activity profile of Harris County, as well as elsewhere in the state, is to improve. Those living outside of the center of Houston are less likely to use walking and biking, thus having fewer opportunities to expend their energy. Instead, they resort to the more expensive option of driving. Planning to grow and support surrounding areas of Houston can aid in the overall wellness of the area. Providing these populations with the infrastructure necessary to allow for walking and biking as a means of transportation is necessary to promote daily exercise requirements. Supporting infrastructure to aid in daily physical activity will subsequently reduce avoidable chronic diseases and improve public health.

If the infrastructure changes can be implemented across Harris County, a public information campaign could be utilized to garner support for decreased use of private vehicles in favor of walking or cycling. A city-wide effort to introduce a walking or biking-centric traveling community could have a resounding impact on the overall health of the community in areas such as reducing the incidence of chronic disease, reducing cardiovascular complications, lowering air and noise pollution levels, reducing traffic, reducing the cost of living in both lower and higher-income regions, and decreasing vehicle-related deaths in the region.

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