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Tran-SET

Solving Emerging Transportation Resiliency, Sustainability, and Economic Challenges through the Use of Innovative Materials and Construction Methods: From Research to Implementation

Evaluating How the Quality of Pedestrian Infrastructure Affects the Choice to Walk

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16. Abstract

While the benefits of walking are well understood, the physical design of sidewalks and their maintenance needs generally receive much less attention in both research and practice than the infrastructure used by other modes of transportation. As a result, we know comparatively little about how the design of sidewalks and quality of the overall pedestrian environment affect the decision to walk. In our study we conducted a household travel survey to collect data on walking frequency and attributes related to sidewalk quality and the quality of the walking environment in Albuquerque, New Mexico. We used summary statistics and statistical modeling to identify sidewalk and related infrastructure attributes associated with more walking. Our study results are limited by a smaller than anticipated sample size; however, we are able to reach several conclusions. We find that walking accounts for a larger share of trips than many prior studies, something we attribute to asking respondents to report walking trips for recreation and pleasure. Surveys that only ask about transportation or commuting trips may be underestimating the frequency that the population walks and the importance of pedestrian infrastructure. We also find, as prior studies have, that neighborhood scale land-use characteristics such as density and land-use mix are significant factors in explaining differences in walking. At the infrastructure level, we find that a lack of marked crosswalks where residential streets cross higher volume roads is significantly associated with less walking. We do not find any other significant infrastructure affects, something we attribute to our small sample size. Having sidewalks and maintaining them well was reported by respondents to be most important for encouraging walking.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

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ACRONYMS, ABBREVIATIONS, AND SYMBOLS

ADA	Americans with Disabilities Act
GIS	Geographic Information System

EXECUTIVE SUMMARY

Sidewalks are an important part of a multimodal transportation system. They enable walking in high traffic environments where walking in the street would be impractical or dangerous, and may encourage walking in other locations by providing a safer and more comfortable walking environment. Walking is an important mode of transportation for several reasons: it requires almost no out of pocket expense, has minimal environmental impact, active transportation such as walking improves public health *(1–4)*, it requires relatively inexpensive infrastructure, it can be used by people who are too young to drive or by those who cannot drive due to certain disabilities or other circumstances, and it may encourage greater social interaction.

Despite these and other benefits, there appears to be a wide gap between the provision and quality of pedestrian infrastructure such as sidewalks and that for motorized travel *(5–7)*. In many cities across the United States, sidewalks are in poor condition *(8, 9)*. This is particularly true in Albuquerque, New Mexico, according to a recent ADA transition study completed for the city *(10)*. There has also been very little research on how the quality and condition of sidewalks and pedestrian infrastructure affect a person's decision to walk. Prior research has mainly focused on how large-scale features of the built environment such as density and land use affect a person's decision to walk *(11–13)*. As a result, we know comparatively little about how the design of sidewalks and quality of the overall pedestrian environment affect the decision to walk. Therefore, we ask the question, does the quality of pedestrian infrastructure affect the choice to walk and which attributes are most important?

In our study, we conducted a household travel survey to collect data on walking frequency and attributes related to sidewalk quality and the quality of the walking environment in Albuquerque, New Mexico. We distributed an internet-based survey through neighborhood associations in an attempt to reduce survey costs and reach a large number of potential respondents. We then evaluated summary statistics and developed statistical models to test for associations between sidewalk and related infrastructure attributes and walking.

Our study results are limited by a smaller than anticipated sample size; however, we are able to reach several conclusions. We find that walking accounts for a larger share of trips than many prior studies, something we attribute to asking respondents to report walking trips for recreation and pleasure and the older population in our sample. Surveys that only ask about transportation or commuting trips may be underestimating the frequency that the population walks and the importance of pedestrian infrastructure. We also find, as prior studies have, that neighborhood scale land-use characteristics such as density and land-use mix are significant factors in explaining differences in walking. At the infrastructure level, we find that a lack of marked crosswalks where residential streets cross higher volume roads is significantly associated with less walking. We did not find any other significant infrastructure affects, something we attribute to our small sample size. Having sidewalks and maintaining them well was reported by respondents to be most important for encouraging walking.

1. INTRODUCTION

Sidewalks are an important part of a multimodal transportation system. They enable walking in high traffic environments where walking in the street would be impractical or dangerous and they may encourage walking in lower traffic environments by providing a safer and more comfortable alterative to sharing the street with vehicle traffic. Since walking has many benefits, understanding how the design and maintenance of sidewalks affects walking is important. Walking requires almost no out of pocket expense, has minimal environmental impact *(2, 12)*, active transportation such as walking improves public health *(1–4)*, walking requires relatively inexpensive infrastructure, people who are too young to drive or who cannot drive due to certain disabilities or other circumstances can often walk, and walking may encourage greater social interaction. However, the majority of the population in the United States does not walk *(14)*. Results from the National Household Travel Survey in 2017 found that only about 10% of all trips and 4% of work trips were made by walking.

Despite these and other benefits, there appears to be a wide gap between the provision and quality of pedestrian infrastructure such as sidewalks and that for motorized travel *(5–7)*. In many cities across the United States, sidewalks are in poor condition *(8, 9)*. This is particularly true in Albuquerque, New Mexico, according to a recent Americans with Disabilities Act (ADA) transition study completed for the city, which estimated over $200 million in necessary sidewalk improvements *(10)*. A similar study for Los Angeles, California estimates sidewalk repair costs are approximately $1.2 billion *(9)*.

The physical condition of sidewalks and their level of compliance with ADA standards are some ways that sidewalk quality can be measured. In our study, we investigate quality as it relates to the physical condition of the infrastructure, its design and the local environment. We hypothesize that some of these smaller scale or more localized factors may affect how much people walk. Prior research has mainly focused on the association between large-scale features of the built environment, such as density and land-use diversity, and walking *(11–13)*. What's largely unknow is which attributes and what level of maintenance most affect walking?

A better understanding of which sidewalk design attributes and infrastructure conditions most affect walking can allow municipalities to make more strategic investment and policies decisions to increase walking. This information could be used to identify the most cost effective (e.g., largest expected increase in walking per dollar spent on construction or maintenance) strategies to increase walking and make the most of municipal budgets that generally have limited funds for pedestrian infrastructure construction and maintenance. Knowing what matters most in the decision to walk is information that could also be used to update municipal and state sidewalk and street design standards which generally focus on meeting ADA standards and physically accommodating a certain volume of pedestrians (e.g., wider sidewalks where more pedestrian activity is expected).

In our study, we evaluated the link between pedestrian infrastructure quality and walking by conducting a household travel survey in Albuquerque, New Mexico. The survey asked respondents from households in different neighborhoods questions related to pedestrian infrastructure quality, such as if sidewalks are maintained or if sidewalks are wide enough for two people to walk side by side. The survey also collected information about travel behavior, including how often respondents walk for transportation and recreation. We evaluated associations between pedestrian infrastructure attributes and walking frequency using summary statistics and linear regression modeling.

2. OBJECTIVES

The overall aim of this project was to evaluate how the quality of pedestrian infrastructure and the overall pedestrian environment affect a person's choice to walk.

Objective 1. Evaluate How Pedestrian Infrastructure Condition affects the Decision to Walk: Here we evaluated how the condition of pedestrian infrastructure affects the decision to walk. We focused on sidewalks in this project to best use the limited funding available. The condition of sidewalks considers how well they are maintained (e.g., free of cracks, holes and displacements) and that they are free from obstacles and obstructions (e.g., poles, benches and overgrown vegetation).

Objective 2. Evaluate How the Quality of the Pedestrian Environment affects the Decision to Walk: Here we evaluated how other street level factors affect the decision to walk. Our specific focus was on sidewalk design attributes that may enhance the walking experience (e.g., sidewalk width and presence of marked crosswalks) and other factors affecting the immediate sidewalk environment (e.g., the amount of traffic of street lighting). Prior studies have given this topic relatively more consideration. In this project we investigated several factors important to understanding walking decisions in Albuquerque that have been evaluated in prior national studies at a relatively macro level. For example, street lighting is important; however, poorly implemented street lighting may not be. Many residential areas of Albuquerque and minor arterials contain one street light per block, leaving most of the street dark. This lighting strategy is not typical of that in most urban areas were prior studies have been performed. Similarly, Albuquerque has many narrow sidewalks (or no sidewalks) placed along high volume urban arterials with no buffer from traffic (including parked cars). Again, this situation is relatively unique for a large urban area.

Objective 3. Develop Guidance for Cost Effective Sidewalk Design: Based on a literature review and the outcome of Objectives 1 and 2 above we planned to develop guidance for cost effective sidewalk design. While there are many sidewalk design guidelines available, our guidance will focus on smaller scale design factors that have not been comprehensively covered in prior studies or where designs have been based on relatively weak evidence. We did not plan to conduct a full cost-benefit analysis but we did plan to provide at least a qualitative ranking of which designs have the largest potential impact on walking along with typical unit costs.

Objective 4. Collect Data to Support a Potential Prospective Study: Our study used two common research methods: a cross sectional comparison of infrastructure attributes and walking activity across neighborhoods and a stated preference survey *(15, 16)*. Both research methods have well known limitations that affect their ability to determine causality. They are best suited for determining correlations that may indicate the presence of a causal relationship. Prospective study designs, such as a study of changes in individual travel behavior before and after an infrastructure project, are much more capable of determining causal relationships. However, prospective studies are complicated by their relatively high costs and the need to coordinate research activities with municipalities who are responsible for building infrastructure. In this study we planned to strategically collect cross sectional and stated preference data so that it may be used in a possible, future, prospective study.

3. LITERATURE REVIEW

Prior studies have investigated factors that may affect a person's decision to walk. Many have found an association between socioeconomic characteristics and walking. Others have found links between the built environment and walking. One area that has not been extensively researched is how the quality of pedestrian infrastructure affects walking.

3.1. Socioeconomics and Demographics

Many studies find associations between the socioeconomic status and demographics of individuals, households and neighborhoods and rates of walking. Minority and lower-income populations are more likely to use active modes of transportation like walking and are also more likely to live in neighborhoods where the pedestrian infrastructure is in poor condition, raising equity concerns *(17–20)*. Perceptions of traffic safety and lower crime rates are also associated with more walking *(21–24)*. Furthermore, the association between walking and these factors can vary depending on gender and age. For example, several studies find that women are more concerned about crime then men and older populations walk more for exercise *(25–30)*.

3.2. Built Environment

Several characteristics of the built environment, particularly land-use mix and density, have been a focal point for many studies investigating how people travel.

Many studies find an association between land-use diversity and walking. Studies that have used household travel survey data find that individuals and households in places with greater land-use diversity walk more *(21, 31, 32)*. Trips in more urbanized areas for shopping and to reach recreation areas are also associated with more walking *(33)*. Cross sectional studies that have compared rates of walking between different neighborhoods also find that greater land-use diversity is associated with more walking *(23, 24, 34)*.

Population and employment density are also associated with increased walking. Prior studies using travel surveys and cross sectional study designs find a positive relationship between population density and the rate of walking *(23, 24, 31, 34–36, 37)*. At least one study also finds that employment density (number of employers in a space) is associated with more work and shopping trips by walking *(12)*.

3.3. Traffic

Traffic is likely to present real and perceived safety threats and it may also discourage people from walking for other reasons such as creating a noisy and uncomfortable environment. Several studies find that roads with heavy traffic and vehicles traveling at high speeds discourage people from walking *(22, 38–43)*.There has been little research on how other aspects of traffic and traffic safety affecting walking decisions.

3.4. Pedestrian Infrastructure

Prior studies also find connections between certain pedestrian infrastructure characteristics and walking. Street lighting may make people feel safer and therefore more inclined to walk *(22, 44)*. Crosswalks are found to increase walking when they are present *(45)*. Aesthetically pleasing environments, such as those with more vegetation may also increase walking *(30, 46–48)*. Few studies have considered how the physical condition, specific design attributes and local environment surrounding sidewalks affect walking.

A study of adults 65 years of age and older in Belgium *(49)* asked participants about their perceptions of sidewalk evenness, separation from traffic, width, and other traffic related questions for streets in their neighborhood. In order to determine what the quality of the pedestrian infrastructure was like in their neighborhood, participants were shown images of different conditions of sidewalks and asked if the sidewalks in their neighborhood matched any of the conditions (poor, ok, great). The study found that the most important sidewalk attribute for walking was sidewalk evenness. The focus on people over the age of 65 limits the ability to draw more general conclusions about the importance of different sidewalk attributes and their quality from this study.

A study of factors affecting walking for leisure in British Columbia, Canada asked survey participants about their attitudes, intentions, and planning habits related to walking *(48)*. The survey also included questions about the participants perceptions of the walking environment such as proximity to retail; availability of parks, trails and paths; infrastructure quality; aesthetics; crime; and traffic volume. The study found small positive correlations between infrastructure quality (0.17), proximity to retail (0.17) and neighborhood aesthetics (0.14) and walking. However, infrastructure quality in this study was defined as the amount of well-maintained sidewalks, rather than the more expansive definition we consider in our study.

Another study in Edmonton, Canada asked focus group participants about perceptions of their neighborhood environment *(41)*. Ten focus groups were held with each focus group consisting of 4 to 9 people. The participants were recruited from neighborhoods defined to have high or low walkability. Path and sidewalk quality, relating to sidewalk attributes and condition, were frequently referenced by participants as influencing their choice to walk.

Stated preference studies have also been used to evaluate the importance of sidewalk quality. Researchers asked participants in one study to watch video clips of sidewalks and then rate the level of service, defined as the level of comfort, of the pedestrian environment in the video *(50)*. They find that an increase in sidewalk width, the presence of a barrier between the sidewalk and street, and parked cars improve the perceived level of service of the pedestrian environment. One limitation with this study design is that higher level of service is not necessarily associated with greater walking frequency.

3.5. Summary

While many studies have evaluated the association between socioeconomic status, demographics, and the built environment and a person’s decision to walk, very few have looked at how smaller scale attributes of pedestrian infrastructure, specifically sidewalks, affect the choice to walk. Pedestrian infrastructure is part of the built environment and the main aspect of the built environment people interact with when walking. However, studies evaluating the built environment have mainly focused on larger scale features like land-use and density while paying less attention to smaller scale attributes such as sidewalk width and maintenance conditions that could also affect the choice to walk.

4. METHODOLOGY

Our study consisted of three tasks. In the first task, we determined where our survey would be distributed and how we would distribute the survey. For the second task, we developed the survey to be distributed. Finally, we analyzed the results from the survey to determine if there is a relationship between the amount of walking and pedestrian infrastructure quality.

4.1. Study Area & Survey Distribution

The main instrument to be used in our study was a household travel survey that was distributed to residents in Albuquerque, New Mexico. Albuquerque has a large number of sidewalks in poor condition that need to be replaced and has one of the highest pedestrian fatality rates in the country. Therefore, understanding what might affect a person's decision to walk in Albuquerque could be of importance.

Our goal was to distribute our survey to as many adult residents from different areas of Albuquerque as possible. We did not have a budget for a paper based, mail out/mail back survey, so we developed a plan to deploy an internet-based survey. One challenge with an internet-based household travel survey is reaching respondents in specific areas of interest (e.g., email addresses are not tied to street addresses and there is no universal directory of e-mail addresses). One way to contact residents electronically is through neighborhood associations since many neighborhood associations in Albuquerque have an email distribution list for most residents within their neighborhood. The city of Albuquerque consists of over 200 neighborhood associations, and 64 of these neighborhood associations have up to date contact information listed on the City of Albuquerque's website. We contacted each of these 64 neighborhoods (see Figure 1) to ask if they could distribute a link to our internet survey.

Figure 1. Map of all contacted neighborhoods in Albuquerque.

We used a commercial web-based survey platform (eSurvey) as our main distribution platform since it would allow us to not only distribute the survey to a large number of people for a low cost, but also allow us to distribute and obtain results faster than a paper-based survey. Following contact with neighborhood associations, we asked if they would be willing to send out a link for our online survey to residents in their neighborhood through their email distribution list. This allowed us to maintain participant anonymity since we did not have access to the email distribution lists but were able to track which responses came from which neighborhood. Tracking responses from individual neighborhoods allowed us to study how differences in neighborhood characteristics could affect walking. The survey link was open for two weeks. Paper-based surveys were also made available upon request.

4.2. Survey

Our survey asked respondents to report how frequently they travel in a typical week using each potential mode of transportation for various trip purposes, including recreation (i.e., non-transportation trips like walking for exercise or pleasure). We then asked respondents questions about their neighborhood's pedestrian infrastructure and street environment and the importance of pedestrian infrastructure and street environment attributes on the decision to walk. We also collected standard socioeconomic and demographic data. The full survey is provided in Appendix A.

Travel Behavior: Previous studies that have evaluated what affects the choice to walk have included questions in their surveys asking participants about their travel behavior and how often they walk or get physical activity in a week *(21, 32, 34, 35, 51, 52)*. Therefore, we began the survey by asking the respondents to report how often within a typical week they drive a vehicle, ride the bus/public transit, walk, ride a bicycle, or ride a skateboard/scooter by ranking their number of trips using a 4-point scale (0 trips, 1 to 2 trips, 3 to 4 trips, 5 or more trips). This allowed us to compare how often people walk compared to other modes of transportation. The amount of walking was used as the dependent variable in our regression analysis.

Pedestrian Infrastructure Characteristics: Previous studies have asked respondents to rate their perceptions of built environment characteristics *(23, 32, 34, 48, 51, 52)*. Therefore, we asked respondents similar questions regarding pedestrian infrastructure in their neighborhoods (Table 1). In the first section of Table 1, we asked participants questions that were either indicators of sidewalk quality or asked for their perceptions of pedestrian infrastructure quality with response categories tailored to each question. For example, we asked if they usually walked on sidewalks or the street and what the street lighting is like at night. In the second section of Table 1, we asked participants to tell us if sidewalks in their neighborhood have certain features using a 4-point scale (1-Most Do, 2-Some Do, 3-Most Do Not, 4-Unsure). In the third section of Table 1, we asked participants to tell us if they thought certain pedestrian infrastructure characteristics encouraged or discouraged them from walking using a 5-point scale (1-strongly discourage from walking to 5-strongly encourage walking).

Table 1. Questions asked in survey.

Section	Statement
1. Indicators and Perceptions of Pedestrian Infrastructure Quality	Do residential streets, like the one you live on, in your neighborhood have sidewalks?
	When walking on streets in your neighborhood how often do you use the sidewalk?
	If you walk with someone else in your neighborhood, do both of you walk on the sidewalk?
	How is the lighting at night on residential streets in your neighborhood?
	How do people park their cars in your neighborhood?
	How would you describe the speed of vehicle traffic in your neighborhood?
	How would you describe the amount of traffic on residential streets in your neighborhood?
2. Pedestrian Infrastructure Features (4-point scale)	Sidewalks wide enough for two or people to walk side by side
	Sidewalks mostly level where they cross driveways
	Sidewalks separated from street by landscaping, grass, etc.
	Sidewalks have ramps at street intersections
	Sidewalks have permanent obstacles in them such as utility poles or fire hydrants
	Sidewalks partially blocked by overgrown bushes, other vegetation
	Sidewalks are frequently blocked by parked cars
	Sidewalks are littered with potentially dangerous items such as broken glass
	There are marked crosswalks where local streets cross busier roads
3. Effect of pedestrian infrastructure characteristics (5 point scale)	Wider Sidewalks
	Evenness of Sidewalks
	Presence of sidewalks
	Sidewalk curb ramps at intersections
	Marked pedestrian crossings at busy streets
	Separations between sidewalk and roadway
	Lighting at night
	Overgrown vegetation
	Crime
	High volume of vehicle traffic
	High traffic speed
	Maintained sidewalks
	Obstacles in sidewalk such as utility poles or fire hydrants
	Broken glass or other potentially dangerous items in sidewalk

Demographics: At the end of our survey, we asked participants to provide basic socioeconomic and demographic information including: age, annual income, education, employment status, number of vehicles owned, number of members in their household, if they had a disability, and race. Previous studies have found many of these factors to be important in understanding the choice to walk *(32, 34, 35)*.

Focus Group/Pilot Survey: We conducted focus groups with two neighborhoods to understand if our initial set of survey questions captured the main concerns people had about walking. The focus groups had 3 and 7 attendees, respectively. We held the focus group meetings at the University of New Mexico on separate evenings to allow more people to attend whom might work during the day. We asked focus group participants to tell us about how they travel, what residential streets were like in their neighborhood, including maintenance issues, and what factors affected how much they walk. For the most part we allowed focus group participants to engage in dialog with each other in discussing these issues while we recorded the meeting and took notes.

The main concerns we heard were that many sidewalks in their neighborhoods are not level, many have holes and cracks from tree roots, there is not enough street lighting, intersection crossings are not safe, and there is too much traffic and too many speeding cars. Questions related to these concerns were included in our final survey. Once the focus groups were completed, we sent our survey to several graduate students within our department as a pilot to identify potential problems with how each question was stated or the logic of the survey questions.

4.3. Survey Response & Regression Analysis

The first task was understanding if the amount of walking varies between neighborhoods. We began by comparing the frequency and share of trips made by walking using boxplots. We also conducted a statistical analysis by constructing linear regression models to test the significance of differences in the share of walking trips between neighborhoods (Model A), and also while controlling for differences in respondent socioeconomic status and demographics (Model B).

Model A:

$$Share\ of\ walking = \alpha + \beta(Neighborhood) \qquad [1]$$

where:
Share of walking = share of all trips made by walking;
$Nieghborhood$ = categorical variables for each neighborhood (1 through 14); and
$\alpha, and\ \ \beta$ = regression coefficients to be estimated.

Model B:

$$Share\ of\ walking = \alpha + \beta(Neighborhood) + \theta(Demographics) \qquad [2]$$

where:
$Demogrpahics$ = independent demographic variables: Age, Income, Education, Employment, # Days you work from home, Household Size, # Vehicles per household, Do you have a disability, Race; and
$\alpha, \beta, and\ \theta$ = regression coefficients to be estimated.

Regression models A and B allowed us to determine which, if any, neighborhoods had a significant difference in walking. Understanding which neighborhoods walk more can help us identify potential characteristics within those neighborhoods that affect walking.

We also created three linear regression models to further explore how various factors affect the share of walking trips: one model comparing the presence of certain pedestrian infrastructure features with the share of walking trips (model 1), another model comparing the perceptions and indicators of pedestrian infrastructure quality with the share of walking trips (model 2), and a third model combining the first two models (model 3).

The first regression model included pedestrian infrastructure features from Table 1, section 1 as the main independent variables. Respondent demographics were incorporated into the model as another set of independent variables as were a set of independent variables describing large-scale built environment features: household density, the ratio of retail to residential land use area, if the neighborhood is a traditional street grid network or a cul-de-sac pattern, the distance to the nearest school, and if the neighborhood is near a Rapid Ride bus route which is an express bus service similar to a bus rapid transit system. Neighborhood sidewalk defect rates were also included as an independent variable to represent the level of sidewalk maintenance in each neighborhood.

The large scale built environment feature variables (Table 2) were constructed from GIS data available from the city of Albuquerque and the state of New Mexico.

Table 2. Large scale neighborhood features.

Neighborhood	HH Density (units/sq. mi)	Ratio of Retail to Residential Land Use	Grid Network	Nearest School Distance (mi)	Near Rapid Ride Bus Route
1	7,554	0.088	No	0.128	Yes
2	53,641	0.046	Yes	0.572	No
3	116,525	0.178	Yes	0.413	Yes
4	41,258	0.028	No	0.500	No
5	18,153	0.149	No	0.663	No
6	13,569	0	No	0.788	No
7	56,916	0.309	Yes	0.175	Yes
8	144,582	0.896	Yes	0.203	Yes
9	88,385	0.247	Yes	0.093	No
10	56,788	0.859	Yes	0.318	Yes
11	25,182	0.089	No	0.844	Yes
12	96,350	0.689	Yes	0.426	Yes
13	28,577	0.724	Yes	0.558	Yes
14	22,502	0.191	No	0.329	Yes

A GIS shapefile of census block groups and their corresponding household density (household units per square mile) was obtained from the New Mexico Resource Geographic Information System Program's website. To determine the household density for each neighborhood, we intersected the neighborhood boundaries, which were found from a shapefile of neighborhood association boundaries from the City of Albuquerque's GIS Data website, with the census block groups containing household density information using ArcGIS. From there, we were able to determine which census block group corresponded with each neighborhood and identify the household density for that neighborhood.

GIS shapefiles of land use, street networks, school locations, bus routes, as well as neighborhood association boundaries were obtained from the City of Albuquerque's GIS Data website. To determine the ratio of retail to residential land use area, we first intersected the land use parcels from the land use shapefile with the neighborhood boundaries using ArcGIS. From there, we determined how much area (square miles) in each neighborhood was for retail land use. We then determined how much area in each neighborhood was for residential land use. We divided the area retail land use by the area of residential land use to find the ratio of retail to residential land use in each neighborhood.

To determine if a neighborhood has a traditional gridded street network or cul-de-sac pattern, we intersected the street network for the city of Albuquerque by neighborhood boundaries. By focusing in on each neighborhood, we observed the street network in each neighborhood to determine if the streets were all connected or if they were mainly cul-de-sacs. Each neighborhood was ranked with a “Yes-there is a grid network” or “No-there is not a grid network.”

The distance to the nearest school location was found by identifying the location of every school within the city using the school location shapefile. The center of each neighborhood was then identified. Using the Near tool in ArcGIS, we calculated the distance (miles) from the center of each neighborhood to the nearest school.

To determine if a neighborhood was near a Rapid Ride bus route, we first created a quarter mile buffer around each neighborhood boundary. We chose a quarter mile buffer since that would most likely be the amount that people would walk to get to the bus. We then overlaid the bus routes over the buffered neighborhoods to determine if any Rapid Ride route was located within the neighborhood or quarter mile buffer around the neighborhood. Each neighborhood was ranked with a “Yes-it’s near a Rapid Ride route” or “No-it’s not near a Rapid Ride route.”

Neighborhood sidewalk defect rates (Table 3) were compiled for each neighborhood using data from our previous Tran-SET study *(53)*. The defect rates consider any vertical discontinuities, holes, cracks, and spalling that would require repair according to ADA guidelines *(54)*.

Table 3. Neighborhood sidewalk defect rates.

Neighborhood	Sidewalk Defect Rate (defects/mile)
1	70.005
2	58.906
3	56.238
4	30.397
5	20.089
6	23.678
7	91.165
8	62.325
9	71.429
10	67.504
11	17.866
12	59.349
13	92.200
14	33.952

Since most variables are categorical and our sample size is not very large, we recoded many of them to combine similar categories to reduce the number of independent variables in the regression models and avoid overfitting. This simplification also made it easier to interpret the results. Table 4 shows how each variable was re-coded.

Table 4. Categorical variable re-coding.

Original Variables	Condensed Variables
When walking on streets in your neighborhood how often do you use the sidewalk?	
-I sometimes use the sidewalks and sometimes walk in the street	All else
-I usually use the sidewalks	I usually use the sidewalks
-I usually walk in the street	All else
-I do not walk	All else
If you walk with someone else in your neighborhood, do both of you walk on the sidewalk?	
-Usually everyone I walk with uses the sidewalks	Usually everyone uses the sidewalks
-Usually I and the people I walk with walk in the street	All else
-Sometimes either I or someone I walk with walks in the street	All else
Do residential streets, like the one you live on, in your neighborhood have sidewalks?	
-Yes-Most of them	Yes – Most of them
-Yes-Some of them	Yes – Some of them
How is the lighting at night on residential streets in your neighborhood?	
-Good- most streets are evenly lit along their entire length	Good
-OK – some places have lighting and others are dark	Poor or OK
-Poor – there is very little light, most of the streets are dark	Poor or OK
How do people park their cars in your neighborhood?	
-Most people park off the street in driveways, garages or parking lots	Park off street
-There are a few cars usually parked on the street	Park on the street
-Most of the street is lined with parked cars	Park on street
How would you describe the speed of vehicle traffic in your neighborhood?	
-Most cars seem to travel at a safe speed	Travel at safe speed
-I have some concerns about the amount of speeding cars	Concerned about speeding
-I am very concerned about how many cars are speeding	Concerned about speeding
How would you describe the amount of traffic on residential streets in your neighborhood?	
-There is not much traffic	Not much traffic
-Sometimes I feel there is too much traffic for a residential area	Concerned about traffic
-There is too much traffic for a residential street	Concerned about traffic
Wide enough for two or more people to walk side by side	
-Most Do	They Do
-Some Do	They Do
-Most Do Not	Most Do Not
Are mostly level where they cross driveways	
-Most Do	They Do
-Some Do	They Do
-Most Do Not	Most Do Not
Are separated from the street by landscaping grass gravel dirt etc.	
-Most Do	They Do
-Some Do	They Do
-Most Do Not	Most Do Not
-Unsure	Unsure
Have ramps at street intersections	
-Most Do	They Do
-Some Do	They Do
-Most Do Not	Most Do Not
-Unsure	Unsure
Have permanent obstacles in them such as utility poles and fire hydrants	
-Most Do	They Do
-Some Do	They Do
-Most Do Not	Most Do Not
-Unsure	Unsure
Are partially blocked by overgrown bushes cactus or other plants	

Original Variables	Condensed Variables
-Most Do	They Do
-Some Do	They Do
-Most Do Not	Most Do Not
-Unsure	Unsure
Are frequently more than once per week blocked by parked cars or trucks	
-Most Do	They Do
-Some Do	They Do
-Most Do Not	Most Do Not
-Unsure	Unsure
Are littered with potentially dangerous items such as broken glass and hypoder mic needles	
-Most Do	They Do
-Some Do	They Do
-Most Do Not	Most Do Not
-Unsure	Unsure
Have marked crosswalks where local streets cross busier roads	
-Most Do	They Do
-Some Do	They Do
-Most Do Not	Most Do Not
-Unsure	Unsure
Age	
-25 – 34 years old	30
-35 – 44 years old	40
-45 – 54 years old	50
-55 – 65 years old	60
-65 – 75 years old	70
-Greater than 75	80
Annual Income	
-$20,000 – $34,999	27,500
-$35,000 – $49,999	42,500
-$50,000 – $74,999	62,500
-$75,000 – $99,999	87,500
-Less than $20,000	15,000
-Over $100,000	150,000
Education	
-Associate Degree	Some College or higher
-Bachelor’s Degree	Some College or higher
-Doctorate	Some College or higher
-High School Degree or equivalent (GED)	High School or Less
-Less than a high school diploma	High School or Less
-Master’s Degree	Some College or higher
-Some college, no degree	Some College or higher
Employment	
-Employed full time (including self-employed)	Employed
-Employed part time (including self-employed)	Employed
-Retired	Retired
-Unemployed and currently looking for work	Unemployed
-Unemployed and not currently looking for work	Unemployed
Work from Home	
-1-2 days	1.5
-3-4 days	3.5
-5 or more	7
-No	0
Household Size	
-1	1
-2	2
-3	3
-4	4

Original Variables	Condensed Variables
-5 or more	5
# Vehicles per Household	
-0	0
-1	1
-2	2
-3	3
-4	4
-5 or more	5
Disability	
-No	-No
-Yes	-Yes
Hispanic/Latinx?	**Hispanic/Lantinx & Race**
-Yes	Non-white
Asian	
-Yes	Non-white
Black or African American	
-Yes	Non-white
White	
-Yes	White
Household Density	Household Density
Ratio of Retail to Residential Land use	Ratio of Retail to Residential Land use
Grid Network	Grid Network
Nearest School Distance	Nearest School Distance
Near Rapid Ride Bus Route	Near Rapid Ride Bus Route
Sidewalk Defect Rate	Defects per Mile

Model 1:

$$share\ of\ walking = \alpha + \beta(quality\ perceptions) + \gamma(neighborhood\ features) + \theta(demographics) + \delta(sidewalk\ defects) \quad [3]$$

where:
$quality\ perceptions$ = Perceptions of pedestrian infrastructure quality = categorical variables for responses to questions in Table 1 section 1;
$neighborhood\ features$ = neighborhood scale built environmental and land-use variables: household density, the ratio of retail to residential land use area, if the neighborhood a traditional street grid network or a cul-de-sac pattern, the distance to the nearest school, and the distance to the Rapid Ride bus route;
$demographics$ = independent demographic variables: Age, Income, Education, Employment, # Days you work from home, Household Size, # Vehicles per household, Do you have a disability, Race;
$sidewalk\ defects$ = neighborhood sidewalk defect rates; and
$\alpha, \beta, \gamma, \theta, and\ \delta$ = regression coefficients to be estimated.

The second regression model includes pedestrian infrastructure features (Table 1, section 2) along with the same demographic and neighborhood scale features as model 1.

Model 2:

$$share\ of\ walking = \alpha + \beta(infrastructure\ features) + \gamma(neighborhood\ features) + \theta(demographics) + \delta(sidewalk\ defects) \quad [4]$$

where:
Share of walking = share of all trips made by walking;
$infrastructure\ features$ = categorical variables indicating the presence of pedestrian infrastructure features from Table 1, section 2; and
Our third model includes both infrastructure features and quality perceptions.

Model 3:

$$share\ of\ walking = \alpha + \beta(infrastructure\ features, quality\ perceptions) + \gamma(neighborhood\ features) + \theta(demographics) + \delta(sidewalk\ defects) \quad [5]$$

We created a fourth model comparing only neighborhood features, demographics, and sidewalk defect rates with the share of walking trips.

Model 4:

$$share\ of\ walking = \alpha + \gamma(neighborhood\ features) + \theta(demographics) + \delta(sidewalk\ defects) \quad [6]$$

We also created a fifth model comparing the effect of pedestrian infrastructure features with the share of walking trips. This model includes the effect of pedestrian infrastructure features (Table 1, section 3) along with the same demographic and neighborhood scale features as the previous models.

Model 5:

$$share\ of\ walking = \alpha + \beta(effect\ of\ pedestrian\ infrastructure\ features) + \gamma(neighborhood\ features) + \theta(demographics) \quad [7]$$

where:
$effect\ of\ pedestrian\ infrastructure\ features$ = variables of whether certain small scale neighborhood features encourage or discourage a person from walking from Table 1.

5. ANALYSIS AND FINDINGS

5.1. Responses & Demographics

We received responses from 14 out of 64 neighborhoods that we contacted in Albuquerque with a total of 202 responses. Responses from each neighborhood ranged from 1 to 41. A map of where each of the 14 neighborhoods is located can be seen in Figure 2 below. The majority of responding neighborhoods are located near the central part of the city which is near the University of New Mexico Campus and downtown. These are urban, mixed use neighborhoods. The other neighborhoods are scattered across the north and southeast parts of the city which tend to be more residential neighborhoods. Table 5 provides a summary of demographics of the survey respondents along with demographics from the U.S. Census American Community Survey for the City of Albuquerque. Generally, survey respondents were older, had higher incomes, had higher educational attainment, and were more likely to be white than the regional population. While survey respondents are not representative of the general population, their responses can still be used to identify important sidewalk quality attributes. The main limitation is that attributes important to underrepresented populations and neighborhoods in our survey may not be identified.

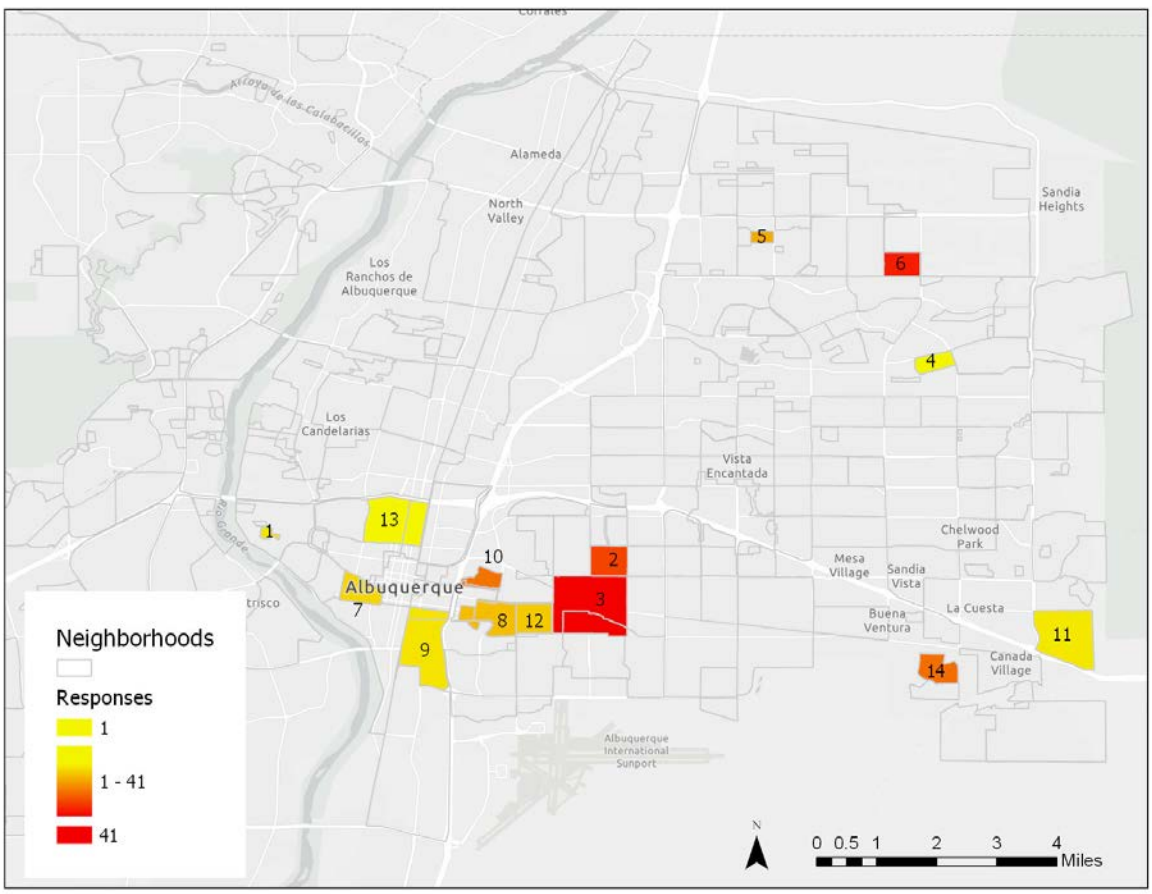

Figure 2. Map of 14 neighborhoods that responded.

Table 5. Demographics of respondents.

	Our Survey (n=202)	Albuquerque[a]
Variable	**Percent**	**Percent**
Age		
25-35	8%	16%
35-45	14%	13%
45-55	14%	12%
55-65	26%	12%
65-75	31%	8%
>75	8%	6%
Annual Income		
<$20,000	1%	20%
$20,000-$35,000	4%	16%
$35,000-$50,000	10%	14%
$50,000-$75,000	24%	17%
$75,000-$100,000	17%	12%
>$100,000	43%	21%
Education		
Less than High School Diploma	0.5%	11%
High School Degree	0.5%	23%
Some College, No Degree	5%	24%
Associate Degree	5%	8%
Bachelor's Degree	32%	19%
Master's Degree	37%	15% (Advanced
Doctorate	20%	Degrees)
Employment Status		
Employed Full-time	45%	60%
Employed Part-time	12%	
Retired	39%	36% (Not in Civilian Labor Force)
Unemployed and looking for work	1%	4%
Unemployed and not looking for work	3%	
Work from Home		
1-2 days	12%	4.3% (Work from
3-4 days	5%	Home)
5 or more	8%	
No	75%	
Household Size		
1	24%	Avg. HH Size =2.5
2	53%	
3	10%	
4	10%	
5+	3%	
# Vehicles per Household		
0	1%	-
1	27%	-
2	52%	-
3	14%	-
4	4%	-
5+	2%	-
Hispanic or Latinx & Race		
Hispanic/Latinx	14%	49%
Asian	0.5%	3%
Black or African American	1%	3%
White	85%	74%
Disability		
Yes	6%	13%
No	94%	-

[a] *Data for the City of Albuquerque from the US Census American Community Survey*

5.2. Amount of Walking in Each Neighborhood

To understand what affects walking, we looked at how much each neighborhood walks. Knowing how walking varies by each neighborhood can help us identify if there are certain characteristics in each neighborhood that correlate with the amount they walk. Figure 3 shows boxplots of the share of trips for each mode of transportation reported by respondents. The two highest reported modes of transportation are walking and driving. The walking mode share is much higher than what most surveys tend to find. This may be because our survey asked respondents to report not just how much they walk for commuting trips and other transportation trips, but also how much they walk for recreational purposes such as how often they walk for exercise, for pleasure, or to walk their dog.

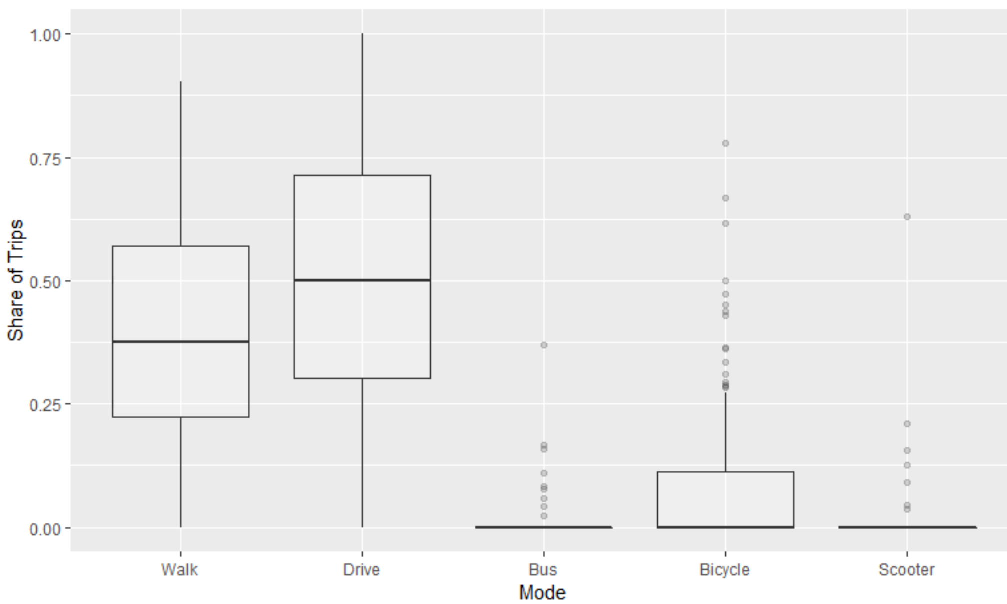

Figure 3. Share of trips for each mode.

Figure 4 shows boxplots for the number of walking trips reported in each neighborhood with the width of the boxplot corresponding to the number of responses that came from each neighborhood (wider boxplots correspond to a greater number of responses). Figure 5 shows boxplots for the share of walking trips for respondents grouped by each neighborhood with the width of the boxplot corresponding to the number of responses from each neighborhood (wider boxplots correspond to a greater number of responses). Looking at the share of walking trips for each neighborhood, it appears that neighborhoods 5, 8, and 12 have higher shares of walking trips than other neighborhoods. Neighborhood 4 also has a very high share of walking trips, however, neighborhood 4 only has one observation and therefore it is unlikely to be representative of the neighborhood as a whole. Generally, the results seem to indicate that there is some variability in walking between neighborhoods.

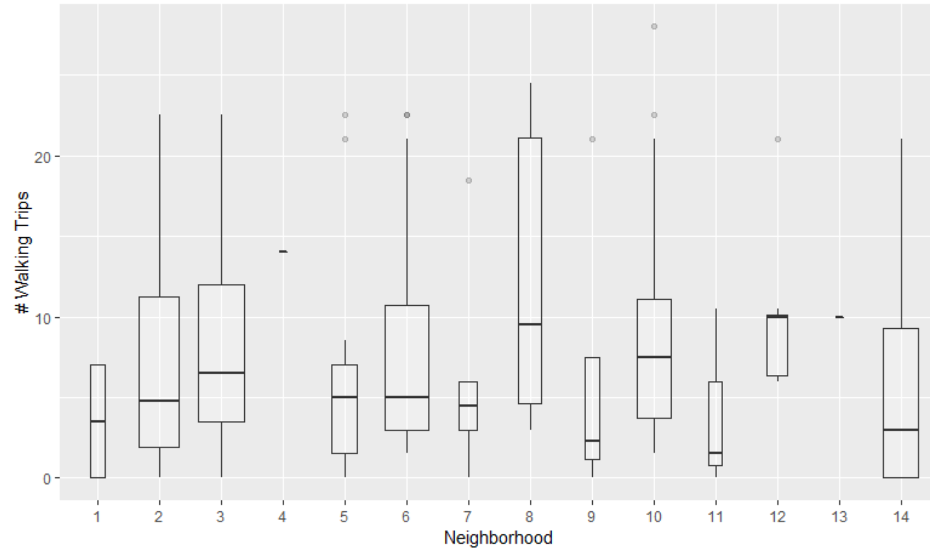

Figure 4. Boxplot of the number of walking trips for each neighborhood.

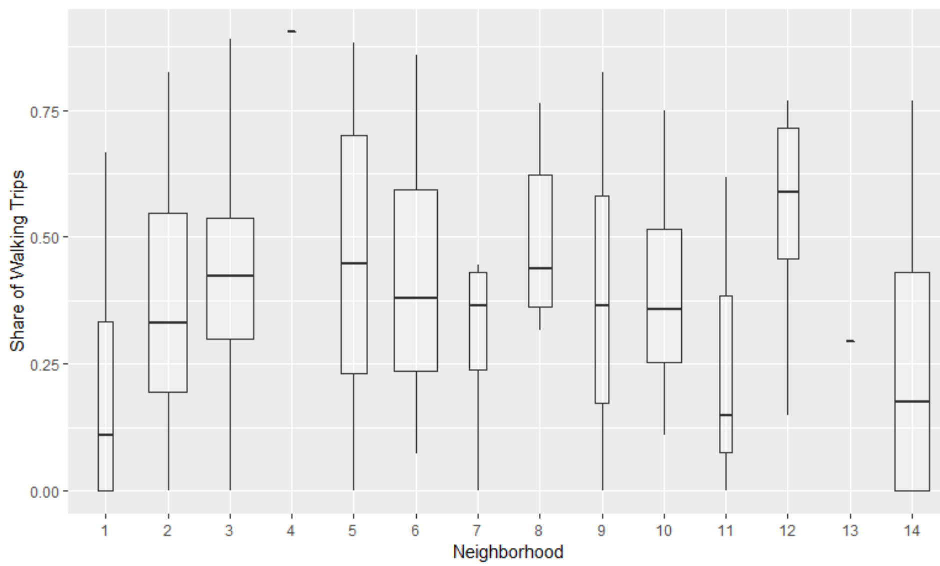

Figure 5. Boxplot of the share of walking trips for each neighborhood.

We also created two linear regression models to identify statistically significant differences in the share of walking trips between neighborhoods (Table 6). The first model includes a dummy variable for each neighborhood. The second model includes dummy variables for each neighborhood and controls for differences in socioeconomic status and demographics of respondents. The regression results in Table 6 indicate that neighborhoods 4, 8, and 12 have significantly higher rates of walking than all other neighborhoods; however, when we control for differences in demographics, only neighborhood 4 is statistically different (and neighborhood 4 has only one data point). The relatively small sample size compared to the number of neighborhoods likely affects the statistical power of our analysis and the ability to detect potentially significant differences. The full regression results are provided in Appendix C.

Table 6. Regression analysis results for the neighborhood regression model.

	Model A	Model B
Variable	**Coeff. Estimate**	**Coeff. Estimate**
Intercept	0.222 *	0.291 .
Neighborhood 2	0.153	0.034
Neighborhood 3	0.207 .	0.136
Neighborhood 4	0.681 **	0.510 *
Neighborhood 5	0.222 .	0.225
Neighborhood 6	0.188	0.110
Neighborhood 7	0.082	0.015
Neighborhood 8	0.267 *	0.235
Neighborhood 9	0.166	0.107
Neighborhood 10	0.159	0.107
Neighborhood 11	0.034	0.006
Neighborhood 12	0.327 *	0.195
Neighborhood 13	0.072	0.031
Neighborhood 14	0.016	-0.071
Education		
High School or Less		0.155
Employment		
Unemployed		0.005
Retired		0.093 .
Age		0.001
HH Annual Income		0.000
Days Work from Home		-0.014
HH Size		-0.006
# Vehicles per HH		0.000
Disability		
Yes		-0.100
Race		
Non-white		0.008
Adj. R^2	0.07	0.14
n	200	179

*Signif. Levels: *** 99.9%, ** 99% , * 95%, . 90%*

5.3. Neighborhood Pedestrian Infrastructure Characteristics

Table 7 provides a summary of responses from each neighborhood regarding questions that asked participants about their perceptions of the quality of pedestrian infrastructure in their neighborhood. The table reports the most frequent response reported in each neighborhood. The results indicate that respondents in 43% of the neighborhoods walk in the street at least some of the time rather than on sidewalks, and more so when walking with another person. This may be an indicator that sidewalks in these neighborhoods present a barrier to walking and are not wide enough for two or more people to walk together. Street lighting is reported to be sufficient in most neighborhoods, but 29% still felt it was inadequate. All but three neighborhoods reported that at least some sidewalk repair is needed. Most neighborhoods, 64%, also have at least some concern about traffic speed. All neighborhoods have sidewalks on most streets. Aggregate responses to these questions can be found in Appendix B.

Table 7. Most frequent response regarding perceptions of pedestrian infrastructure quality.

Quality Perception	Neighborhood						
	1 (4)	**2 (30)**	**3 (41)**	**4 (1)**	**5 (13)**	**6 (36)**	**7 (6)**
Sidewalks present?	Yes-mostly (75%)	Yes-mostly (100%)	Yes-mostly (100%)	Yes-mostly (100%)	Yes-mostly (100%)	Yes-mostly (97%)	Yes-mostly (100%)
How often do you use the sidewalk?	Sometimes use sidewalk, sometimes use street (50%)	Sometimes use sidewalk, sometimes use street (60%)	Sometimes use sidewalk, sometimes use street (49%)	Sometimes use sidewalk, sometimes use street (100%)	Usually (85%)	Usually (81%)	Usually (50%)
If you walk with someone else in your neighborhood, do both of you walk on the sidewalk?	One of us walks in street (50%)	One of us walks in street (77%)	One of us walks in street (61%)	One of us walks in street (100%)	Usually (69%)	Usually 64%)	Usually (50%)
Sidewalks maintained?	A few need repairs (50%)	A few need repairs (50%)	A few need repairs (54%)	A few need repairs (100%)	A few need repairs (69%)	Yes, most (58%)	A few need repairs (50%)
Lighting?	Poor (75%)	OK (67%)	OK (56%)	Poor (100%)	OK (62%)	OK (75%)	OK (67%)
Parked cars?	Driveway (100%)	Few in street (70%)	Few in street (73%)	Few in street (100%)	Few in street (85%)	Few in street (61%)	Most in street (67%)
Traffic speeding?	OK (75%)	Some concerns/OK (37%/37%)	Some concerns (54%)	OK (100%)	Some concerns (62%)	Some concerns (50%)	Some concerns (50%)
Traffic?	Not much (75%)	Not much (53%)	Not much (44%)	Sometimes too much (100%)	Not much (77%)	Not much (645)	Not much (100%)
	8 (10)	**9 (4)**	**10 (22)**	**11 (3)**	**12 (8)**	**13 (1)**	**14 (23)**
Sidewalks present?	Yes-mostly (100%)	Yes-mostly (100%)	Yes-mostly (86%)	Yes-mostly (67%)	Yes-mostly (100%)	Yes-mostly (100%)	Yes-mostly (100%)
How often do you use the sidewalk?	Usually (90%)	Usually (75%)	Sometimes use sidewalk, sometimes use street (59%)	Sometimes use sidewalk, sometimes use street (67%)	Usually (100%)	Usually (100%)	Usually (96%)
If you walk with someone else in your neighborhood, do both of you walk on the sidewalk?	Usually 80%)	Usually 75%)	One of us walks in street (55%)	One of us walks in street 67%)	Usually (75%)	One of us walks in street (100%)	Usually (83%)
Sidewalks maintained?	Most need repairs (50%)	A few need repairs (50%)	A few need repairs 64%)	Yes, most (67%)	Most need repairs (50%)	Most need repairs (100%)	Yes, most (52%)
Lighting?	Poor (60%)	OK (100%)	OK (73%)	OK (67%)	OK (75%)	Poor (100%)	OK (61%)
Parked cars?	Most in street (80%)	Few in street (50%)	Few in street (68%)	Driveway (67%)	Most in street (75%)	Most in street (100%)	Few in street (61%)
Traffic speeding?	Some concerns (50%)	OK (50%)	Some concerns (55%)	OK (100%)	Very concerned (63%)	Some concerns (100%)	OK (48%)

Quality Perception	Neighborhood						
Traffic?	Sometimes too much (50%)	Not much (75%)	Sometimes too much (50%)	Not much (100%)	Sometimes too much (50%)	Sometimes too much (100%)	Not much (52%)

We also asked respondents to identify if their neighborhood had certain pedestrian infrastructure attributes using a 4-point scale (1-Most Do, 2-Some Do, 3-Most Do Not, 4-Unsure). Figure 6 shows the average response to each question (excluding the responses of 4-Unsure) for each neighborhood along with the share of walking for each neighborhood. The average response to each question is represented by a symbol and the share of walking is represented by the bar plot. Overall, pedestrian infrastructure attributes varied across neighborhoods. Respondents in most neighborhoods generally indicate that sidewalks have a mix of positive and negative attributes. The main theme appears to be inconsistency in attributes within each neighborhood. Aggregate responses to these questions can be found in Appendix B.

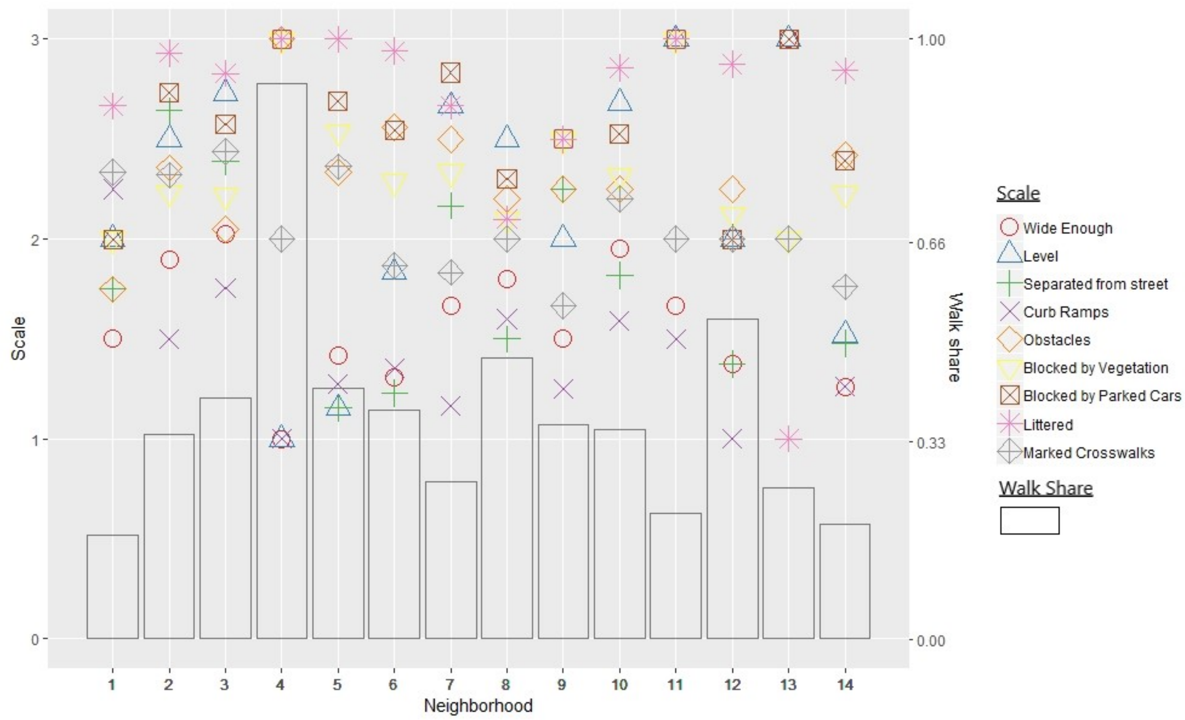

Figure 6. Average responses for whether certain pedestrian infrastructure features are present in one's neighborhood.

5.4. Regression Analysis

A regression analysis was completed comparing the effect of perceptions of pedestrian infrastructure quality on the share of walking trips. Table 8 provides a summary of the regression results showing the coefficient estimate for each independent variable in the linear regression model and indicators for which variables are found to be significant (full regression results are provided in Appendix C). Note that many of the independent variables are categorical (they are not numbers, they are discrete responses). The effect of the base level of each categorical variable is included in the intercept term. The coefficient estimates indicate the size and significance of categorical variable levels shown from the base level.

Models 1, 2, and 3 have a reasonable fit with all having an adjusted R^2 around 0.14 – 0.16. Overall, larger scale features of each neighborhood are most important in explaining differences in the share of walking trips made by respondents. Increasing household density and a greater mix of residential and retail land-use are both statistically significant. Household density and residential and retail land-use mix are associated with an increase in the share of walking trips. These results agree with what we would expect based on the results of previous studies. The presence of a grid like street network is associated with a decrease in the share of walking trips. This result is not what we would expect, as a gridded street network generally provides a shorter route to destination; however, many of the walking trips our respondents made were for recreation or pleasure, and therefore, the time saving potential of a grid network may not provide any benefit. Neighborhoods with a gridded street network may also be associated with more urban features that could deter walking trips for recreation and pleasure or be capturing the influence of other unique features of these neighborhoods that are not accounted for by the other independent variables. Being near a rapid ride bus route is also associated with a decrease in the share of walking trips. This is also not something we expected. Our hypothesis was that being near a rapid bus route would encourage more people to walk to or from the bus route or walk around the surrounding area where there might be more of a mixed land-use pattern. However, being near a rapid bus route may be a proxy for other factors, such as being located near Central Avenue which has high traffic volumes and passes through some areas known to have high crime rates. Being retired is also statistically significant and associated with an increase in the share of walking trips.

Some smaller scale attributes of the pedestrian environment show some significance. A lack of marked crosswalks at busy road crossings is statistically significant and associated with a decrease in the share of walking trips. Being unsure of how common curb ramps are in your neighborhood is also statistically significant and associated with a large decrease in the share of walking trips. We are not sure what this result means. It could indicate respondents who don’t walk frequently do not know about the presence of curb ramps. The sidewalk defect rate is not significant.

A regression analysis comparing sidewalk defect rates with the share of walking trips was also completed. A summary of the regression results can be found in Table 9 below. Again, larger scale features of density, land-use mix, and being near a rapid ride bus route are statistically significant. Density and land-use mix are associated with an increase in the share of walking trips while being near a rapid bus route is associated with a decrease in the share of waling trips as found in the previous regression models. Being retired is also statistically significant and associated with an increase in the share of walking trips. The sidewalk defect rate is not statistically significant.

Table 8. Regression modeling results for Models 1, 2, and 3.

	Model 1	Model 2	Model 3
Variable	**Coeff. Value**		
(Intercept)	0.124	-0.063	-0.018
When walking on streets in your neighborhood how often do you use the si dewalk?			
-I usually walk in street	-2.4e-4		-0.029
If you walk with someone else in your neighborhood, do both of you walk o n the sidewalk?			
-Usually I and the people I walk with walk in the street	0.066		0.056
Do residential streets, like the one you live on, in your neighborhood have s idewalks?			
-Yes – Some of them	-0.111		-0.128
How is the lighting at night on residential streets in your neighborhood?			
-Poor or OK	-0.054		-0.079
How do people park their cars in your neighborhood?			
- Park on the street	-0.049		-0.070
How would you describe the speed of vehicle traffic in your neighborhood?			
-Concerned about speeding	0.031		0.054
How would you describe the amount of traffic on residential streets in you r neighborhood?			
-Too much traffic	0.040		0.020
Wide enough for two or more people to walk side by side			
-Most Do Not		-0.057	-0.056
Are mostly level where they cross driveways			
-Most Do Not		0.040	0.047
Are separated from the street by landscaping grass gravel dirt etc.			
-Most Do Not		0.057	0.090 .
-Unsure		0.523 .	0.482
Have ramps at street intersections			
-Most Do Not		-0.038	-0.072
-Unsure		-0.510*	-0.500*
Have permanent obstacles in them such as utility poles and fire hydrants			
-Most Do Not		0.001	-0.023
-Unsure		0.082	0.056
Are partially blocked by overgrown bushes cactus or other plants			
-Most Do Not		-0.008	-0.011
-Unsure		0.084	0.030
Are frequently more than once per week blocked by parked cars or trucks			
-Most Do Not		-0.046	-0.042
-Unsure		0.070	0.077
Are littered with potentially dangerous items such as broken glass and hyp odermic needles			
-Most Do Not		0.051	0.064
-Unsure		0.098	0.075
Have marked crosswalks where local streets cross busier roads			
-Most Do Not		-0.103**	-0.090*
-Unsure		-0.068	-0.061
Age	0.001	0.001	0.001
Annual Income	-2.4e-7	-6.8e-8	
Education			
-High School or Less	0.028	0.085	-0.042
Employment			
-Unemployed	0.015	0.022	0.047
-Retired	0.115*	0.116*	0.132*
# Days Work from Home	-0.017 .	-0.010	-0.018 .
Household Size	-0.009	-0.012	-0.008
# Vehicles per Household	-0.003	-0.004	-0.003
Disability			

	Model 1	Model 2	Model 3
-Yes	-0.069	-0.069	-0.077
Race			
-Non-white	-0.001	-0.001	0.015
Household Density	3.2e-6**	3.8e-6***	3.9e-6**
Ratio of Retail to Residential Land use	0.284**	0.264**	0.363***
Grid Network	-0.298 .	-0.326 .	-0.407*
Nearest School Distance	0.225	0.372 .	0.345
Near Rapid Ride Bus Route	-0.135*	-0.139*	-0.153*
Sidewalk Defect Rate	0.003	0.004	0.005
Adj. R^2	0.14	0.15	0.16
n	168	176	166

*Signif. Levels: *** 99.9%, ** 99%, * 95%, . 90%*

Table 9. Regression results for Model 4.

Variable	Coeff. Value
(Intercept)	0.060
Age	0.001
Annual Income	-1.9e-7
Education	
-High School or Less	0.099
Employment	
-Unemployed	0.003
-Retired	0.098*
# Days Work from Home	-0.014
Household Size	-0.012
# Vehicles per Household	-0.001
Disability	
-Yes	-0.084
Race	
-Non-white	3.3e-4
Household Density	3.2e-6**
Ratio of Retail to Residential Land use	0.214**
Grid Network	-0.244
Nearest School Distance	0.265
Near Rapid Ride Bus Route	-0.125*
Sidewalk Defect Rate	0.003
Adj. R^2	0.13
n	179

*Signif. Levels: *** 99.9%, ** 99%, * 95%, . 90%.*

5.5. Infrastructure Attributes that Encourage or Discourage People From Walking

Finally, we analyzed participants responses to whether they thought certain pedestrian infrastructure attributes encouraged or discouraged them from walking. Figure 7 is a summary of those results for each neighborhood (1-strongly discourage from walking to 5-strongly encourage walking) along with the share of walking for each neighborhood. Overall, responses are fairly consistent across neighborhoods. Having sidewalks and maintaining them well is reported to be most important for encouraging walking. Marked pedestrian crossings and street lighting are also relatively important for encouraging walking. Crime, hazardous litter, and high traffic speed (and almost to a similar extent high traffic volume) are the most important factors reported to discourage walking. Other factors are reported to be relatively less important than these at encouraging and discouraging walking but may also be important. Overall percentages of responses to these questions can be found in Appendix B.

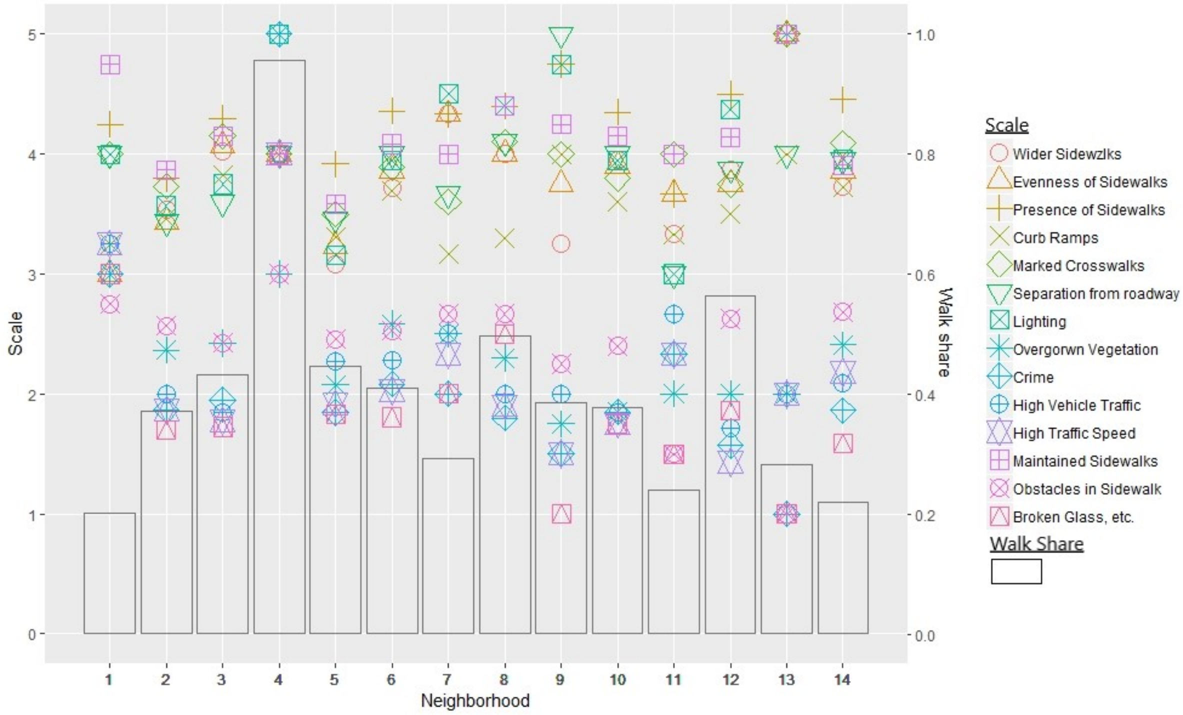

Figure 7. Responses to if certain sidewalk features encourage or discourage someone from walking.

A regression analysis was also completed comparing the effect of whether certain sidewalk features encourage or discourage someone from walking on the share of walking trips. Table 10 is a summary of the regression results with the coefficient estimates and indicators for which variables are found to be significant (full regression results are provided in Appendix C). Both household density and residential and retail land-use mix are statistically significant and associated with an increase in the share of walking trips. The only small-scale attribute of the pedestrian environment that is statistically significant is the evenness of sidewalks which is associated with an increase in the share of walking trips. This tells us that evenness of sidewalks is an important consideration for people when walking and could mean that people who walk more are more aware of uneven conditions of sidewalks which they might like to see improved.

Table 10. Regression results for Model 5.

Variable	Coeff. Value
(Intercept)	-0.116
Wider Sidewalks	-0.042
Evenness of Sidewalks	0.068 **
Presence of sidewalks	0.018
Sidewalk curb ramps at intersections	-0.001
Marked pedestrian crossings at busy streets	-0.004
Separations between sidewalk and roadway	0.011
Lighting at night	0.009
Overgrown vegetation	0.013
Crime	-0.014
High volume of vehicle traffic	-0.026
High traffic speed	0.011
Maintained sidewalks	0.003
Obstacles in sidewalk such as utility poles or fire hydrants	-0.020
Broken glass or other potentially dangerous items in sidewalk	0.048 .
Age	0.002
Annual Income	5.450e-08
Education	
-High School or Less	0.057
Employment	
-Unemployed	-0.027
-Retired	0.089 .
# Days Work from Home	-0.016
Household Size	0.001
# Vehicles per Household	-0.010
Disability	
-Yes	-0.087
Race	
-Non-white	0.042
Household Density	2.384e-06 **
Ratio of Retail to Residential Land use	0.198 *
Grid Network	-0.094
Nearest School Distance	0.143
Near Rapid Ride Bus Route	-0.132 .
Adj. R^2	0.15
n	171
Signif. Levels: * 99.9% ** 99% * 95% . 90%**	

6. CONCLUSIONS

In this study, our goal was to understand the relationship between the quality of pedestrian infrastructure and the choice to walk. After reviewing previous studies, we found that many had evaluated how large-scale built environment characteristics affect walking; however, we found that very few studies had considered smaller scale features of the pedestrian environment and pedestrian infrastructure.

Our study conclusions are limited by a smaller sample size than we had anticipated and one that is generally older, wealthier and more white than the general population of the city. We contacted neighborhood associations where we did not receive any responses after our initial analysis of the survey results a second time; however, we did not receive any additional responses. Our analysis of the survey data, as presented in this report, also raises additional limitations. How we recoded variables to reduce categories and which variables we included in the regression models may have had important impacts on the results, given the relatively small sample size.

Given the above limitations, there are several conclusions we can draw from our study. First, respondents make a surprisingly large share of trips by walking. We think this is a result of asking respondents to explicitly report walking trips for recreation and pleasure in addition to transportation trips. Many travel surveys are focused on commute and transportation trips and therefore may result in a general under appreciation for how much people walk. While many travel surveys to include an option to report trips for recreation or exercise, how these questions are phrased or asked may also be important. Given that most of our respondents walk very frequently, it seems important to consider the quality and safety of the infrastructure they use. Responses to many of our survey questions indicate that the provision and quality of pedestrian infrastructure is quite variable (see Table 7 and Figure 6), indicating opportunities for improvement.

We do not find much difference in walking rates between neighborhoods, but we believe this is largely due to the small sample size. However, we do find, as other studies have, that neighborhood scale land-use and transportation features are significantly associated with walking. Household density and greater land-use mix are both associated with greater shares of walking. While there may be opportunities to encourage walking through improved walking infrastructure, these results confirm that supportive land-use patterns are important too.

We also find that being retired is significantly associated with a larger share of walking trips which generally makes sense given that many walking trips in our sample are for recreation and pleasure, and retired individuals may have more time for these activities. We do not find any association with other socioeconomic status or demographic variables. This is not entirely surprising given that our sample was not as diverse as the general population. Additionally, prior studies have generally found mixed results regrading socioeconomic status and walking rates. Since retired, and presumably older, individuals appear to make more walking trips, this should reinforce the case for maintaining sidewalks and ensuring they meet accessibility standards.

We do find some association between smaller scale attributes of the pedestrian environment and walking. The lack of marked crosswalks at busy road crossings stands out as being important and significantly associated with lower shares of walking. Respondents in our study also indicate that sidewalks are important for encouraging walking. Having curb cuts produced unexpected results (being unsure of the presence of curb cuts is a significant indicator of lower walking shares). We think that this variable may be proxy for walking experience. If you walk less, you may not know if sidewalks have curb ramps. This variable could also be picking up unique attributes in certain neighborhoods that the variable we included in our study did not. Respondents also indicated that having sidewalks in general, sidewalks that are even, and sidewalks that are maintained are important for encouraging them to walk while crime, high traffic speeds and volumes, and dangerous litter are important factors that discouraged walking. Considering these results, we think that providing more marked crosswalks at high volume road crossings is most likely to increase walking although this may also raise safety concerns. Many high-volume roads in Albuquerque are multilane arterials with relatively high traffic speeds where additional traffic control devices and traffic calming measures would likely be needed to provide safe crossing opportunities. We think that other small-scale attributes of the street environment could also be important to increasing walking; however, without a larger and more representative sample we simply do not have the statistical power to evaluate these in a robust way.

We had originally planned to rank which pedestrian infrastructure attributes would be most important to address to cost effectively increase walking. Given the limited nature of our findings we have not done that. As noted, marked pedestrian crossings seem to be important but there is less evidence for other attributes. While respondents did indicate that other attributes are important (see Figure 16), these were not revealed in their walking behavior. We also envisioned collecting data as part of a larger effort to conduct a longitudinal (before and after) study. The data we collected could still be used for this purpose if changes in sidewalk attributes are made in neighborhoods where we received a relatively large number of responses (or where we are able to increase our sample size with additional recruitment efforts). It would be particularly interesting to evaluate if the addition of improved, marked, pedestrian crossings indeed correspond to an increase in the share of walking trips.

Weaknesses in our study can be addressed by additional efforts to increase our sample size and collect similar data from neighborhoods where the city is planning to make changes to residential streets or sidewalks. Collecting travel behavior data before projects are implemented in affected neighborhoods and a set of similar control neighborhoods would allow the city to learn over time how various changes affect walking and other travel behavior. This is something that is not regularly done by any municipality that we are aware of but could be a relatively inexpensive way to improve the function of residential streets and pedestrian infrastructure.

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APPENDIX A: SURVEY

Dear Albuquerque Resident,

We invite you to participate in a research study being conducted by the Department of Civil, Construction and Environmental Engineering at the University of New Mexico. The purpose of this study is to better understand how people in Albuquerque travel around their neighborhoods and use neighborhood streets. The information that you provide through a survey for this study is expected to help cities like Albuquerque identify opportunities for improving neighborhood streets and the wellbeing of residents who use them.

There is no direct benefit to participating in this survey, but the information you provide us will be used in our study, which aims to better inform decisions affecting residential streets in Albuquerque and elsewhere. The survey should take about 15 minutes to complete. Your participation in this survey is completely voluntary and you can refuse to answer any of the questions at any time. There are no known risks to participating in this survey. We will not collect names, addresses or other identifying information about you. Your responses will remain anonymous and confidential. The data from this study will only be reported in aggregate and only used for this study. We will send you a copy of the study results when completed.

If you have any questions or concerns about the survey or our research, or if you would like a paper based survey form [or for paper based surveys: if you would like a second copy of the survey for an additional household member] please contact Alexis Corning-Padilla, Research Assistant at acorningpadilla@unm.edu or (505) 277-2877. If you have questions regarding your rights as a research participant, or about what you should do in case of any harm to you, or if you want to obtain information or offer input, please contact the UNM Office of the IRB (OIRB) at (505) 277-2644 or irb.unm.edu.

By clicking "OK" you verify that you are 18 years of age or older and will be agreeing to participate in the research described above.

Thank you for your help,

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Question 1
Are you at least 18 years old?

☐ Yes, please continue with the survey

☐ No (on electronic survey participant will be directed to a screen that states: "Thank you for your interest in this study; however, we are only collecting information through this survey on adults of at least 18 years of age." and on the paper based survey text will be included here stating "Thank you for your interest in this study; however, we are only collecting information through this survey on adults of at least 18 years of age.")

Section 1: How you travel

Please consider how you typically traveled during the year 2018 when answering the questions in this section of the survey.

Question 2
During a typical week, tell us how you traveled in the table below. Think about how you usually traveled in 2018 which may be different than how you traveled this week.

	Monday – Friday				Saturday - Sunday			
Drive alone or with someone else (including taxis, Uber, Lyft, etc.)	0	1-2	3-4	5 or more	0	1-2	3-4	5 or more
Work	☐	☐	☐	☐	☐	☐	☐	☐
School	☐	☐	☐	☐	☐	☐	☐	☐
Shopping	☐	☐	☐	☐	☐	☐	☐	☐
Other: ________	☐	☐	☐	☐	☐	☐	☐	☐
Ride the bus								
Work	☐	☐	☐	☐	☐	☐	☐	☐
School	☐	☐	☐	☐	☐	☐	☐	☐
Shopping	☐	☐	☐	☐	☐	☐	☐	☐
Other: ________	☐	☐	☐	☐	☐	☐	☐	☐
Ride a bicycle								
Trips for a specific purpose								
Work	☐	☐	☐	☐	☐	☐	☐	☐
School	☐	☐	☐	☐	☐	☐	☐	☐
Shopping	☐	☐	☐	☐	☐	☐	☐	☐
Other: ________	☐	☐	☐	☐	☐	☐	☐	☐
Trips for Pleasure or Exercise								
Bicycle for exercise	☐	☐	☐	☐	☐	☐	☐	☐
Bicycle for pleasure	☐	☐	☐	☐	☐	☐	☐	☐
Other: ___________	☐	☐	☐	☐	☐	☐	☐	☐
Walk, jog, or run								
Trips for a specific purpose								
Work	☐	☐	☐	☐	☐	☐	☐	☐
School	☐	☐	☐	☐	☐	☐	☐	☐
Shopping	☐	☐	☐	☐	☐	☐	☐	☐
Other: ________	☐	☐	☐	☐	☐	☐	☐	☐
Trips for Pleasure or Exercise								
Exercise (Running, etc.)	☐	☐	☐	☐	☐	☐	☐	☐
Walk for pleasure	☐	☐	☐	☐	☐	☐	☐	☐
Walk dog (other pet)	☐	☐	☐	☐	☐	☐	☐	☐
Other: ___________	☐	☐	☐	☐	☐	☐	☐	☐

Scooter, skateboard, etc.								
Trips for a specific purpose								
Work	☐	☐	☐	☐	☐	☐	☐	☐
School	☐	☐	☐	☐	☐	☐	☐	☐
Shopping	☐	☐	☐	☐	☐	☐	☐	☐
Other: ________	☐	☐	☐	☐	☐	☐	☐	☐
Trips for Pleasure or Exercise								
Exercise	☐	☐	☐	☐	☐	☐	☐	☐
Ride for pleasure	☐	☐	☐	☐	☐	☐	☐	☐
Other: ___________	☐	☐	☐	☐	☐	☐	☐	☐

Question 3

When walking on streets in your neighborhood how often do you use the sidewalk?

☐ I usually use the sidewalks

☐ I sometimes use the sidewalks and sometimes walk in the street

☐ I usually walk in the street

☐ I do not walk

If you walk with someone else in your neighborhood, do both of you walk on the sidewalk?

☐ Usually everyone I walk with uses the sidewalks

☐ Sometimes either I or someone I walk with walks in the street

☐ Usually I and the people I walk with walk in the street

When riding a bicycle in your neighborhood, do you ride in the street or on the sidewalk?

☐ I usually use the sidewalks

☐ I sometimes use the sidewalks and sometimes ride in the street

☐ I usually ride in the street

☐ I do not ride a bicycle

Section 2: What are the streets like in your neighborhood?

Describe the sidewalks on residential streets in your neighborhood.

Question 4

Do residential streets, like the one you live on, in your neighborhood have sidewalks?

☐ Yes – Most of them

☐ Yes – Some of them

☐ No – Most do not

Question 5

Do sidewalks in your neighborhood have the following features:

	Most Do	Some Do	Most Do Not	Unsure
Wide enough for two or more people to walk side by side	☐	☐	☐	☐
Are mostly level where they cross driveways	☐	☐	☐	☐
Are separated from the street by landscaping, grass, gravel, dirt, etc.	☐	☐	☐	☐
Have ramps at street intersections	☐	☐	☐	☐
Have permanent obstacles in them such as utility poles and fire hydrants	☐	☐	☐	☐
Are partially blocked by overgrown bushes, cactus, or other plants	☐	☐	☐	☐
Are frequently (more than once per week) blocked by parked cars or trucks	☐	☐	☐	☐
Are littered with potentially dangerous items such as broken glass and hypodermic needles	☐	☐	☐	☐
Have marked crosswalks where local streets cross busier roads?	☐	☐	☐	☐

Question 6

How well maintained are sidewalks in your neighborhood? For example, are there large cracks, holes, or crumbling surfaces that make it difficult to use sidewalks?

☐ Most are well maintained

☐ A few sections need to be repaired or replaced

☐ Many sections need to be repaired or replaced

☐ Most need to be repaired or replaced

☐ I am not sure

Describe the residential streets in your neighborhood.

Question 7

How is the lighting at night on residential streets in your neighborhood?

☐ Good – most streets are evenly lit along their entire length

☐ Ok – some places have lighting and others are dark

☐ Poor – there is very little light, most of the streets are dark

Question 8

How do people park their cars in your neighborhood?

☐ Most people park off the street in driveways, garages or parking lots

☐ There are a few cars usually parked on the street

☐ Most of the street is lined with parked cars

Question 9
How would you describe the speed of vehicle traffic in your neighborhood?

☐ Most cars seem to travel at a safe speed

☐ I have some concerns about the amount of speeding cars

☐ I am very concerned about how many cars are speeding

Question 10
How would you describe the amount of traffic on residential streets in your neighborhood?

☐ There is not much traffic

☐ Sometimes I feel there is too much traffic for a residential area

☐ I think there is too much traffic for a residential street

Section 3: In this section we are interested in knowing about how neighborhood streets might affect how much your walk or if you walk at all for any purpose.

Question 11
Please tell us how each of the following neighborhood street features or neighborhood conditions either encourage, discourage or have no affect on how much you walk or if you walk at all.

	Strongly Discourage 1	2	Has No Affect 3	4	Strongly Encourage 5
Wider sidewalks	☐	☐	☐	☐	☐
Evenness of sidewalks	☐	☐	☐	☐	☐
Presence of Sidewalks	☐	☐	☐	☐	☐
Sidewalk curb ramps at Intersections	☐	☐	☐	☐	☐
Marked Pedestrian Crossings at busy streets	☐	☐	☐	☐	☐
Separation between sidewalk & roadway	☐	☐	☐	☐	☐
Lighting at night	☐	☐	☐	☐	☐
Overgrown Vegetation	☐	☐	☐	☐	☐
Crime	☐	☐	☐	☐	☐
High vehicle traffic	☐	☐	☐	☐	☐
High Traffic speed	☐	☐	☐	☐	☐
Maintained sidewalks	☐	☐	☐	☐	☐
Obstacles in the sidewalk such as utility poles and fire hydrants	☐	☐	☐	☐	☐
Broken glass, hypodermic needles and other potentially	☐	☐	☐	☐	☐

dangerous items

Now we would like to know about how you travel with other household members.

Question 12

If you have children under the age of 16 in your household, please tell us how each child usually gets to school.

	Drive with parent	Bus	Walk	Bike	Other
1st Child	☐	☐	☐	☐	☐
2nd Child	☐	☐	☐	☐	☐
3rd Child	☐	☐	☐	☐	☐
4th Child	☐	☐	☐	☐	☐
5th Child	☐	☐	☐	☐	☐
6th Child	☐	☐	☐	☐	☐
7th Child	☐	☐	☐	☐	☐
8th Child	☐	☐	☐	☐	☐
9th Child	☐	☐	☐	☐	☐
10th Child	☐	☐	☐	☐	☐

Section 4: In this last section, we would like to know a little bit more about you.

Question 13

What is your age?

☐ 18 – 24 years old

☐ 25 – 34 years old

☐ 35 – 44 years old

☐ 45 – 54 years old

☐ 55 – 65 years old

☐ 65 – 75 years old

☐ >75 years old

Question 14

What is the annual income for your household?

☐ Less than $20,000

☐ $20,000 – $34,999

☐ $35,000 – $49,999

☐ $50,000 – $74,999

☐ $75,000 – $99,999

☐ Over $100,000

Question 15

What is the highest level of education you have completed?

☐ Less than a high school diploma

☐ High School Degree or equivalent (GED)

☐ Some college, no degree

☐ Associate Degree

☐ Bachelor's Degree

☐ Master's Degree

☐ Doctorate

Question 16
Are you a student?

☐ Full time college student

☐ Part time college student

☐ High school student

☐ No

Question 17
What is your current employment status?

☐ Employed full time (including self-employed)

☐ Employed part time (including self-employed)

☐ Unemployed and currently looking for work

☐ Unemployed and not currently looking for work

☐ Retired

☐ Unable to work

Question 18
Do you work from home?

☐ No

☐ 1-2 days per week

☐ 3-4 days per week

☐ 5 or more days per week

Question 19
How many people live in your household?

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5 or more

Question 20
How many vehicles does your household own?

☐ 0

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5 or more

Question 21
Do you have a physical disability that limits your mobility?

☐ Yes

☐ No

Question 22
Are you of Hispanic, Latino, or Spanish origin?

☐ Yes

☐ No

How would you describe yourself?

☐ American Indian or Alaska Native

☐ Asian

☐ Black or African American

☐ Native Hawaiian or Other Pacific Islander

☐ White

Other:___________________

Is there anything else you wish to tell us about the streets or how you travel in your neighborhood?
____
____
____
____

If you have any questions or concerns about the survey or our research, please contact Alexis Corning-Padilla, Research Assistant at acorningpadilla@unm.edu or (505) 277-2877. If you have questions regarding your rights as a research participant, or about what you should do in case of any harm to you, or if you want to obtain information or offer input, please contact the UNM Office of the IRB (OIRB) at (505) 277-2644 or irb.unm.edu.

APPENDIX B: SURVEY RESPONSES

Table B1. Summarized survey responses.

Questions	Responses
When walking on streets in your neighborhood how often do you use the sidewalk?	
-I sometimes use the sidewalks and sometimes walk in the street	34%
-I usually use the sidewalks	56%
-I usually walk in the street	9%
-I do not walk	1%
If you walk with someone else in your neighborhood, do both of you walk on the sidewalk?	
-Usually everyone I walk with uses the sidewalks	44%
-Usually I and the people I walk with walk in the street	9%
-Sometimes either I or someone I walk with walks in the street	47%
Do residential streets, like the one you live on, in your neighborhood have sidewalks?	
-Yes-Most of them	97%
-Yes-Some of them	3%
How well maintained are sidewalks in your neighborhood?	
-Most are well maintained	30%
-A few sections need to be repaired or replaced	48%
-Many sections need to be repaired or replaced	20%
-Most need to be repaired or replaced	2%
-I am not sure	0% (1 respondent)
How is the lighting at night on residential streets in your neighborhood?	
-Good- most streets are evenly lit along their entire length	13%
-OK – some places have lighting and others are dark	64%
-Poor – there is very little light, most of the streets are dark	23%
How do people park their cars in your neighborhood?	
-Most people park off the street in driveways, garages or parking lots	21%
-There are a few cars usually parked on the street	61%
-Most of the street is lined with parked cars	19%
How would you describe the speed of vehicle traffic in your neighborhood?	
-Most cars seem to travel at a safe speed	35%
-I have some concerns about the amount of speeding cars	46%
-I am very concerned about how many cars are speeding	19%
How would you describe the amount of traffic on residential streets in your neighborhood?	
-There is not much traffic	52%
-Sometimes I feel there is too much traffic for a residential area	38%
-There is too much traffic for a residential street	9%
Wide enough for two or more people to walk side by side	
-Most Do	53%
-Some Do	26%
-Most Do Not	20%
-Unsure	1%
Are mostly level where they cross driveways	
-Most Do	29%
-Some Do	20%
-Most Do Not	51%
Are separated from the street by landscaping grass gravel dirt etc.	
-Most Do	41%
-Some Do	30.5%
-Most Do Not	27.5%
-Unsure	1%
Have ramps at street intersections	
-Most Do	60%
-Some Do	27%
-Most Do Not	10%
-Unsure	3%

Questions	Responses
Have permanent obstacles in them such as utility poles and fire hydrants	
-Most Do	10%
-Some Do	46.5%
-Most Do Not	38%
-Unsure	5.5%
Are partially blocked by overgrown bushes cactus or other plants	
-Most Do	5%
-Some Do	63%
-Most Do Not	31%
-Unsure	1%
Are frequently more than once per week blocked by parked cars or trucks	
-Most Do	5%
-Some Do	34%
-Most Do Not	59%
-Unsure	2%
Are littered with potentially dangerous items such as broken glass and hypoder mic needles	
-Most Do	2%
-Some Do	13%
-Most Do Not	81%
-Unsure	4%
Have marked crosswalks where local streets cross busier roads	
-Most Do	23.5%
-Some Do	31.5%
-Most Do Not	35.5%
-Unsure	9.5%
Wider Sidewalks	
1-Strongly Discourage	3%
2	0%
3-Has No Effect	44%
4	26%
5-Strongly Encourage	27%
Evenness of Sidewalks	
1-Strongly Discourage	1%
2	6%
3-Has No Effect	33%
4	31%
5-Strongly Encourage	29%
Presence of sidewalks	
1-Strongly Discourage	1%
2	0%
3-Has No Effect	21%
4	28%
5-Strongly Encourage	50%
Sidewalk curb ramps at intersections	
1-Strongly Discourage	1%
2	2%
3-Has No Effect	52%
4	25%
5-Strongly Encourage	20%
Marked pedestrian crossings at busy streets	
1-Strongly Discourage	0%
2	2%
3-Has No Effect	37%
4	29%
5-Strongly Encourage	32%
Separations between sidewalk and roadway	
1-Strongly Discourage	1%
2	2%
3-Has No Effect	40%
4	33%

Questions	Responses
5-Strongly Encourage	24%
Lighting at night	
1-Strongly Discourage	5%
2	11%
3-Has No Effect	16%
4	28%
5-Strongly Encourage	40%
Overgrown vegetation	
1-Strongly Discourage	22%
2	37%
3-Has No Effect	30%
4	10%
5-Strongly Encourage	2%
Crime	
1-Strongly Discourage	51%
2	21%
3-Has No Effect	18%
4	3%
5-Strongly Encourage	7%
High volume of vehicle traffic	
1-Strongly Discourage	34%
2	35%
3-Has No Effect	24%
4	4%
5-Strongly Encourage	3%
High traffic speed	
1-Strongly Discourage	44%
2	30%
3-Has No Effect	17%
4	5%
5-Strongly Encourage	4%
Maintained sidewalks	
1-Strongly Discourage	1%
2	4%
3-Has No Effect	22%
4	33%
5-Strongly Encourage	40%
Obstacles in sidewalk such as utility poles or fire hydrants	
1-Strongly Discourage	15%
2	29%
3-Has No Effect	48%
4	6%
5-Strongly Encourage	2%
Broken glass or other potentially dangerous items in sidewalk	
1-Strongly Discourage	56%
2	20%
3-Has No Effect	16%
4	3%
5-Strongly Encourage	5%

APPENDIX C: REGRESSION RESULTS

C.1. Results for Model A

```
Call:
lm(formula = walkshare ~ as.factor(Neighborhood), data = x, na.action = na.om
it)

Residuals:
     Min       1Q   Median       3Q      Max 
-0.44376 -0.16907 -0.02201  0.16373  0.53070 

Coefficients:
                          Estimate Std. Error t value Pr(>|t|)  
(Intercept)                0.22222    0.11171   1.989  0.04813 *
as.factor(Neighborhood)2   0.15328    0.11942   1.284  0.20090  
as.factor(Neighborhood)3   0.20725    0.11703   1.771  0.07821 .
as.factor(Neighborhood)4   0.68100    0.24978   2.726  0.00702 **
as.factor(Neighborhood)5   0.22154    0.12774   1.734  0.08452 .
as.factor(Neighborhood)6   0.18827    0.11775   1.599  0.11153  
as.factor(Neighborhood)7   0.08171    0.14421   0.567  0.57166  
as.factor(Neighborhood)8   0.26692    0.13217   2.020  0.04487 *
as.factor(Neighborhood)9   0.16635    0.15798   1.053  0.29369  
as.factor(Neighborhood)10  0.15931    0.12144   1.312  0.19117  
as.factor(Neighborhood)11  0.03366    0.17063   0.197  0.84383  
as.factor(Neighborhood)12  0.32696    0.13681   2.390  0.01785 *
as.factor(Neighborhood)13  0.07190    0.24978   0.288  0.77379  
as.factor(Neighborhood)14  0.01630    0.12103   0.135  0.89298  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.2234 on 186 degrees of freedom
  (2 observations deleted due to missingness)
Multiple R-squared:  0.134,	Adjusted R-squared:  0.07346 
F-statistic: 2.214 on 13 and 186 DF,  p-value: 0.0105
```

C.2. Results for Model B

```
Call:
lm(formula = walkshare ~ as.factor(Neighborhood) + as.factor(Education) +
    as.factor(Employment) + Age + Income + WorkHome + HHSize +
    Vehicles + as.factor(Disability) + as.factor(Race), data = x,
    na.action = na.omit)

Residuals:
     Min       1Q   Median       3Q      Max
-0.46940 -0.15685 -0.01065  0.17152  0.45249

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                2.914e-01  1.755e-01   1.661   0.0988 .
as.factor(Neighborhood)2   3.403e-02  1.349e-01   0.252   0.8012
as.factor(Neighborhood)3   1.359e-01  1.314e-01   1.034   0.3026
as.factor(Neighborhood)4   5.100e-01  2.521e-01   2.023   0.0448 *
as.factor(Neighborhood)5   2.254e-01  1.470e-01   1.533   0.1272
as.factor(Neighborhood)6   1.099e-01  1.338e-01   0.821   0.4127
as.factor(Neighborhood)7   1.500e-02  1.629e-01   0.092   0.9267
as.factor(Neighborhood)8   2.354e-01  1.470e-01   1.601   0.1115
as.factor(Neighborhood)9   1.065e-01  1.695e-01   0.628   0.5307
as.factor(Neighborhood)10  1.073e-01  1.378e-01   0.779   0.4373
as.factor(Neighborhood)11  6.062e-03  1.789e-01   0.034   0.9730
as.factor(Neighborhood)12  1.950e-01  1.530e-01   1.274   0.2044
as.factor(Neighborhood)13  3.110e-02  2.597e-01   0.120   0.9048
as.factor(Neighborhood)14 -7.139e-02  1.371e-01  -0.521   0.6033
as.factor(Education)2      1.545e-01  2.246e-01   0.688   0.4925
as.factor(Employment)2     4.661e-03  8.818e-02   0.053   0.9579
as.factor(Employment)3     9.290e-02  4.811e-02   1.931   0.0553 .
Age                        6.686e-04  1.700e-03   0.393   0.6946
Income                    -3.872e-07  6.058e-07  -0.639   0.5236
WorkHome                  -1.384e-02  9.541e-03  -1.451   0.1488
HHSize                    -6.435e-03  2.177e-02  -0.296   0.7679
Vehicles                  -4.297e-04  2.206e-02  -0.019   0.9845
as.factor(Disability)2    -1.004e-01  7.511e-02  -1.336   0.1834
as.factor(Race)2           8.498e-03  5.605e-02   0.152   0.8797
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.2157 on 155 degrees of freedom
  (23 observations deleted due to missingness)
Multiple R-squared:  0.2507,   Adjusted R-squared:  0.1395
F-statistic: 2.255 on 23 and 155 DF,  p-value: 0.001852
```

C.3. Results for Model 1

```
Call:
lm(formula = walkshare ~ as.factor(Use_Sidewalk) + as.factor(Walk_others) +
    as.factor(Sidewalks_Present) + as.factor(Lighting) + as.factor(Parking) +
    as.factor(Speeding) + as.factor(Traffic) + Age + Income +
    as.factor(Education) + as.factor(Employment) + WorkHome +
    HHSize + Vehicles + as.factor(Disability) + as.factor(Race) +
    Density + Retail_to_Residential + Grid + Nearest_School_Distance +
    Near_Rapid_Ride + Defects, data = x, na.action = na.omit)

Residuals:
     Min       1Q   Median       3Q      Max
-0.47785 -0.16645 -0.00346  0.16504  0.47435

Coefficients:
                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                    1.240e-01  2.784e-01   0.446  0.65660
as.factor(Use_Sidewalk)2      -2.432e-04  5.159e-02  -0.005  0.99624
as.factor(Walk_others)2        6.570e-02  5.018e-02   1.309  0.19255
as.factor(Sidewalks_Present)2 -1.108e-01  1.105e-01  -1.003  0.31742
as.factor(Lighting)2          -5.414e-02  5.545e-02  -0.976  0.33054
as.factor(Parking)2           -4.889e-02  4.863e-02  -1.005  0.31645
as.factor(Speeding)2           3.115e-02  4.311e-02   0.723  0.47114
as.factor(Traffic)2            4.050e-02  4.114e-02   0.984  0.32663
Age                            8.365e-04  1.826e-03   0.458  0.64752
Income                        -2.455e-07  6.128e-07  -0.401  0.68930
as.factor(Education)2          2.757e-02  2.316e-01   0.119  0.90541
as.factor(Employment)2         1.544e-02  9.136e-02   0.169  0.86602
as.factor(Employment)3         1.147e-01  5.119e-02   2.240  0.02664 *
WorkHome                      -1.695e-02  9.743e-03  -1.740  0.08400 .
HHSize                        -8.738e-03  2.295e-02  -0.381  0.70402
Vehicles                      -3.436e-03  2.256e-02  -0.152  0.87917
as.factor(Disability)2        -6.899e-02  8.247e-02  -0.837  0.40422
as.factor(Race)2              -5.684e-04  5.914e-02  -0.010  0.99235
Density                        3.183e-06  1.082e-06   2.942  0.00380 **
Retail_to_Residential          2.838e-01  8.677e-02   3.270  0.00134 **
Grid                          -2.976e-01  1.650e-01  -1.804  0.07339 .
Nearest_School_Distance        2.249e-01  2.094e-01   1.074  0.28447
Near_Rapid_Ride               -1.350e-01  6.264e-02  -2.155  0.03283 *
Defects                        3.098e-03  3.736e-03   0.829  0.40838
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.2194 on 144 degrees of freedom
  (34 observations deleted due to missingness)
Multiple R-squared:  0.2621,  Adjusted R-squared:  0.1443
F-statistic: 2.224 on 23 and 144 DF,  p-value: 0.002345
```

C.4. Results for Model 2

```
Call:
lm(formula = walkshare ~ as.factor(Wide_enough) + as.factor(Level) + 
    as.factor(Separated) + as.factor(Ramps) + as.factor(Obstacles) + 
    as.factor(Vegetation) + as.factor(Blockedcars) + as.factor(Littered) + 
    as.factor(Crosswalks) + Age + Income + as.factor(Education) + 
    as.factor(Employment) + WorkHome + HHSize + Vehicles + as.factor(Disabili
ty) + 
    as.factor(Race) + Density + Retail_to_Residential + Grid + 
    Nearest_School_Distance + Near_Rapid_Ride + Defects, data = x, 
    na.action = na.omit)

Residuals:
     Min       1Q   Median       3Q      Max 
-0.47394 -0.14276 -0.00849  0.14250  0.53082 

Coefficients:
                          Estimate Std. Error t value Pr(>|t|)    
(Intercept)             -6.345e-02  2.829e-01  -0.224 0.822863    
as.factor(Wide_enough)2 -5.724e-02  4.576e-02  -1.251 0.212955    
as.factor(Level)2        4.042e-02  4.049e-02   0.998 0.319798    
as.factor(Separated)2    5.718e-02  4.855e-02   1.178 0.240816    
as.factor(Separated)3    5.234e-01  2.840e-01   1.843 0.067403 .  
as.factor(Ramps)2       -3.804e-02  6.120e-02  -0.622 0.535242    
as.factor(Ramps)3       -5.100e-01  1.983e-01  -2.572 0.011146 *  
as.factor(Obstacles)2    1.073e-03  4.078e-02   0.026 0.979041    
as.factor(Obstacles)3    8.195e-02  9.162e-02   0.894 0.372573    
as.factor(Vegetation)2  -7.622e-03  4.123e-02  -0.185 0.853605    
as.factor(Vegetation)3   8.364e-02  2.011e-01   0.416 0.678112    
as.factor(Blockedcars)2 -4.649e-02  3.761e-02  -1.236 0.218391    
as.factor(Blockedcars)3  6.974e-02  1.568e-01   0.445 0.657198    
as.factor(Littered)2     5.075e-02  5.536e-02   0.917 0.360797    
as.factor(Littered)3     9.753e-02  1.232e-01   0.792 0.429765    
as.factor(Crosswalks)2  -1.026e-01  3.922e-02  -2.615 0.009870 ** 
as.factor(Crosswalks)3  -6.769e-02  6.679e-02  -1.014 0.312485    
Age                      1.428e-03  1.741e-03   0.820 0.413619    
Income                  -6.851e-08  6.034e-07  -0.114 0.909758    
as.factor(Education)2    8.497e-02  2.373e-01   0.358 0.720864    
as.factor(Employment)2   2.207e-02  8.920e-02   0.247 0.804942    
as.factor(Employment)3   1.156e-01  5.123e-02   2.257 0.025528 *  
WorkHome                -1.031e-02  9.917e-03  -1.039 0.300498    
HHSize                  -1.166e-02  2.363e-02  -0.493 0.622520    
Vehicles                -4.019e-03  2.275e-02  -0.177 0.860043    
as.factor(Disability)2  -6.888e-02  8.036e-02  -0.857 0.392801    
as.factor(Race)2        -1.230e-03  6.272e-02  -0.020 0.984384    
Density                  3.825e-06  1.121e-06   3.413 0.000836 ***
Retail_to_Residential    2.639e-01  8.934e-02   2.954 0.003672 ** 
Grid                    -3.261e-01  1.696e-01  -1.923 0.056429 .  
Nearest_School_Distance  3.723e-01  2.177e-01   1.710 0.089371 .  
Near_Rapid_Ride         -1.385e-01  6.529e-02  -2.121 0.035620 *  
Defects                  3.992e-03  3.840e-03   1.040 0.300234    
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.2144 on 143 degrees of freedom
  (26 observations deleted due to missingness)
Multiple R-squared:  0.304,	Adjusted R-squared:  0.1483 
F-statistic: 1.952 on 32 and 143 DF,  p-value: 0.00422
```

C.5. Results for Model 3

```
Call:
lm(formula = walkshare ~ as.factor(Use_Sidewalk) + as.factor(Walk_others) +
    as.factor(Sidewalks_Present) + as.factor(Lighting) + as.factor(Parking) +
    as.factor(Speeding) + as.factor(Traffic) + as.factor(Wide_enough) +
    as.factor(Level) + as.factor(Separated) + as.factor(Ramps) +
    as.factor(Obstacles) + as.factor(Vegetation) + as.factor(Blockedcars) +
    as.factor(Littered) + as.factor(Crosswalks) + Age + Income +
    as.factor(Education) + as.factor(Employment) + WorkHome +
    HHSize + Vehicles + as.factor(Disability) + as.factor(Race) +
    Density + Retail_to_Residential + Grid + Nearest_School_Distance +
    Near_Rapid_Ride + Defects, data = x, na.action = na.omit)

Residuals:
     Min       1Q   Median       3Q      Max
-0.57079 -0.13332  0.00216  0.14666  0.47747

Coefficients:
                              Estimate Std. Error t value Pr(>|t|)
(Intercept)                 -1.795e-02  3.097e-01  -0.058 0.953870
as.factor(Use_Sidewalk)2    -2.922e-02  5.651e-02  -0.517 0.606056
as.factor(Walk_others)2      5.609e-02  5.249e-02   1.069 0.287326
as.factor(Sidewalks_Present)2 -1.284e-01  1.138e-01  -1.128 0.261508
as.factor(Lighting)2        -7.879e-02  6.012e-02  -1.310 0.192413
as.factor(Parking)2         -6.977e-02  5.252e-02  -1.329 0.186398
as.factor(Speeding)2         5.412e-02  4.786e-02   1.131 0.260324
as.factor(Traffic)2          2.042e-02  4.385e-02   0.466 0.642327
as.factor(Wide_enough)2     -5.609e-02  4.938e-02  -1.136 0.258162
as.factor(Level)2            4.711e-02  4.497e-02   1.048 0.296846
as.factor(Separated)2        8.952e-02  5.351e-02   1.673 0.096857 .
as.factor(Separated)3        4.815e-01  3.376e-01   1.426 0.156262
as.factor(Ramps)2           -7.165e-02  6.501e-02  -1.102 0.272505
as.factor(Ramps)3           -4.998e-01  2.057e-01  -2.430 0.016508 *
as.factor(Obstacles)2       -2.254e-02  4.317e-02  -0.522 0.602581
as.factor(Obstacles)3        5.580e-02  9.735e-02   0.573 0.567524
as.factor(Vegetation)2      -1.103e-02  4.502e-02  -0.245 0.806943
as.factor(Vegetation)3       3.019e-02  2.123e-01   0.142 0.887144
as.factor(Blockedcars)2     -4.192e-02  4.094e-02  -1.024 0.307859
as.factor(Blockedcars)3      7.731e-02  1.629e-01   0.474 0.636014
as.factor(Littered)2         6.410e-02  5.770e-02   1.111 0.268673
as.factor(Littered)3         7.467e-02  1.291e-01   0.578 0.564089
as.factor(Crosswalks)2      -9.035e-02  4.330e-02  -2.087 0.038923 *
as.factor(Crosswalks)3      -6.063e-02  7.048e-02  -0.860 0.391311
Age                          1.474e-03  2.001e-03   0.737 0.462747
Income                      -1.169e-07  6.411e-07  -0.182 0.855634
as.factor(Education)2       -4.158e-02  2.496e-01  -0.167 0.867991
as.factor(Employment)2       4.700e-02  9.333e-02   0.504 0.615464
as.factor(Employment)3       1.320e-01  5.460e-02   2.417 0.017091 *
WorkHome                    -1.833e-02  1.072e-02  -1.709 0.089941 .
HHSize                      -8.016e-03  2.535e-02  -0.316 0.752360
Vehicles                    -3.110e-03  2.401e-02  -0.130 0.897139
as.factor(Disability)2      -7.741e-02  8.665e-02  -0.893 0.373373
as.factor(Race)2             1.494e-02  6.708e-02   0.223 0.824084
Density                      3.968e-06  1.179e-06   3.366 0.001012 **
Retail_to_Residential        3.625e-01  9.728e-02   3.726 0.000292 ***
Grid                        -4.069e-01  1.867e-01  -2.179 0.031155 *
Nearest_School_Distance      3.447e-01  2.307e-01   1.494 0.137571
Near_Rapid_Ride             -1.531e-01  6.862e-02  -2.231 0.027454 *
Defects                      4.745e-03  4.129e-03   1.149 0.252667
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.2166 on 126 degrees of freedom
  (36 observations deleted due to missingness)
Multiple R-squared:  0.3589,	Adjusted R-squared:  0.1604
F-statistic: 1.808 on 39 and 126 DF,  p-value: 0.007459
```

Model 4

```
Call:
lm(formula = walkshare ~ Age + Income + as.factor(Education) +
    as.factor(Employment) + WorkHome + HHSize + Vehicles + as.factor(Disabili
ty) +
    as.factor(Race) + Density + Retail_to_Residential + Grid +
    Nearest_School_Distance + Near_Rapid_Ride + Defects, data = x,
    na.action = na.omit)

Residuals:
     Min       1Q   Median       3Q      Max
-0.45864 -0.17840 -0.00774  0.18057  0.47305

Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)              6.015e-02  2.558e-01   0.235  0.81439
Age                      1.120e-03  1.636e-03   0.684  0.49471
Income                  -1.912e-07  5.693e-07  -0.336  0.73742
as.factor(Education)2    9.862e-02  2.234e-01   0.441  0.65947
as.factor(Employment)2   2.540e-03  8.756e-02   0.029  0.97689
as.factor(Employment)3   9.817e-02  4.788e-02   2.050  0.04195 *
WorkHome                -1.365e-02  9.132e-03  -1.494  0.13700
HHSize                  -1.170e-02  2.140e-02  -0.547  0.58539
Vehicles                -1.410e-03  2.163e-02  -0.065  0.94813
as.factor(Disability)2  -8.418e-02  7.182e-02  -1.172  0.24288
as.factor(Race)2         3.293e-04  5.597e-02   0.006  0.99531
Density                  3.175e-06  1.029e-06   3.086  0.00238 **
Retail_to_Residential    2.142e-01  7.662e-02   2.795  0.00581 **
Grid                    -2.440e-01  1.504e-01  -1.622  0.10673
Nearest_School_Distance  2.647e-01  1.981e-01   1.336  0.18332
Near_Rapid_Ride         -1.247e-01  5.867e-02  -2.126  0.03506 *
Defects                  2.927e-03  3.474e-03   0.842  0.40080
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.2163 on 162 degrees of freedom
  (23 observations deleted due to missingness)
Multiple R-squared:  0.2122,  Adjusted R-squared:  0.1344
F-statistic: 2.728 on 16 and 162 DF,  p-value: 0.0007111
```

C.6. Results for Model 5

```
Call:
lm(formula = walkshare ~ Wider.sidewalks + Evenness.of.sidewalks +
    Presence.of.Sidewalks + Sidewalk.curb.ramps.at.Intersections +
    Marked.Pedestrian.Crossings.at.busy.streets + Separation.between.sidewalk..amp..roadway +
    Lighting.at.night + Overgrown.Vegetation + Crime + High.volume.of.vehicle.traffic +
    High.traffic.speed + Maintained.sidewalks + Obstacles.in.the.sidewalk.such.as.utility.poles.and.fire.hydrants +
    Broken.glass..hypodermic.needles.and.other.potentially.dangerous.items +
    Age + Income + as.factor(Education) + as.factor(Employment) +
    WorkHome + HHSize + Vehicles + as.factor(Disability) + as.factor(Race) +
    Density + Retail_to_Residential + Grid + Nearest_School_Distance +
    Near_Rapid_Ride, data = x, na.action = na.omit)

Residuals:
     Min       1Q   Median       3Q      Max
-0.47424 -0.15409 -0.00624  0.14649  0.47971

Coefficients:
                                                                        Estimate Std. Error t value Pr(>|t|)
(Intercept)                                                           -1.160e-01  2.398e-01  -0.484  0.62939
Wider.sidewalks                                                       -4.229e-02  2.761e-02  -1.532  0.12782
Evenness.of.sidewalks                                                  6.761e-02  2.248e-02   3.008  0.00312 **
Presence.of.Sidewalks                                                  1.756e-02  2.968e-02   0.592  0.55503
Sidewalk.curb.ramps.at.Intersections                                  -1.414e-03  2.723e-02  -0.052  0.95867
Marked.Pedestrian.Crossings.at.busy.streets                           -3.799e-03  2.597e-02  -0.146  0.88393
Separation.between.sidewalk..amp..roadway                              1.140e-02  2.716e-02   0.420  0.67535
Lighting.at.night                                                      9.331e-03  1.653e-02   0.564  0.57344
Overgrown.Vegetation                                                   1.266e-02  2.459e-02   0.515  0.60760
Crime                                                                 -1.361e-02  2.559e-02  -0.532  0.59565
High.volume.of.vehicle.traffic                                        -2.611e-02  3.532e-02  -0.739  0.46108
High.traffic.speed                                                     1.149e-02  3.232e-02   0.356  0.72266
Maintained.sidewalks                                                   2.602e-03  2.376e-02   0.110  0.91294
Obstacles.in.the.sidewalk.such.as.utility.poles.and.fire.hydrants     -2.012e-02  2.562e-02  -0.785  0.43367
Broken.glass..hypodermic.needles.and.other.potentially.dangerous.items  4.826e-02  2.547e-02   1.895  0.06016 .
Age                                                                    2.197e-03  1.839e-03   1.195  0.23405
Income                                                                 5.450e-08  5.970e-07   0.091  0.92740
as.factor(Education)2                                                  5.722e-02  2.375e-01   0.241  0.80996
as.factor(Employment)2                                                -2.706e-02  9.320e-02  -0.290  0.77198
as.factor(Employment)3                                                 8.863e-02  5.189e-02   1.708  0.08984 .
WorkHome                                                              -1.551e-02  9.883e-03  -1.570  0.11874
HHSize                                                                 1.028e-03  2.317e-02   0.044  0.96468
Vehicles                                                              -9.839e-03  2.283e-02  -0.431  0.66707
as.factor(Disability)2                                                -8.663e-02  8.363e-02  -1.036  0.30202
as.factor(Race)2                                                       4.242e-02  6.218e-02   0.682  0.49620
Density                                                                2.384e-06  8.238e-07   2.894  0.00441 **
Retail_to_Residential                                                  1.977e-01  8.599e-02   2.299  0.02299 *
Grid                                                                  -9.357e-02  7.380e-02  -1.268  0.20695
Nearest_School_Distance                                                1.429e-01  1.601e-01   0.892  0.37367
Near_Rapid_Ride                                                       -1.318e-01  6.721e-02  -1.960  0.05192 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2184 on 141 degrees of freedom
  (31 observations deleted due to missingness)
Multiple R-squared:  0.2917,	Adjusted R-squared:  0.146
F-statistic: 2.002 on 29 and 141 DF,  p-value: 0.004128
```