Why the Sidewalk Ends: Analysis of Sidewalk Infrastructure in Tucson, Arizona

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WHY THE SIDEWALK ENDS?

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Introduction

- **Poor sidewalks** are associated with **lower socio-economic status** [1].
- **Good pedestrian** infrastructure increases walkability and has many **health, economic, and social benefits** [2].

Research Questions

(1) What factors contribute to inequitable sidewalk infrastructure?
(2) What are possible solutions?

Methodology

1. Literature Review and Site Selection
2. Sidewalk Mapping using ArcGIS Pro (quantitative data)
3. In Person Canvassing (qualitative data)
4. In Person and Virtual Interviews (qualitative data)
5. Literature Review to find possible solutions

Figure 1: Data collection methods.

Study Sites

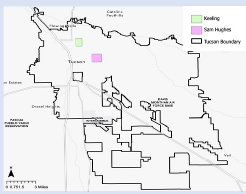

Figure 2: Neighborhoods selected for the study.

Table 1: Sam Hughes and Keeling neighborhood demographic information [4], [5].

	Sam Hughes	Keeling
Population	4,861	4,736
Approx. Age	1920	1930
Mean HH Income	$89,106	$30,903
Largest Racial Group	White	Hispanic
Percent renter occupied	43.5%	69.2%

Results

Figure 4: Sidewalk makeup map (GIS data from the City of Tucson) [3].

- **23.24 %** paved sidewalks
- Poor connectivity
- Lack of shade
- Obstacles in paths
- Individuals walking on road

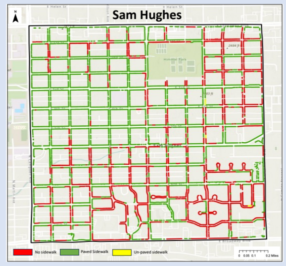

Figure 3: Sidewalk makeup map (GIS data from the City of Tucson) [3].

- **57.54 %** paved sidewalks
- Good connectivity
- Plenty of shade
- Leisure walking

Table 2: Summary of interview results on past and present funding for sidewalk development in two neighborhoods.

Themes	**Codes**	**Explanation**
Sources of past funding	"There **used to be funding** that you could write grants to apply for."	Back To Basics Program; Pima Neighborhood Reinvestment
Past funding process	"Acquiring funding was **labor intensive**."	Neighborhood meetings; writing grants; planning of sidewalks
State of current funding	"There is **currently a lack of funding.**" **"**Sidewalks are **market driven** not a city initiative."	Highway User Revenue Fund
Responsibility of sidewalk development	"The **financial burden** of sidewalk development is on the **homeowner** or **developer.**"	Property owners responsible for the maintenance of sidewalks in front of their property.

Discussion and Conclusion

What factors contribute to inequitable sidewalk infrastructure?

- **Sidewalk development** in Tucson **doesn't function as a public amenity** like roads and other infrastructure.
- **The process** of sidewalk development **creates barriers.**
  - It is **labor** and **time-**intensive
  - It requires **education**
  - It can be **expensive**
  - Relies on **homeowner initiative**
- Current **funding** sources are **problematic** (Highway User Revenue Fund).

Moving Forward

What are possible solutions?

- Sidewalks need to be **a city initiative**
- An alternate funding source needs to be created
  - **Development tax to fund sidewalk projects**
- **Need based allocations** should be implemented for funding

References:
[1] Rajaee, M., Echeverri, B., Zuchowicz, Z., Wiltfang, K., & Lucarelli, J. F. (2021). Socioeconomic and racial disparities of sidewalk quality in a traditional rust belt city. *SSM - Population Health*, *16*, 100975. https://doi.org/10.1016/j.ssmph.2021.100975
[2]Adam Brenneman, & Kerf, M. (2002). *Infrastructure & Poverty Linkages A Literature Review*. World Bank. file:///Users/anna/Downloads/wcms_asist_8281.pdf
[3] Tucson.(2015). Pedestrian Sidewalks[Data set]. Tucson Open Data.
[4] American Community Survey (2018-2023). Occupancy Tenure [Data set]. Census.gov.
[5] Tucson. (2019). Poverty and Urban Stress[Data sets]. City of Tucson housing and development.

Abstract

Inequitable sidewalk infrastructure perpetuates social inequalities. Furthermore, good sidewalk infrastructure has many health, social, and environmental benefits. To study the inequitable sidewalk infrastructure in Tucson, I did a case study analysis of two neighborhoods of different socio-economic status. The neighborhood with higher income levels had more and better sidewalks. I conducted interviews with neighborhood representatives and the city of Tucson professionals to understand why this was. I found that the main issues with current sidewalk development were that the funding sources are problematic and the responsibility for sidewalk development often ended up on the property owners or developers. To remedy these issues, I propose a new funding source, a development tax, and a city-run program to target areas in the greatest need of sidewalk infrastructure.

Keywords:
Tucson, sidewalk, walking infrastructure, inequitable development, funding sources

Introduction

The links between poverty and inadequate infrastructure can be seen all over the world (Henninger & Snel, 2002). In The United States, the saying "the wrong side of the tracks" has often been used to distinguish the affluent side of the city from the impoverished areas. The differences in these two sides are not just financial. They are often racial and infrastructural as well. Roads in areas with higher family poverty rates and higher percentages of minority racial populations are in worse condition with more potholes, worn paint, and other signs of degradation (National Highways, 2022). This is also the case for sidewalks. Poor sidewalk infrastructure correlates with areas of lower socioeconomic status and high proportions of minority residents (Rajaee et al., 2021). Addressing these infrastructure inequities can benefit the affected communities. Furthermore, walkability is an indicator of the livability and quality of life in urban areas (Baobeid et al., 2021). Inequitable pedestrian infrastructure creates disparities in quality of life. Equitable advancement in walking infrastructure creates more opportunities to lift communities out of poverty. Increased mobility from better walking infrastructure increases access to services like food and education. It makes access to better jobs more feasible and improves public health by increasing opportunities for physical activity and decreasing pedestrian accidents. Additionally, these effects have economic benefits, such as better health and increased access to jobs, which remove barriers to working. Good pedestrian infrastructure decreases the costs of accessing necessary services like school, work, and food (Brenneman & Kerf, 2002).

Tucson has a higher-than-average number of pedestrian accidents and a higher proportion of the population in poverty (Smith & Kentworthy, 2014). Furthermore, rates of pedestrian fatalities are higher in areas with lower income levels (Ingram et al., 2020). The rates of poverty in Tucson are disproportionately high for Black and Latino populations (Pullen, 2022). This is consistent with the greater United States. According to the United States Census Bureau (2023), the poverty rate of African Americans and Hispanic individuals is nearly twice as high as poverty rates seen in the White population. By addressing the inequitable pedestrian infrastructure in Tucson, the economic and health disparities among races can be decreased.

These infrastructure inequalities must be addressed to move in a more sustainable direction. Poorer areas have less walking infrastructure, which makes it harder for residents to be mobile and reach desired destinations. Because people of color have higher rates of poverty, they often live in neighborhoods of lower socioeconomic status with less walking infrastructure. This makes it harder for them to get to work or school, further disadvantaging them. Poor walking infrastructure prevents individuals from getting out of poverty and this disproportionately affects people of color. This is why sidewalk inequity is a social justice issue as well as a transportation issue. A lack of sidewalks has stronger negative effects on poor communities than wealthier ones. This is because walking is a form of exercise that is incredibly accessible. There are no membership fees, equipment, or skills required, making walking a very important and doable form of physical exercise for people with fewer resources. In the same way, walking is an important form of transportation as it does not require a license, a vehicle, or any associated costs. The impacts of inequitable sidewalk infrastructure are disproportionately negative to people in poverty, further disadvantaging an already vulnerable population (Rajaee et al., 2021).

Sustainability is multi-faceted and can be generalized into three interconnected pillars: environmental, social, and economic. Environmental sustainability means responsible and efficient use of resources, protection of biodiversity, reduction in greenhouse gas emissions, etc. It focuses on keeping the earth healthy and viable. Social sustainability means a community with good health and social justice. This means no poverty, quality education, gender, and racial equality. Finally, economic sustainability refers to an area that is economically viable with opportunities for work and advancements. Without any of these three pillars a society cannot be sustainable (Mangukiya & Sklarew, 2023). Quality pedestrian infrastructure impacts all three of these areas. Better pedestrian infrastructure means fewer cars and a lower need for parking. This has environmental benefits. Fewer cars reduce greenhouse gas emissions, and less parking means less pavement which is a major contributor to the urban heat island effect. Equitable pedestrian infrastructure has many social sustainability implications. It helps to decrease poverty, increase equity, and contribute to better public health, and social connections. Walking infrastructure has economic benefits not only for individuals but also neighborhoods. Literature states that walking infrastructure increases land values and promotes economic development and efficient land use

(Economic Value of Walkability, 2003). These effects create an economically viable and sustainable community.

This study will examine the connection between poverty and poor infrastructure in the context of Tucson, Arizona, by comparing sidewalks in two neighborhoods of different socioeconomic status. This report will answer three main questions to explore this overarching topic: What does the current sidewalk infrastructure look like? How was the current sidewalk infrastructure developed? What can be done to create more equitable sidewalk infrastructure? Equitable sidewalk infrastructure means quality sidewalks for everyone but especially for those who need it, sidewalks that are ADA accessible, and safe.

Methods

Research Questions

This is a case study comparing sidewalk infrastructure and the process of sidewalk development in two neighborhoods. I selected sidewalk infrastructure as the focus of this study because good quality sidewalks are an indicator of overall infrastructure quality and sustainability. Additionally, sidewalks have been shown to have major walkability impacts such as making walking safer, more accessible, and more enjoyable (Rajaee et al., 2021). For these reasons, this study will focus solely on sidewalk infrastructure to answer the following questions: What factors contribute to inequitable sidewalk infrastructure? What are possible solutions?

The two different neighborhoods have different demographic makeups. I looked at the race, income levels, and renter or owner occupancy of both neighborhoods to see if there was a connection between race and poverty with inadequate sidewalk infrastructure. I also considered the age and history of each neighborhood to designate historical impacts on the current sidewalk infrastructure. I looked at how the current sidewalks were developed and the process that led to their development. I also researched current sidewalk development to look for possible issues with the processes that may create blocks for certain groups to access sidewalks or further the problem of inequitable development.

Design

I selected two neighborhoods with different income levels. These neighborhoods were relatively similar in population and age. This minimized the differences between the neighborhoods that could affect the disparity in sidewalk infrastructure.

Once selected, I mapped each of the neighborhoods using ArcGIS PRO. The city of Tucson provided data that cataloged all the sidewalks in each area by type. I grouped the type of sidewalks into two categories: paved and unpaved. The unpaved sidewalks are generally dirt or gravel, which is far less accessible for Individuals who use mobility aids, push strollers, or have balance and other physical problems. In these cases, individuals often walk on the paved and connected streets avoiding the sidewalks entirely, rendering them useless. I did this mapping to get quantitative data on the amount and quality of sidewalks in both neighborhoods. This allowed me to compare the quantity of sidewalk area by square feet in both neighborhoods and learn what the current sidewalk infrastructure looked like.

While data can give an understanding of the general amount and type of sidewalks in the neighborhoods, I also chose to canvas the sidewalks in each neighborhood. I made my observations on Tuesday afternoons for two consecutive weeks. The first week I went to Keeling and the second week I went to Sam Hughes. I did this to ensure the time and day of the week didn't contribute to the differences I found in my observations. While walking each neighborhood I observed how residents used the sidewalks, how walkable they truly were, and how comfortable they were to walk on. The aspects of the sidewalks I chose to evaluate to determine quality were proximity to traffic, shade, and connectivity. These aspects were identified in the literature as key walkability indicators (Zuniga-Teran et al., 2017;Gao et al., 2022). I then used Google Street View to get images of sidewalks from several locations within each neighborhood to compare. This way, I could compare not only the number of sidewalks in both neighborhoods but also the quality of those sidewalks.

After gathering data from mapping and canvassing both neighborhoods, I conducted a series of interviews with long-time neighborhood residents and representatives as well as various city employees from different departments. These questions helped me to understand the history of the neighborhoods and their culture. I was also able to learn about the process that occurred to get sidewalks in each neighborhood and perspectives on how to better these processes. First, I met with neighborhood residents. I identified my interviewees by emailing the presidents of the respective neighborhood associations and asking them to meet or to be connected with a resident who may be able to answer my questions. I met with two long-time residents who had been active in neighborhood planning, one from Keeling and one from Sam Hughes. I also conducted a resident interview with an individual who grew up in Sam Hughes but later in life moved to Keeling and has been an active part of that community. I asked each of these individuals background questions regarding how long they have lived in the neighborhood, how they have seen the neighborhood change over time and any information they might have on the history of the neighborhood. I then asked questions about each individual's involvement with sidewalk development and the process that they went through to get sidewalks in their respective neighborhoods. I ended the interviews by asking why they think the sidewalk infrastructure exists as it is and how they would remedy the infrastructure inequality.

I also conducted interviews with various City of Tucson employees to learn about the processes in place for current sidewalk development and programs that have existed in the past for neighborhood improvements like sidewalks. This was important as land use and planning professionals have different perspectives and unique knowledge regarding why and how sidewalk development happens and how funding for projects works. To find Interviewees, I used a snowballing approach where I relied on referrals from my interviews to find my next interview subject. I was first referred to the neighborhood engagement specialist from the planning department by one of my resident interviewees. Then, in each interview with the professional, I asked to be referred to someone who might be helpful to my research. Through this process, I was able to connect with city officials from various departments. This method allowed me to gain wide perspectives from professionals with a wide range of expertise related to project funding, neighborhood coordination, transportation, historical conservation, and public processes. All these areas touch on the topic of sidewalks. In these interviews, I asked questions tailored to each official's area of expertise. These interviews touched on the history of each neighborhood, past neighborhood improvement programs that contributed to sidewalk development, current processes for sidewalk development, funding sources for sidewalk infrastructure, and possible solutions to improve the status of sidewalks in Tucson.

I used a thematic approach to analyze my interview data to extract common themes from my conversations with residents and city professionals. I used a systematic approach with five steps to create these themes: (1) familiarization with data, (2) identification of keywords, (3) coding of keywords, (4) theme development, (5) conceptualization and interpretation of themes (Neem et al., 2023). First, I familiarized myself with the data by reading all my interview notes. I then identified keywords that had come up in multiple conversations. Next, I coded the data by creating short phrases from these keywords that summarize the ideas represented by the keywords. Afterward, I developed themes by organizing the codes into groups and finding connections between ideas. Then, I interpreted these groups of ideas to conceptualize themes that provided answers to my research questions.

Next, I did a secondary literature review to research solutions for the issues identified in my research. I looked at what other municipalities had done to try and fix the problem and the literature on beneficial sidewalk programs. This allowed me to see what has worked for areas in a similar position to Tucson and what solutions have had unintended consequences. This is how I answered my second research question; What are possible solutions to correct the inequitable sidewalk infrastructure in Tucson?

Site Selection

The two neighborhoods selected for the study were Sam Hughes and Keeling. They are both located in the northwest portion of Tucson (Figure 1).

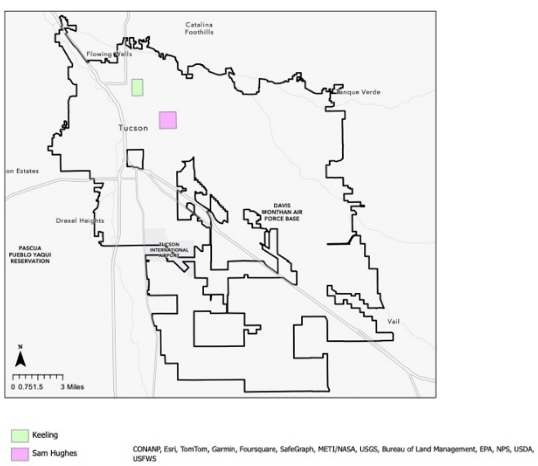

Figure 1: Map of Sam Hughes and Keeling in Tucson, AZ.

The two neighborhoods are relatively the same age and size but have different demographic makeups. The City of Tucson poverty and urban stress data sets were used to determine the size and demographic makeup of each neighborhood and the age of the homes were used to determine age of each neighborhood. To gather demographic information, I used datasets provided by the City of Tucson for neighborhood demographics. The city used census data and area approximations to determine neighborhood-level statistics using census tract data. I also used census data to provide information about renter vs owner occupancy. For these statistics, I used census tract data from the census tracts that make up the largest portion of each neighborhood. Sam Hughes has a very similar population to Keeling and they both became established neighborhoods in the early 1900s. However Sam Hughes has significantly higher income levels, the homes are mainly owner-occupied, and residents are mostly White. Keeling, on the other hand, has relatively low-income levels, a higher population of renters, and is largely Hispanic (Table 1).

Table 1: Demographic information of the residents in Sam Hughes and Keeling neighborhoods.

Neighborhood	Keeling (tract 001304)	Sam Hughes (tract 000600)
Largest Racial Group	Hispanic	White
Mean household income	$30,903	$89,106
Population	4,736	4,861
Percent owner-occupied	30.8%	56.5%
Percent renter occupied	69.2%	43.5%

Keeling Neighborhood Context

Keeling is an older neighborhood in Tucson. It is bounded by Fort Lowell and Grant on the northern and southern edges, and N Stone Avenue and First Avenue on its western and eastern boundaries (Figure 2).

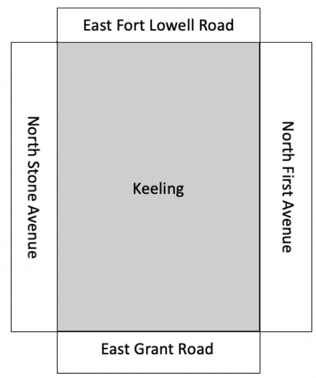

Figure 1: Boundaries of Keeling neighborhood.

It started as a rural portion of town with large parcels approximately 1.67 acres. Many of the homes in the area are from the 1930s. In the 1960s, the area saw a population increase and started to densify and parcels were split into smaller segments. While Keeling was never an upper-class neighborhood during these times, the area was comprised of mainly middle-class small business owners. Then, in the 1980s, there was another large population spike in the area with the development of two apartment complexes: Las Brisas and Los Altos apartments. A significant portion of the population growth that occurred from 1960-1980 was from families that had been displaced from downtown Tucson during the urban renewal projects of the 1960s and 1970s. The displaced were mainly Hispanic and, due to the displacement, struggled to create community and wealth (Warner, 2012). This is when the area began to shift in socioeconomic status. With these demographic shifts, the average parcel size in the neighborhood decreased and the area shifted from mostly owner to renter occupied. Today, it is apparent that many of the buildings in the area require maintenance and that there is a lack of significant infrastructure developments. Currently, Keeling mainly has R-2 zoning, which is defined by the City of Tucson as an area for medium-density single and multifamily residential housing and other related uses and, due to the current zoning code, any new developments in the area will have to put in sidewalks (Unified Development Code, 2024). However, there is not any current developer interest in the area.

Sam Hughes Neighborhood Context

The Sam Hughes neighborhood was created in the early 1920s. E Speedway Boulevard and E Broadway bound it on the northern and southern edges and N Campbell Avenue and N Country Club on the western and eastern edges (Figure 3).

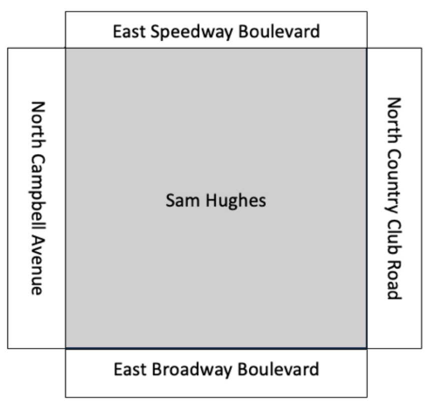

Figure 3: Boundaries of Sam Hughes neighborhood.

It is one of the oldest neighborhoods in Tucson with a long history of white affluence. It is named after a man who came to Tucson in the 1800s, made a fortune in the California gold rush, and was influential in the incorporation of Tucson as a United States city. With its proximity to the University of Arizona, which was established before Sam Hughes in 1885, the neighborhood has historically housed some university professionals. It has also been home to many mayors of Tucson from various points in the city's history. One contributor to the area's history of affluence was the deed restrictions put in place during very early development projects in the 1920s that required residences to have a minimum value of $5,000 which would have been the cost of a relatively nice home in Tucson during that time. These deed restrictions also prohibited individuals who weren't Caucasian from owning or occupying residences in the area until the Supreme Court ruled racially restrictive covenants unconstitutional in 1950. These deed restrictions paint a picture of how the neighborhood historically excluded individuals of color and lower socioeconomic status. Today, it is apparent that there has been investment in the neighborhood. There are good quality connected sidewalks, plenty of landscaping, and the historic homes have been impeccably maintained. The neighborhood is mainly zoned R-1 which means it is for low destiny single-family residential uses (Unified Development Code, 2024). It also has a historic designation which places restrictions on new development and provides property tax credits for its residents.

Results

Mapping and Canvassing

Using ArcGIS, I mapped the sidewalks in both Keeling and Sam Hughes. I used a data set created by the city of Tucson called pedestrian sidewalks. Using this data set, I sorted the sidewalks into paved and unpaved sidewalks. Paved sidewalk segments are shown in green, unpaved sidewalk segments are shown in yellow, and areas with no sidewalks are shown in red (Figure 4).

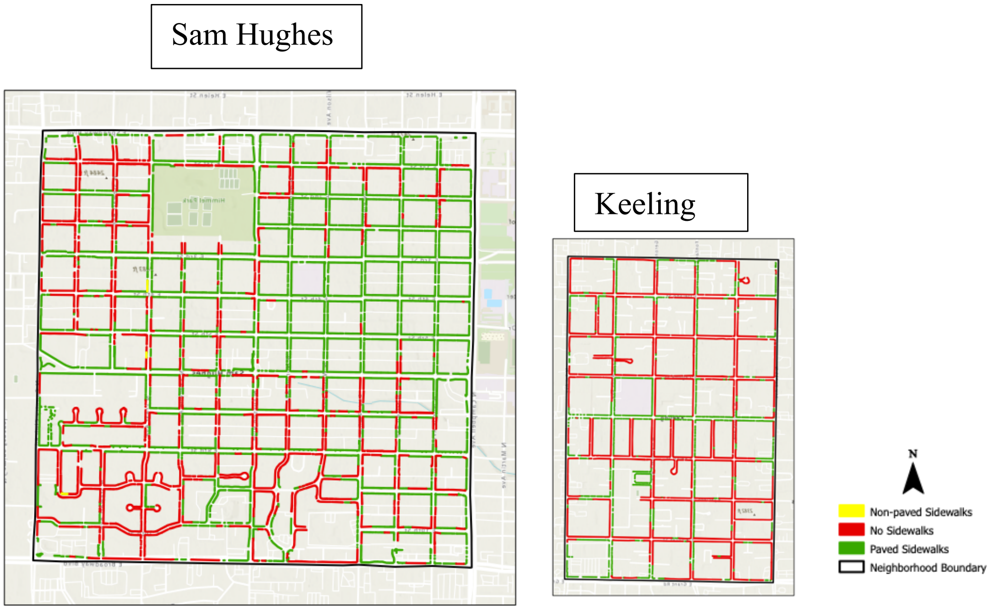

Figure 2: Sidewalks in Sam Hughes and Keeling**.**

This allowed me to see the distribution of sidewalks in both neighborhoods. Keeling has relatively few sidewalks with most of them running around the perimeter and through the middle of the neighborhood going north-south and east-west. These sections of sidewalks were put in between1990s and 2000s from a neighborhood initiative and funding from city and county sources. Sam Hughes has most of its paved sidewalks in the northwestern portion of the neighborhood. Most of these sidewalks were put in during the Great Depression by the Works Progress Administration which, was created to give jobs to Americans through infrastructure construction projects.

I then did a statistical analysis using the data set created. I found the percentage of sidewalk areas that were paved. By normalizing the area of paved sidewalks by the total area of possible sidewalk areas, I got a number that could be used to accurately compare the paved sidewalk quantity in both neighborhoods I also found the average percent of sidewalk areas that are paved in all of the neighborhoods in Tucson so, I could compare the values for Sam Hughes and Keeling to Tucson as a whole. Around 23% of the sidewalk areas in Keeling are paved.

Around 58% of sidewalk areas in Sam Hughes are paved. The average percentage of paved sidewalk areas in Tucson neighborhoods is 44.92%. The amount of paved sidewalks is above the city average in Sam Hughes and below the city average in Keeling. This quantitatively established that there was a difference in the sidewalk distribution in the two areas.

I then wanted to see if there was also a discrepancy in sidewalk quality. To do this, I canvased the areas in person making observations regarding various physical aspects of the sidewalks that have been established by literature to impact sidewalk quality and walkability. These aspects were the proximity to traffic, amount of shade, connectivity of the sidewalks, and how the sidewalks were being utilized (Zuniga-Teran et al., 2017).

From walking around Keeling, I observed that there was very poor connectivity. Many of the paved sidewalk areas ended abruptly or there were obstacles in the path such as overgrown vegetation and vehicles. I also observed large piles of garbage that blocked the paths. The sidewalks were unshaded, and I was walking in direct sun. Additionally, some of the only sidewalks in the area are located along the periphery of the neighborhood which is bounded by major roads. These sidewalks have no separation from the road. This made my walk along them loud, smelly, and a little scary. The interior sidewalks also lacked separation from the road, but the traffic was far less, so it was not an issue. Most of the people I observed seemed to be walking for a transportation purpose. There were adolescents walking with backpacks at the time that school got out and adults carrying bags of groceries and wearing work clothes (i.e. overalls with a mechanic logo, construction clothes, work clothes covered with paint splatters). Most of these individuals were not walking on the sidewalks, even when they were an option. They were walking alongside the sidewalks on the road. There was one stretch of sidewalk that was an exception to this. The sidewalk running down Fontana (Image1) is well connected and has more shade than other sidewalks, and people were walking on it. These individuals seemed to be walking for leisure. They were walking dogs or wearing workout clothes walking and talking in pairs. This provides evidence for the idea that more shaded and connected sidewalks create more opportunities not only for transportation but for physical activity and social cohesion too.

In Sam Hughes, I observed that there was good connectivity between sidewalks. My path rarely ended or had obstacles in it that required me to step into the street. Additionally, most of the paths were very shaded. The interior sidewalks had good separation from the street. However, the sidewalks along the periphery of the neighborhood lacked separation from the street and were the least shaded. This made them the least pleasant sidewalks in the area. I also observed that they were the least utilized in the area. I observed fewer people walking in Sam Hughes than I did in Keeling. Additionally, I observed that the individuals who were walking were on average older adults who seemed to be leisure/exercise walking. They were walking dogs or power walking with small weights. I also observed individuals with binoculars presumably looking for birds in the trees that shade the sidewalks (Table 2).

Table 2: Observations on the quality of sidewalks in Sam Hughes and Keeling neighborhoods.

	Keeling	Sam Hughes
Shade	Lack of shade (Image 2)	Well shaded (Image 6)
Connectivity	Poor connectivity -Pavement came to abrupt ends (Image 3) -Path blocked by vegetation (Image 4) -Path blocked by vehicles parked on the sidewalk	Good Connectivity -no abrupt ends or obstacles
Proximity to traffic	sidewalks along major roadways lack separation from the traffic (Image 5) Interior neighborhood sidewalks also lacked separation from the road	Periphery sidewalks along major streets lacked separation from traffic (Image 7) Interior sidewalks had a great separation from the street (Image 8) -trees and bushes between the walkway and road -sidewalks set back from the road by a few feet
Use of Sidewalks	Total 32 individuals walking 6 individuals walking on the sidewalk. -most seemed to be walking for transportation -people on the sidewalk were leisure walking mainly along Fontana	Total 16 individuals walking -all of them were on the sidewalk -most seemed to be leisure walking

Table 3: Images that illustrate the observations made about the quality of sidewalks in Sam Hughes and Keeling (Retrieved from Google Maps Street view, May 2024).

Image Number	Location	Image	Description
1	Keeling		Connected sidewalk running down N Fontana with some shade and separation from the street
2	Keeling		Unshaded sidewalk
3	Keeling		Pavement ending abruptly
4	Keeling		Sidewalk that is blocked by overgrown vegetation
5	Keeling		Lack of separation between the sidewalk and a major road (N Stone)
6	Sam Hughes		Shaded sidewalk
7	Sam Hughes		Sidewalk along the edge of Sam Hughes that lacks separation from a busy road
8	Sam Hughes		Sidewalk with great separation between pedestrian area and road

Other than the difference in quantity, the sidewalk quality in Keeling was different from Sam Hughes. My walking experience was far more pleasant in Sam Hughes due to the distance from traffic, connectivity, and shade provided by the sidewalks in the neighborhood. The better quality sidewalks encourage physical exercise. This is supported by the greater number of individuals walking for leisure in Sam Hughes and the location of individuals who were leisure walking in Keeling. The mapping and canvassing of the areas allowed me to determine the quantity and quality of sidewalks in both areas. My observations allowed me to surmise the possible consequences of these differences. Due to the lack of connectivity in Keeling, individuals are encouraged to walk in the street. This has safety implications. Additionally, the unpleasant nature of the sidewalks discourages people from walking for physical exercise or to create social connections. This has negative health and social implications for the neighborhood (Gao et al., 2022). On the other hand, the pleasant and connected nature of the sidewalks in Sam Hughes encourages individuals to go outside and walk. This has positive health and social benefits for the residents of this neighborhood (Gao et al., 2022).

Interviews

I held seven interviews, three with neighborhood representatives and four with City of Tucson employees from various departments to learn the causes of the current inequitable sidewalk infrastructure in Tucson. From these interviews, I identified four codes that represent common threads throughout the interviews (Table 4).

Table 4: Themes gathered from the interviews.

Themes	Codes	Explanation
Sources of past funding	"There **used to be funding** that you could write grants to apply for."	Back To Basics Program; Pima Neighborhood Reinvestment
Past funding process	"Acquiring funding was **labor intensive**."	Neighborhood meetings; writing grants; planning of sidewalks
State of current funding	"There is **currently a lack of funding." "**Sidewalks are **market driven** not a city initiative."	Highway User Revenue Fund
Responsibility of sidewalk development	"The **financial burden** of sidewalk development is on the **homeowner** or **developer."**	Property owners responsible for the maintenance of sidewalks in front of their property.

In the 1990s and early 2000s, there was publicly available funding for neighborhood improvements from the Back to Basics Program and the Pima Neighborhood Reinvestment Program. These funding sources allowed neighborhoods to apply and receive funding for sidewalk development. Keeling received funding from both sources to develop two stretches of sidewalk through the neighborhood. The process to apply for these past funding sources created barriers as it required time, skill, and initiative. To acquire funding, planning needed to be done to select the areas that could benefit from sidewalks, neighborhood meetings needed to be facilitated, letters had to be mailed, and grants needed to be written. This labor intensive process restricts the access of the funding to areas with individuals with the time and know how to take this on. Keeling was only able to obtain this funding thanks to a few highly motivated and educated individuals.

Today a great majority of sidewalk development is happening due to private development. Current zoning codes in Tucson require sidewalks to be put in during development and major renovations. This means that sidewalks are being put in areas where development is happening. The economy and land values dictate development. Areas that attract development generally have higher land values and more wealth. The reason that sidewalk development is market-driven is due to a lack of funding. Currently, in Tucson, there is no public funding available for sidewalk development and the city does not have any funding sources specifically allocated for sidewalks. The main funding source that is sometimes used for sidewalk development by the city comes from the Highway User Revenue Fund (HURF). HURF comes from an 18-cent per gallon gas tax that was created in 1990 and has not been increased since. There are some issues with this funding source as the purchasing power of that 18 cents has decreased by 40%. Additionally, cars are getting better mileage, so people are driving further but buying less gas. Furthermore, individuals with electric vehicles purchase far less gas, if any. This means that this funding source is much smaller than it used to be. This is incredibly harmful to sidewalks specifically, due to the limited amount of money in HURF, sidewalks are only improved in tandem with major road developments. In the context of Tucson, this is generally a road widening. With this development, the city will also put in sidewalks, crosswalks, and other walking infrastructure. This major development only happens in major corridors meaning neighborhood streets go ignored.

Another possible funding source is money collected by Park Tucson. This organization runs a parking Permit program where neighborhoods can opt-in to have permit-only parking on their streets. This has been done by neighborhoods to prevent the public from parking on their residential roads taking up the street parking space. This means that neighbors pay to have permits on their vehicles to park and individuals who park without a permit get ticketed. This creates a pot of money that neighborhoods who have this program may be able to access for infrastructure improvements like sidewalk development. The issue with this fund source is that it still places a cost burden on the residents and areas of lower socio-economic status are less likely to opt into a program where they will have to pay to park in front of their homes meaning they are ineligible for the funding.

The themes I identified answer my research question: Why does the current inequitable sidewalk infrastructure exist? Sidewalks do not function as public amenities; they operate as a market-driven private asset. This is due to the few problematic funding sources currently available. In areas that are not ripe for development or located on major corridors the market-driven nature, lack of city funding and initiative puts the burden of sidewalk development squarely on the shoulders of residents. This burden is both an initiative and cost. Residents are responsible for finding funds either through extensive public processes or paying for development themselves. This burden is harder to bear for disadvantaged communities as it makes them more likely to have poor sidewalk infrastructure.

Secondary Literature Review

A lack of funding for infrastructure development is an issue that is not unique to Tucson. An analysis of the funding sources for sidewalks in Albuquerque, New Mexico, found that, similarly to Tucson, the sources disproportionately placed the cost, burden of development, and maintenance on individuals and resulted in inequitable sidewalk infrastructure. One of the proposed solutions was to put the burden of development on the municipality and to fund this with a designated funding source that comes from an increase in the gas tax (Corning-Padilla & Rowangould, 2020). Increasing the gas tax may be a good option for Tucson as this taxes all drivers using gas, not just residents. However, increasing the tax may not be doable due to the political will of Tucson. Individuals may not support this option. Also, if sidewalk funding is reliant on a gas tax, then it is reliant on a car-centric community to produce adequate funding. What may work better is the implementation of a corporate tax or development tax. A corporate tax is levied on the income or capital of companies and corporations. Literature shows that a corporate tax can support sustainable city development without disproportionately burdening lower-income individuals (Rahman, 2022). This may be a more feasible funding source for Tucson as it doesn't raise taxes on individuals but rather taxes corporations operating in Tucson. Another funding source that does not put additional financial strain on individual residents would be the implementation of a development tax. A development tax is levied on new construction as a percentage of the construction costs. This is a current practice in France and has been able to fund public infrastructure projects like transportation systems (Gueltion et al., 2021). A development tax is a form of value-capture taxation. This allows municipalities to obtain some of the property value increases that occur from development and use them for the public good (Chapman, 2017). If a development tax were implemented in Tucson, it could be used for public capital improvements similarly to how it is used in France. If this funding could be managed and allocated by the city equitably, it has the potential to remedy the inequitable sidewalk infrastructure in Tucson in a way that does not tie equitable walking infrastructure to vehicle usage.

Discussion

By utilizing multiple research techniques, I was able to compare the sidewalk infrastructure in two neighborhoods of different socioeconomic levels, identify possible reasons for this inequitable distribution and possible solutions to this problem.

Keeling is a lower income neighborhood consisting of mainly single-family homes. The area lacked sidewalk infrastructure; only 23.4% of sidewalk areas were paved. The sidewalks that did exist lacked shade and connectivity making them unpleasant to use and less useful according to walkability indicators identified in research (Zuniga-Teran et al., 2017;Gao et al., 2022). My observations of individuals walking in the neighborhood support this as most chose to walk in the street instead of the sidewalk and there was a lack of individual walking for reasons that were not transportation related. This is in stark opposition to the data I collected about Sam Hughes, a higher income neighborhood made up of single-family homes. About 58% of sidewalk areas were paved in this neighborhood. Additionally, the sidewalks in Sam Hughes had great connectivity and shade making them easy and pleasant to utilize. I observed individuals using these sidewalks mainly for recreational purposes. Individuals seem more apt to walk for recreational purposes when there are pleasant sidewalks to use. The fact that lower income neighborhoods like Keeling do not have access to these pleasant places for recreational walking can create health and social disparities. Additionally, the lack of sidewalks in Keeling creates barriers for residents to get to necessary destinations, further burdening an already vulnerable group. While wealthy neighborhoods such as Sam Hughes have access to great walking infrastructure and all their necessary destinations thus advancing an already advantaged group. This disadvantaging of the vulnerable and aiding the privileged perpetuates racial and economic disparities.

By interviewing residents and city professionals, I was able to identify possible reasons for the current disparity in sidewalk infrastructure. The main issue seems to be with funding. There is a lack of funding, and the available funding sources are problematic. Tucson gets money for sidewalk development from HURF, which comes from a gas tax. This is an issue as this funding source is reliant on gas sales and by extension, car usage. Additionally, this funding is not specifically allocated to sidewalk developers. It is used for transportation infrastructure, mainly roads. Sidewalks are developed using HURF money only in tandem with major road development. This development usually happens on major corridors thus sidewalk development by the city of Tucson only provides the sidewalks on major roadways, not throughout neighborhoods. Currently there are no public funding sources for sidewalk development that neighborhoods could apply for. This leaves the current funding of sidewalk development in neighborhoods up to residents or developers.

In the past, there were public funding sources that neighborhoods could apply for but the process for this was labor intensive and required education on how to properly write grants. This places skill and time barriers to access the funding, making it less available for neighborhoods who lack the time or skills. Funding is not the only issue with sidewalk development that contributes to inequitable infrastructure. The burden of initiative is also on individuals. The city does not have any programs working to develop sidewalks, researching where they should be located for minimum benefit, or doing the community outreach necessary to get sidewalk development. All this initiative is left up to individuals. This burden is greater for neighborhoods with fewer resources. Higher-income neighborhoods are more likely to have the resources to take these necessary steps toward development while lower-income neighborhoods may have less time and resources to spend on pushing for sidewalks in their area.

This lack of funding and city initiative has led to a situation where sidewalk development is largely market-driven and contingent on development. Development is occurring mostly in areas with higher property values. Areas of a lower socioeconomic status have lower property values. Because sidewalk development is market driven, sidewalk development is mainly happening in higher income areas making the inequitable distribution of sidewalks worse.

This is why the city of Tucson needs to take the initiative and create a sidewalk development project. One possible funding source is a development tax that could be implemented on new construction. If the city was able to use this funding source to create a program that efficiently managed the funds and equitably distributed them focusing development in areas that were in the greatest need of sidewalk infrastructure this issue could be solved.

Conclusion

The distribution of sidewalk infrastructure is inequitable with more and higher quality sidewalks in areas of higher socioeconomic status. This disadvantages already vulnerable populations living in areas of lower socioeconomic status, as they are impacted more strongly by a lack of sidewalk infrastructure. Through a case study analysis of the sidewalk infrastructure analysis, I was able to understand how this inevitable sidewalk infrastructure came to be and come up with some possible solutions. The current sidewalk infrastructure is a result of the problematic funding sources that are tied to car transit, as well as a process to obtain funding that requires time, skill, and resources. As well as a lack of city initiative that leaves sidewalk development up to the free market and private development. To fix these issues, a new funding source needs to be acquired that has specific allocations for sidewalk development. One possible funding source is the implementation of a development tax. Furthermore, this funding needs to be managed by the city program that initiates sidewalk development and allocates resources to neighborhoods based on need.

There are some limitations to this study as only two neighborhoods were studied. To improve this study, more neighborhoods could be incorporated. Furthermore, I only conducted interviews with three neighborhood representatives who were recommended to me by neighborhood associations. Their thoughts may not be representative of the whole neighborhood.

Also, I used a thematic approach to identify the key takeaways from my interviews. This approach relies on my interpretation and leaves room for personal bias. In the future, more individuals should review the interview data to minimize personal bias. Additionally, the data sets I used from the City of Tucson are from 2019. There may have been some changes in the amount of sidewalks, since then that are not represented in my maps or calculations.

Some next steps for this research are to look more closely at possible funding options as well as what other cities are doing to remedy inequitable infrastructure. Additionally, the link between poverty and other kinds of infrastructure, like housing or transit, should be explored to find other areas that have inequities. Infrastructure inequity is a prevalent problem with many facets. This study only looks at sidewalks, so in the future, more of these areas should be researched.

References

Adam Brenneman, & Kerf, M. (2002). *Infrastructure & Poverty Linkages A Literature Review*. World Bank. file:///Users/anna/Downloads/wcms_asist_8281.pdf

Adkins, A., Makarewicz, C., Scanze, M., Ingram, M., & Luhr, G. (2017). Contextualizing Walkability: Do Relationships Between Built Environments and Walking Vary by Socioeconomic Context? *Journal of the American Planning Association*, *83*(3), 296–314. https://doi.org/10.1080/01944363.2017.1322527

American Community Survey (2018-2023). Occupancy Tenure [Data set]. Census.gov

Baobeid, A., Koç, M., & Al-Ghamdi, S. G. (2021). Walkability and Its Relationships With Health, Sustainability, and Livability: Elements of Physical Environment and Evaluation Frameworks. *Frontiers in Built Environment*, *7*. https://doi.org/10.3389/fbuil.2021.721218

Chatterjee, S., & Turnovsky, S. J. (2012). Infrastructure and inequality. *European Economic Review*, *56*(8), 1730–1745. https://doi.org/10.1016/j.euroecorev.2012.08.003

Corning-Padilla, A., & Rowangould, G. (2020). Sustainable and equitable financing for sidewalk maintenance. *Cities*, *107*, 102874. https://doi.org/10.1016/j.cities.2020.102874

Deener, A. (2020). *The Problem with Feeding Cities: The Social Transformation of Infrastructure, Abundance, and Inequality in America*. University of Chicago Press. https://ebookcentral.proquest.com/lib/UAZ/detail.action?docID=6268375

Development Tax in France as a Tool for Land Value Capture and Social Equity | Lincoln Institute of Land Policy. (n.d.). Retrieved April 28, 2024, from https://www.lincolninst.edu/publications/working-papers/development-tax-in-france-tool-land-value-capture-social-equity

Economic Value of Walkability. (n.d.). https://doi.org/10.3141/1828-01

Edt, A. (n.d.). *POVERTY IN THE UNITED STATES:*

Fullilove, M. T., & Wallace, R. (2011). Serial Forced Displacement in American Cities, 1916–2010. *Journal of Urban Health*, *88*(3), 381–389. https://doi.org/10.1007/s11524-011-9585-2

Gao, W., Qian, Y., Chen, H., Zhong, Z., Zhou, M., & Aminpour, F. (2022). Assessment of sidewalk walkability: Integrating objective and subjective measures of identical context-based sidewalk features. *Sustainable Cities and Society*, *87*, 104142. https://doi.org/10.1016/j.scs.2022.104142

Hood, E. (2005). Dwelling Disparities: How Poor Housing Leads to Poor Health. *Environmental Health Perspectives*, *113*(5), A310–A317.

Ingram, M., Leih, R., Adkins, A., Sonmez, E., & Yetman, E. (2020). Health Disparities, Transportation Equity and Complete Streets: A Case Study of a Policy Development 1