TRANSIT DESERTS: AN ANALYSIS OF THEIR IMPACT ON HEALTH AND ACCESS TO HEALTH CARE

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TRANSIT DESERTS: AN ANALYSIS OF THEIR IMPACT ON HEALTH AND ACCESS TO HEALTH CARE

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Para mi familia, mi pareja y la comunidad de Houston.

Dedicated to my family, my partner, and the Houston Community.

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Abstract

A transit desert is defined as an area with limited transportation supply and or infrastructure, which may limit people's ability to procure jobs, access health care, and obstructs economic mobility (Junfeng & Dillivan, 2013). The University of Texas Professor Junfeng Jiao first coined the term transit desert in 2012. Transit-dependent communities are immobile, unable to afford private transportation costs such as insurance or gas, and poverty-stricken. Using panel data of 3,974 block groups from 2013 to 2019, we investigate whether there is a relationship between vehicle availability and access to health care. We estimate the relationship between vehicle availability and various health outcome measurements, such as self-reported Unmet Medical Need, Emergency Room Visits by Children in the last 12 Months, and Last Reported Health Care Visit. We found that there is a relationship between vehicle availability and access to health; however, there are other vital factors such as not having insurance or having income below the poverty line, that transcend the effects of vehicle availability.

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Introduction

Questions about health care access have permeated the political and social circles of society, with many wondering how and what would boost access. In recent years, it has become clear that unaffordable care is the most significant barrier preventing people from visiting the doctor or from going to a clinic. However, recent research suggests that transportation is also a barrier. Still, researchers have conducted little empirical work to show how transit deficiencies impact access to health care. This paper investigates whether a lack of, or inadequate public and private transportation in the four major Texas cities, Austin, San Antonio, Dallas, and Houston, impacts people's ability to access health care. We choose Texas for its size, in population and landmass, and because it serves as a benchmark of what other states may experience. Currently, there does not exist a universal definition for "access to health care." For this research, it means the ability to travel to and visit doctors, clinics, and other physicians, the ability to pay for services, and the availability of services.

We retrieved the data for this project from the United States Census and American Community Survey, using the third-party software Simply Analytics. The estimation model is a random effect panel, which assumes that the individual block group effects are captured by the intercept and a random component, which is associated with the error term and not the independent variables. The results indicate that some transit barriers exist, but most of the effects are related to the variable, uninsured. Even though transit may play a part, it is unclear just how much due to the overwhelming impact of not having insurance. Most people do not have "access to health care" because of the inability to pay, either for the services or for insurance coverage.

Regardless, this paper aims to show how and to what extent transit deficiencies pose a barrier to health care access for Texans.

Objective

This paper analyzes the effects of vehicle availability on access to health care in Texas communities. Texas was chosen for its size, in population and landmass, and serves as a benchmark of what other states may experience. We define access to health care as the ability to travel to and visit doctors, physicians, clinics, the ability to pay for services, and the availability of services. Previous research focused on either empirical work or literature on the relationship between health access and transit and not both. This paper expands current transportation and health research by investigating the extent to which transit poses a threat to communities' ability to access health care, empirically, with a focus on the Houston community. We chose Houston because it has the most extensive transit system of the four cities and is one of the only cities to produce a comprehensive transit report that examines both public and private transit availability. However, we discuss all four major Texas cities, Houston, San Antonio, Dallas, and Austin, to determine how these cities are affected, and to compare the differences between them.

Transit Deserts and Transit Costs

A transit desert, as defined by Jiao, describes an area with a limited or lack of transit service. Jiao's research focused on calculating the difference between transit demand and transit

supply at the block group level. Junfeng Jiao and Maxwell Dillivan, from Ball State University, analyzed fifty-two United States cities' transportation demand and supply. Researchers used the 2012 American Community Survey and the U.S Department of Transportation formula for transit dependency to calculate transit demand and supply at the block group level spatially (Junfeng & Dillivan, 2013). Jiao and Dillivan found that "transit deserts" exist in many cities across the US. They define transit or transportation deserts as "areas where demand for transportation exceeds supply. They represent underserved areas of a city, not a citywide transportation shortage" (Junfeng & Dillivan, 2013). Transit Deserts, they claim, inhibit upward mobility by reducing access to jobs, health care, and education. Upward Mobility is the move from one social or economic status to another.

Other researchers have studied racism, shifts in culture, technological innovation, education, and income, to name a few, to determine what factors stall upward mobility. Recent research suggests that two main factors inhibit upward mobility, housing prices (including housing availability and knowledge of housing supply) and accessibility of transportation (both private and public, with an emphasis on public transit). After housing, transportation is the second biggest expense for United States consumers and has a significant impact on an individual's and household's available disposable income (U.S Bureau of Labor Statistics, 2019). The Bureau of Labor Statistics defined transportation as vehicle purchases (net outlay), vehicle finance charges, gasoline and motor oil, maintenance and repairs, vehicle insurance, public transit, vehicle rental, leases, licenses, and other fees. Public and private transportation costs, therefore, take up a large amount of a household's disposable income. It is unclear, however, how those costs impact a household's ability to pay for other household expenses.

Transit Availability in Houston and Affected Populations

On the surface, Texas may not have a substantial amount of people who lack access to transit, either public or private. For some, that may be a reason to ignore the question of transit availability and its relationship to health care access. However, no matter how small the affected population is, they are often the most vulnerable, such as the elderly, and those in poverty. To address the issue of transit availability, it is essential to look at every person and analyze how their circumstances limit them. LINK Houston is a non-profit organization dedicated to doing just that. They examine the socio-economic circumstances of Houston riders that deter some from accessing health, education, and jobs.

We used LINK Houston's report because it investigates transit deficiencies at the census tract and city level, and examines the direct impact on individuals. Furthermore, Houston is one of the only cities that produces an extensive report on transit issues. The organization studies the effect of not having access to public transit and vehicles; they focus on exploring the span of service hours, reliability, accessibility, and frequency of public transportation. Research conducted by LINK Houston found that many areas are lacking public and private transit and transportation infrastructure, which severely limits people's ability to procure jobs, access health care, and education. LINK Houston, in *Equity in Transit: 2018 Report,* developed the Transportation Equity Demand Index or TEDI. The TEDI metric "combines 15 indicators of demographic, economic, and built-environment conditions to identify areas in Houston where safe, affordable transportation is needed to improve quality-of-life" (LINK Houston, 2018).

The TEDI Methodology objectively identifies high-need regions that could benefit from infrastructure upgrades (LINK Houston, 2018). They used a 99% confidence interval to

determine areas of Low TEDI and High TEDI Need. TEDI Need is measured as the need for sidewalks, crosswalks, bikeways, and transit stops/stations, or transportation services. They conducted a geographical analysis, by block group, and used United States Census Data to determine the areas with the Highest Confidence and Lowest Confidence TEDI Needs. According to the report, "people take more than 285,000 trips each weekday on public transit in Houston – 67% on the local bus, 22% on light rail, and 11% on park-and-ride" (LINK Houston, 2018). Houston's current transit infrastructure is a result of the "Reimagine" initiative that took place in 2015 and completely transformed the public transportation landscape of the city. This project, however, focused on connecting high-density areas to city centers, leaving many people out of the transportation loop.

LINK Houston grouped riders into three categories, occasional, all-purpose, and commuters. They found that 61% of passengers are casual riders, 23% of riders use it regularly for multiple purposes, and only 15% of passengers are commuters, who only use it to travel for work or school (Equity in Transit 2018, 9). They also found that about 75% of Houston riders are people from communities of color, such as the Black and Hispanic communities, and that about 33% of transit riders live in households below the poverty level. Interestingly, those who ride light-rail (19%) or local buses (20%) are more likely to live in homes under the poverty level, while park-and-ride, riders only make up 3% of households in poverty. Park-and-ride passengers were, on average, from affluent suburban neighborhoods or even further outside of Houston, and 43% of riders came from households that earned $100,000 or more. If that disparity were not enough, the study conducted by LINK Houston, found that 40% of local bus riders and 34% of light-rail riders lived in households with no vehicles, compared to 2% of park-and-ride passengers who lived in households with no cars. The LINK Houston Report highlights

the transit inequity in Houston; many of the people and groups affected are low-income, minority populations, and the elderly. According to the TEDI report, about 23% of the Houston population is in a high-need area, which is 983,678 people living in areas of low or poor public transit. Out of this population, 24% are below poverty, 50% are minorities, and 12% do not own a vehicle. It is clear then that many of the poorest Houstonians lack adequate public and private transportation.

LINK Houston's report highlights the social and economic disparities underlying transit issues. Jiao's research suggested that areas with low or inadequate public and private transportation limited people's ability to procure jobs, access health care, and education, and the LINK Houston report quantifies those findings. LINK Houston measures how average people are affected by deficiencies in-transit supply and availability.

Health and Transit Availability

A lack of public and private transportation impacts access to health, according to research conducted in 2013 by Samina T. Syed, Ben S. Gerber, and Lisa K. Sharp. Researchers suggest that "transportation barriers lead to rescheduled or missed appointments, delayed care, and missed or delayed medication use. These consequences may lead to poor management of chronic illness and thus, poorer health outcomes." Their research concluded that transportation barriers are a barrier to health care access, particularly for those with lower incomes or under/uninsured. They did not, however, (1) determine which aspects of transportation limit access to health and (2) measure the impact of transportation barriers on clinically meaningful outcomes, and (3) measure the effect of transportation barrier interventions and transportation policy changes. In

their research, they found that those who owned a vehicle had higher health care utilization than those who did not own a car. Those who owned at least one car were more likely to have visited a physician or health care site.

Research conducted by Yang S, Zarr RL, Kass-Hout TA., Kourosh A, and Kelly NR shows how access to health care impacts the Houston community stating that "25% of patients missed an appointment due to transportation problems". The study investigated 183 urban caregivers from Houston and their children's missed appointments, finding that an inability to find a ride resulted in at least one missed appointment for 25% of the sample. The study also found that 82% of those who kept their appointments had access to a car, compared to just 58% of those who did not keep their appointments. Similarly, in the study conducted by Silver, Blustein, & Weitzman, of 698 low-income adult patients, researchers found that 25% of missed appointments/rescheduling needs were due to transportation problems. Researchers concluded that bus users were twice as likely to miss their appointments compared to car users.

Other studies which investigated what populations are most affected, showed mixed results when it comes to whether lack of public and private transit negatively impacts rural communities more than urban communities. The study by Probst, Laditka, Wang, & Johnson, found that "rural patients reported more problems with transportation and travel distance to health care providers and had a higher burden of travel for health care when measured by distance and time traveled." However, other studies did not find any significant differences in urban and rural communities.

Researchers generally agree that at-risk populations tend to be those classified as low-income, minority communities, children, and the elderly, with some research indicating that rural residents typically have lower access to health care resources compared to urban

residents. Research by Wallace R, Hughes-Cromwick P, Mull H, and Khasnabis estimated that "3.6 million people do not obtain medical care due to transportation barriers. These individuals were more likely to be older, poorer, less educated, female, and from an ethnic minority group. Individuals carrying the highest burden of disease also faced the greatest burden of transportation barriers." In a second study titled *Healthcare disparities for American Indian veterans in the United States: A population-based study*, researchers used data from 1997 to 2006 to compare reasons for delayed health care access between 34,504 American Indian/Alaskan Natives and White Veterans. They found that American Indian/Alaskan Natives were more likely to delay care due to transportation problems.

In a study of 593 adults with cancer titled *Transportation as a Barrier to Cancer Treatment,* researchers found that Hispanics' transportation barriers to cancer treatment were higher than those of African Americans, and African Americans' barriers were more significant than White people. Transportation barriers included distance to a treatment center, access to a vehicle, and finding someone to drive them to get treatment. In the study titled *Barriers to Care Among American Indians in Public Health Care Programs,* researchers contrasted barriers to health care access between 1,853 American Indians and Whites enrolled in the Minnesota Health Care program. The study found that 39% of American Indians reported transportation barriers compared to 18% of Whites.

Overall, researchers found that low-income, non-white communities generally have less access to health care than their white counterparts because of transit issues, even when accounting for socioeconomic status among the different ethnic groups. Studies used a variety of existing health and transit literature, as well as personal accounts from willing participants to investigate the relationship between transit availability and health care access. Research on

health access and transit has, therefore, only focused on what people reported, and not empirical work on how transit supply and demand directly affects health care access.

Data

Data was retrieved from Simply Analytics, modeled by the third-party dataset provider EASI Analytics. EASI Analytics incorporates the decennial census, American Community Survey, and the United States Postal Service (USPS) mailable Households at a County, ZIP Code, Census Tract, and Block Group level. This data is used as the primary input to estimate current local changes within a small area, such as a Block Group. These changes are combined with an EASI proprietary model for updating and forecasting at the Block Group level.

Health and transit data do not exist at the block group level but have been estimated from national and local data using the United States Census, American Community Survey, United States Postal Service, and Public Use Microdata Sample. The variable Gap Z-Score comes from Jiao's research. The Gap Z-score variable measures the transit gap or the difference between transit demand and supply nationally (Junfeng & Dillivan, 2013). Furthermore, Jiao's Gap Z-Score provides a comprehensive look at transit demand and supply, both public and private, at the national and city levels. A negative Z-Score represents a more significant gap between demand and supply, and a positive Z-Score represents a smaller gap between demand and supply.

We consider 53 other variables with the data ranging from 2013 to 2019. The variables are listed in the appendix. All variables are percentages, except for the variables Population Density and Population, which are count variables. This paper specifically addresses the four major Texas cities: Austin, Dallas, Houston, and San Antonio, with a closer inspection of Houston. We choose Texas for its large population and landmass, and Houston because it is one of the only cities that produces a comprehensive transit report. The standard demographic variables were included, such as age, race, gender, education, and income.

Additionally, for this research, the variable percentage of vehicles within a household was also included. Four health variables were included. They are: Unmet Medical Need, Emergency Room Visits by Children in the Last 12 Months (One or More), Last Health Care Visit was More Than two Years Ago, but Less than five and Last Health Care Visit was More Than five Years Ago. Health variables were chosen because of availability since health data rarely exists at the block group level. Additionally, they also covered both children and adult populations.

We also combined some variables to create new ones suitable for this project and regression purposes. We wanted to isolate those with low-income, no higher education degree, and between the ages of 12 to 18 and over 55. Note that the variable no degree consists of those over the age of 25 with a high school degree and some college. The variable income below the poverty line consists of those with income below $15,000 and up to $24,999. We created the variable Over 55 using the variables Population Aged 55 to 64 Years, Population Aged 65 to 74 Years, Population Aged 75 to 84 Years, Population Aged 85 Years and Older. We also created the variable Emergency Room Visits – One Plus using Emergency Room Visits – One and

Emergency Room Visits – Two or More. Furthermore, the variable Younger Than 18 is another name for Population Aged 12 to 17 Years of Age, created for convenience purposes.

Measurement Error

It is important to note that summary statistics reports show little variation from year-to-year among the health variables, even though the data is panel data. As such, it was not possible to run a fixed effect panel data regression, as initially intended. Also, the number of observations was different for each city.

Methodology

The four major Texas cities were analyzed at the block group level, along with 53 other variables. The dependent variables are: Unmet Medical Need, Emergency Room Visits by Children in the Last 12 Months (One or More), Last Health Care Visit was More Than two Years Ago, but Less than five and Last Health Care Visit was More Than five Years Ago. The controlled variables are Self-Reported Uninsured for Health Care, and Self-Reported Health Status - Fair or Poor. All other relevant demographic variables were also independent variables, alongside the three most important variables: Households with One Vehicle, Households with No Vehicles, and Gap Z-Score. The Gap Z-score is a benchmark; thus, the Gap Z-score measures how public and private transportation deficits in 2012 compare to health data and health access within the last couple of years.

Descriptive Statistics and Analysis

The following tables are selected summary statistics. This section analyzes some of the patterns found in the dataset. These summary statistics are worth examining because the dataset is relatively new and may yield novel conclusions on how race, income, and other factors limit access to health care and relationship to transportation availability. Furthermore, these summary statistics highlight differences between Houston, San Antonio, Dallas, and Austin.

Table 1: Summary Statistics for Percentage of Households with Income Up to But Less Than $24,999, Observations from 2010 – 2019

Statistic	All	Austin	Dallas	Houston	San Antonio
Mean	23.88	19.75	24.62	23.91	25.42

Table 2: Summary Statistics for Percentage of Hispanics, Observations from 2010 – 2019

Statistic	All	Austin	Dallas	Houston	San Antonio
Mean	45.75	32.41	39.19	42.42	65.61

The most evident pattern we can observe from these tables is that on average, Austin has fewer households living below the poverty line than the other cities. San Antonio has the most households living below the poverty line, with 65.61% of the population being of Hispanic descent, a minority group. Out of the four cities, San Antonio has the highest Hispanic population. In this case, race/ethnicity and income are related, at least to the extent that those who are Hispanic and live in San Antonio are more likely to live below the poverty line compared to their Hispanic peers in Austin, Dallas, and Houston. Dallas is second to San Antonio in terms of households with income below the poverty line, and Houston is second concerning the percentage of Hispanics.

Table 3: Summary Statistics for Percentage of Household with No Vehicles, Observations from 2010 – 2019

Statistic	All	Austin	Dallas	Houston	San Antonio
Mean	9.33	7.00	9.87	9.39	9.99

San Antonio has the most households that own no vehicles, and San Antonio's average is higher than the national average. Taking into consideration the percentage of people living below the poverty line in San Antonio, it makes sense that San Antonio has a higher population of people without vehicles. A lower-income suggests an inability to buy, pay, or own a car or afford the costs associated with owning a car. The critical thing to note is that these findings are

inconsistent with both Jiao's research and the LINK Houston report, both of which suggested that Houston had the highest number of people needing transit solutions. However, Jiao's study uses data from 2012, and Houston's updated its public transportation infrastructure in 2015.

Furthermore, without a comprehensive report by the San Antonio government or nonprofit organizations, it is impossible to know how big the gap between transit supply and demand is. The same is true for Dallas, which leads San Antonio in the percentage of households who do not own any vehicles. In the last three tables, Austin has the least amount of people living below the poverty line and households without cars. The Austin average is 2% below the national average in terms of households who do not own a vehicle; this does not mean that Austin does not have transit deficiencies.

Table 4: Summary Statistics for the Percentage of the Population Uninsured for Health Care, Observations from 2010 – 2019

Statistic	All	Austin	Dallas	Houston	San Antonio
Mean	6.68	6.61	6.70	6.63	6.78

Table 5: Summary Statistics for the Population Aged 55 Years of Age and Over, Observations from 2010 – 2019

Statistic	All	Austin	Dallas	Houston	San Antonio

Mean	32.59	28.97	31.86	32.71	35.21

San Antonio has the most people over the age of 55 and who are uninsured, higher than the national average. Knowing that San Antonio has a high Hispanic and low-income population, some of the reasons why the uninsured population is high are likely due to income barriers. Furthermore, there is an overlap between those that are uninsured and over 55. Austin falls behind the other three cities, with the least amount of people over the age of 55 and who are uninsured.

Table 6: Summary Statistics for the Percentage of the Population with Self-Reported Unmet Medical Need, Observations from 2010 – 2019

Statistic	All	Austin	Dallas	Houston	San Antonio
Mean	1.87	1.82	1.89	1.87	1.88

Even though previous tables indicate that San Antonio has the most households living below the poverty line, and who are uninsured, Dallas had the most people report unmet medical need. San Antonio follows closely behind Dallas, and Dallas residents are second to San Antonio in terms of percentage of the population who is uninsured. However, from Table 1, we can see that Dallas is second to San Antonio, with the most people living below the poverty line. It is

likely that Dallas, like San Antonio, has a high percentage of people with unmet medical needs because of income barriers.

Table 7: Correlation Matrix for Selected Sample Data

Variable	1	2	3	4	5	6
1. Emergency Room Visits -One Plus	1.00					
2. No Car	0.36	1.00				
3. One Car	0.18	0.23	1.00			
4. Younger Than 18	0.12	-0.04	-0.49	1.00		
5. Income Below the Poverty Line	0.49	0.65	0.27	0.04	1.00	
6. Uninsured	0.65	0.12	0.04	0.1400	0.2262	1.00

From the table above, we can conclude that emergency room visits are highly positively correlated with the variable uninsured, and to households with income below $24,999 (Income Below the Poverty Line). Furthermore, emergency room visits are also positively correlated with the variable, no car. Households who report not owning a vehicle are more likely to indicate one or more emergency room visits in the last 12 months compared to households with at least one car. Also note that the variables no vehicle and income below the poverty line are highly positively correlated, which indicates that there a relationship between households who do not own a car and income. Households who do not own a vehicle are therefore more likely to live in households below the poverty line.

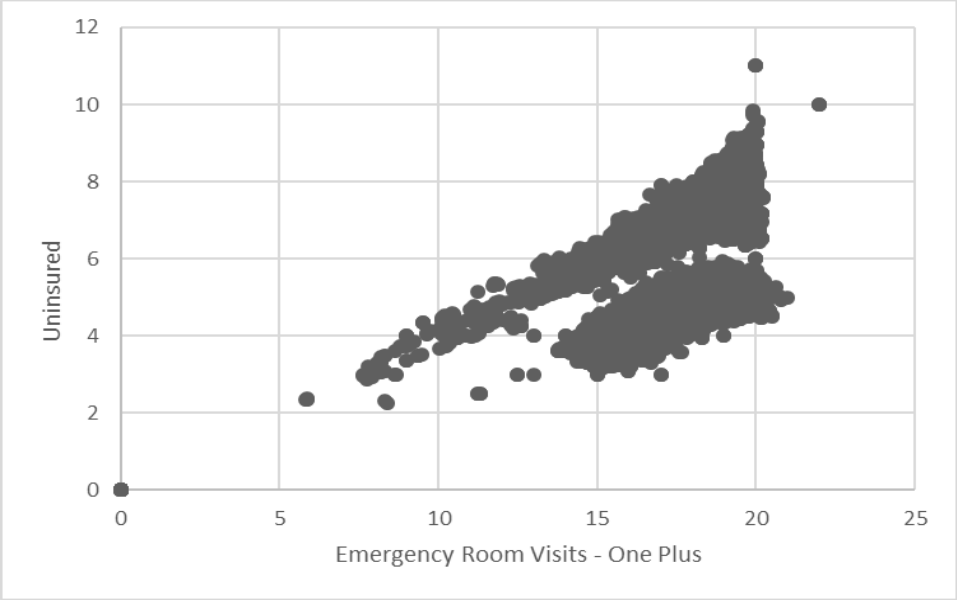

Figure 1: Scatter Plot, Emergency Room Visits One Plus, and Uninsured

Figure 1 shows that Emergency Room visits cap out at around 20%, with a couple of outliers at 0 and above 20%, which means that only about 20% of the population reports one or more Emergency Room visits. More importantly, there is a positive relationship between those who are uninsured and those who report Emergency Room visits. More importantly, the percentage of the population who reported one or more Emergency Room visits increased as the percentage of the uninsured population did.

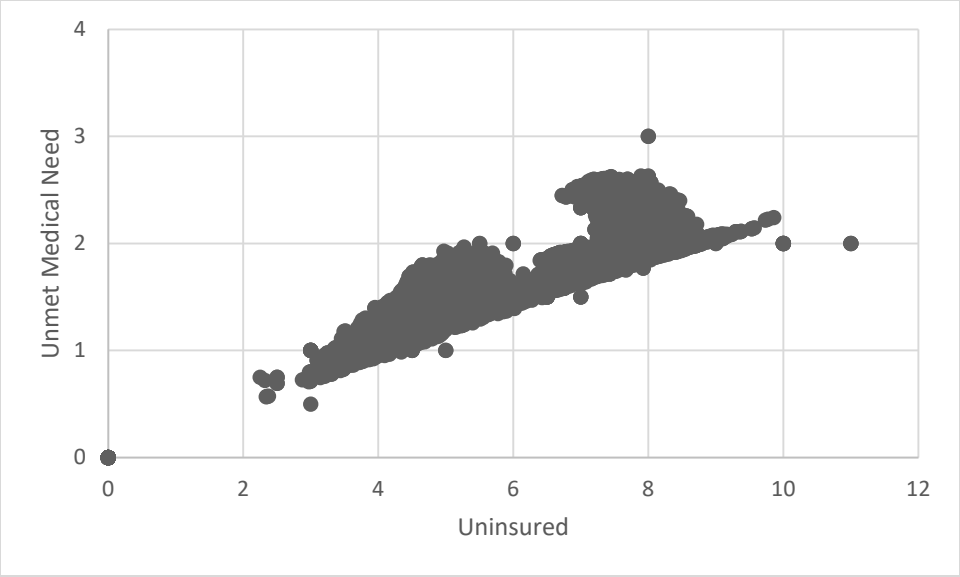

Figure 2: Scatter Plot**,** Unmet Medical Need, and Uninsured

Figure 2 shows that there is a strong positive relationship between those that are uninsured and those who reported unmet medical need. Not having insurance appears to be the primary reason why both children and adults delay care, with vehicle availability playing a minor role. The percentage of the population with unmet medical needs increased as the percentage of the population who reported not being insured did.

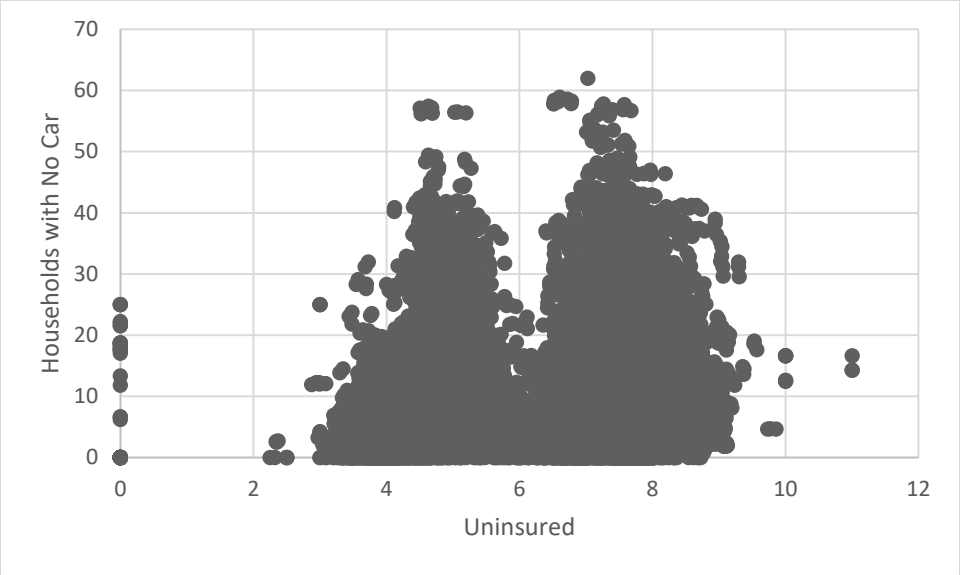

Figure 3: Scatter Plot, No Car and Uninsured

Figure 3 is not as precise as Figures 1 and 2 are. The relationship between not having a car and not being insured is not linear. It appears that those who are uninsured, about 4% to 8% of the population also reported not owning a car. These results are consistent with prior findings that show that those who are uninsured and do not own a vehicle have income below the poverty line.

After the Affordable Health Care Act, the percentage of uninsured decreased from over 46.5 million in 2010 to just below 27 million in 2016. However, for the second year in a row, the number of uninsured people increased from 2017 to 2018 by nearly 500,000 people. The graph above likely demonstrates this change. Health care providers responded to the ACA by changing what types of insurance they accepted, what types of people and diseases were covered, and, in some cases, excluded certain patients, like the elderly or those with a history of sickness/disease, from accessing care.

Regressions

We first estimate the effect of car ownership on different health outcomes (i.e., Unmet Medical Need, Emergency Room Visits by Children in the Last 12 Months, and Last Health Care Visit). We also estimate the effect using the Gap Z-Score to highlight how that impacts health outcome variables today.

Random-Effect Model

$$Y_{it=\beta_0+\ \beta_1 X_{it1}+\ B_k X_{itk}+\alpha_i+U_{it}}$$

In the equation above Y_{it} is the dependent variable, a measure of health, or a health outcome. In our random- effect model β_1 is the coefficient of the independent variable, a measure of transportation availability and where X_{it1} is the independent variable, also the measure of transportation availability. α_i represents the random individual effect, unrelated to the explanatory variables and part of the error term. Where U_{it} serves the error term. i represents the unique block group identifier, and t is the time fixed effect. Finally, where X_k represents the control variables: Population Density, Younger Than 18, Over 55, Income Below the Poverty Line (less than $24,999), Female, Unemployed, American Indian and Alaska Native, Hispanics, Asian, Black, Uninsured, Health Status – Fair or Poor, No Degree. Furthermore, we clustered the model around the Fips, the unique identifier of the block groups.

Regression Results

The following regressions show two tables of eight regressions of panel data; the first uses the independent variables of interest, no car, and one car. The second table shows results using the transportation variable, Gap Z-Score, a measure of both public and private transit demand and supply. The relationship between the variables is as follows: for every one percentage point increase in X, there is an increase or decrease in Y by a percentage point.

Table 8: Regression Results, Using No Car and One Car

	(1) Emergency Room Visits – One Plus	(2) Unmet Medical Need	(3) Last Health Care Visit 2 to 5 Years	(4) Last Health Care Visit 5 Years or More
	b/se	b/se	b/se	b/se
No Car	0.01***	0.00*	0.00	0.00*
	(0.00)	(0.00)	(0.00)	(0.00)
One Car	0.00*	-0.00	-0.00**	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Population Density	0.00**	0.00	-0.00**	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Younger Than 18	-0.02*	0.00***	0.01***	0.00
	(0.01)	(0.00)	(0.00)	(0.00)
Over 55	-0.01***	-0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Income Below Poverty Line	0.01***	0.00***	-0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Female	0.03***	0.00	0.00	0.00
	(0.01)	(0.00)	(0.00)	(0.00)
Unemployed	0.01***	-0.00	0.00**	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian and Alaska Native	0.02	-0.00	-0.01***	0.00
	(0.01)	(0.00)	(0.00)	(0.00)
Hispanics	-0.01***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	-0.04***	-0.00***	-0.00***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Black	0.01***	0.00***	-0.01***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Uninsured	1.67***	0.22***	0.04**	0.97***
	(0.03)	(0.00)	(0.01)	(0.01)
Health Status Fair or Poor	0.12***	0.05***	0.07***	-0.09***
	(0.01)	(0.00)	(0.00)	(0.00)
No Degree	-0.00	0.00***	0.00	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Year=2014	0.00	-0.42***	-0.70***	-0.03***
	(.)	(0.00)	(0.01)	(0.00)
Year=2015	0.01	-0.42***	-0.70***	-0.03***
	(0.01)	(0.00)	(0.01)	(0.01)
Year=2016	-0.02	-0.43***	-0.71***	-0.03***
	(0.01)	(0.00)	(0.01)	(0.01)

Year=2017	3.69***	-0.24***	-0.69***	-2.63***
	(0.11)	(0.01)	(0.05)	(0.03)
Year=2018	3.71***	-0.24***	-0.68***	-2.62***
	(0.11)	(0.01)	(0.05)	(0.03)
Year=2019	2.95***	-0.38***	-0.90***	-3.02***
	(0.09)	(0.01)	(0.04)	(0.03)
Year=2012		0.00	0.00	0.00
		(.)	(.)	(.)
Year=2013		0.01***	0.01***	0.01***
		(0.00)	(0.00)	(0.00)
Constant	3.67***	0.06	0.78***	1.33***
	(0.59)	(0.03)	(0.09)	(0.09)
R-sqr.	0.83	0.98	0.82	1.00
Observations	23789.00	31717.00	31717.00	31717.00

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression (1), Emergency Room Visits – One Plus, shows that there is a positive relationship between households who own a car and Emergency Room Visits by Children, One or More, (.00), which is less than the coefficient for households who own no car (.01). This result indicates that households who own at least one car are less likely to visit the Emergency Room. Initially, the assumption was that those who did not own a car would be more likely to visit the Emergency Room because they held off going to the doctor to the point that it leads to an Emergency Room visit. The results of the regression do indicate that there is a positive relationship between households who do not own a car and Emergency Room visits, likely because parents wait to take their children to the doctor until the condition worsens. Important to note, there is a relationship between the variables Emergency Room visits and No car of .36. There is a strong, positive association between Emergency Room visits and Income Below the Poverty Line at .49. Correlated variables, Income Below the Poverty Line and No Car, suggest that households who do not own a car are more likely to live in households below the poverty

level and more likely to visit the Emergency Room.

However, despite the positive relationship between households who do not own a car and Emergency Room visits, the variable uninsured has the most significant coefficient at 1.67. For every one percentage point increase in the population who reported they were uninsured, there was a 1.67 increase in households who reported one or more Emergency Room visits. This result is consistent with previous research findings and suggests that not having insurance has a significant impact on a household's ability to access health care resources. The Black, American Indian, and Female populations results indicate that these groups are more likely to visit the Emergency Room one or more times, compared to their white, male counterparts. Those who reported poor or fair health and who live below the poverty line are also more likely to indicate one or more Emergency Room visits compared to those who reported good or excellent health, and income above the poverty line.

Regression (2), Unmet Medical Need, shows that there is a positive relationship between those who reported unmet medical needs and households who own no vehicles. Also note that there is a negative relationship between households who own at least one car and unmet medical need, suggesting that those who own a car are less likely to report unmet medical needs. The variables no car and one car are not significant at an alpha of 0.05. The regression shows that there is a positive relationship between unmet medical needs and children between the ages of 12 to 18 but a negative correlation between unmet medical needs and those ages 55 and over. Like in the previous regression, there is a positive relationship between those that are uninsured and those who reported unmet medical need, the coefficient is significant at an alpha of 0.05. Those who said their last health care visit was more than five years ago are negatively correlated with the variable no car and one car but positively related with the variables uninsured and income

below the poverty line. These results indicate that after a threshold of five years, the reason people do not visit a doctor or health care site has to do with the ability to pay for services, and not with transit. These results also suggest that transportation barriers are secondary to insurance and income issues concerning health care access.

The third regression showcases a negative relationship between households who own at least one car and adults who reported their last health care visit was 2 to 5 years ago. This model suggests that people who own a vehicle are more likely to have visited a health care site recently compared to those who do not own a car. At the very least, people who own a vehicle will not wait two or more years to visit a health care site. While there is a positive relationship between households who do not own a car and those who reported their last health care visit was 2 to 5 years ago, the result is not significant. Regardless, it is clear from the model that people who own a vehicle will not wait as long to visit a health care site. The relationship between households who live below the poverty line and report their last health care visit was 2 to 5 years ago is negative, suggesting that income does not play a role in how long it takes for adults to visit a health care site. Not having insurance also plays a role in why adults take so long to visit a health care site and appear to have a more significant impact than those who do not own a car or only have access to one. Also interesting is that those who are unemployed, younger than 18, over 55, or reported poor or fair health are more likely to have had their last health care visit more than two years ago. This result is consistent with previous research, once again suggesting that older adults and children are more likely not to visit a health care site, even though these populations are more susceptible to disease because of weaker immune systems.

Regression (4) shows that there is a positive relationship between those that are uninsured and reported that their last health care visit was more than five years ago. While there is a

positive relationship between those who own no car and those who said their previous health care visit was more than five years ago, the coefficient is not significant at an alpha at 0.05. Important to note is that that the variable Income Below the Poverty Line and those that reported their last health care visit was more than five years ago have a positive relationship. A significant coefficient—indicates that income has a lot to do with why adults wait so long to visit a health care site. Also, those over 55 are more likely to have visited a health care site more than five years ago compared to those who are between the ages of 18 to 54. In this case, race or ethnicity and gender do not play a role in why people wait so long to visit a health care site, but income and age do.

From the four regressions, we know that the variables income, age, and uninsured account for some of the same effects. Most people who live below the poverty line tend to be older and not have insurance or own a car. However, from the regressions, we also know that while age and income may or may not be significant, the reason people do not visit a doctor or health care site has to do with whether they have insurance or not. Of course, not having insurance or having insurance is often a reflection of a person's or household's income, though not always. The same is true for households who do not own a car. Given how small the coefficients are, and that not all are significant at an alpha of 0.05, it is unclear whether not having a vehicle contributes to households' low income (people cannot travel to their jobs or to find work). It is unclear if having a lower income is the reason people do not own a car. Regardless, most health outcomes seem to be most affected by the variable uninsured.

Table 9: Regression Results, Using Gap Z – Score

	(1)	(2)	(3)	(4)

	Emergency Room Visits – One Plus	Unmet Medical Need	Last Health Care Visit 2 to 5 Years	Last Health Care Visit 5 or More Years
	b/se	b/se	b/se	b/se
Gap Z - score	0.04*	0.00	0.00	-0.00
	(0.02)	(0.00)	(0.00)	(0.00)
Population Density	0.00***	0.00*	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Younger Than 18	-0.02***	0.00***	0.01***	0.00***
	(0.01)	(0.00)	(0.00)	(0.00)
Over 55	-0.01***	-0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Income Below Poverty Line	0.01***	0.00***	-0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Female	0.03***	0.00	0.00	-0.00
	(0.01)	(0.00)	(0.00)	(0.00)
Unemployed	0.01***	-0.00	0.00**	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian and Alaska Native	0.02	-0.00	-0.01***	0.00
	(0.01)	(0.00)	(0.00)	(0.00)
Hispanics	-0.01***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	-0.04***	-0.00***	-0.00***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Black	0.01***	0.00***	-0.01***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Uninsured	1.67***	0.22***	0.03**	0.97***
	(0.03)	(0.00)	(0.01)	(0.01)
Health Status Fair or Poor	0.12***	0.05***	0.07***	-0.09***
	(0.01)	(0.00)	(0.00)	(0.00)
No Degree	-0.00	0.00***	0.00	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Year=2014	0.00	-0.42***	-0.71***	-0.03***
	(.)	(0.00)	(0.01)	(0.00)
Year=2015	0.01	-0.42***	-0.70***	-0.03***
	(0.01)	(0.00)	(0.01)	(0.01)
Year=2016	-0.02	-0.42***	-0.71***	-0.03***
	(0.01)	(0.00)	(0.01)	(0.01)
Year=2017	3.69***	-0.24***	-0.69***	-2.63***
	(0.11)	(0.01)	(0.05)	(0.03)
Year=2018	3.71***	-0.24***	-0.68***	-2.62***
	(0.11)	(0.01)	(0.05)	(0.03)
Year=2019	2.95***	-0.37***	-0.90***	-3.02***

	(0.09)	(0.01)	(0.04)	(0.03)
Year=2012		0.00	0.00	0.00
		(.)	(.)	(.)
Year=2013		0.01***	0.01***	0.01***
		(0.00)	(0.00)	(0.00)
Constant	3.74***	0.05	0.76***	1.30***
	(0.59)	(0.03)	(0.08)	(0.08)
R-sqr.	0.83	0.98	0.82	1.00
Observations	23650.00	31530.00	31530.00	31530.00

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

These regressions show that there is a relationship between positive Gap Z-Scores and those who reported emergency room visits, unmet medical need, last health care visit was more than 2, but less than five years ago, or more than five years ago. The results, however, are not significant at an alpha of 0.05. As previously mentioned in this paper, the Gap Z-Score uses data from 2012, while the data used for this project range from 2013 to 2019. Enough may have changed within a city's public and private transportation availability that the 2012 data does not serve as an appropriate benchmark. Regardless, in all cases, not having insurance is the primary reason why people do not visit a doctor or health care site, have an unmet medical need, or visit the emergency room. Those who reported poor or fair health are also more likely to have an unmet medical need and income below the poverty line.

These regressions, like the ones in Table 8, show that Hispanic and Asian children and adults are less likely to visit the emergency room, report unmet medical needs, or indicate their last health care visit was less than or more than five years ago. However, this does not mean that these populations are healthier compared to their white counterparts, which the regression would suggest. The results could indicate that these groups are less likely to visit a doctor or health care site, even if they are sick and have access to transit, because of cultural or language barriers,

which might explain why San Antonio has such a large uninsured population and a high percentage of people who reported unmet medical need.

Finally, there is a significant jump in the coefficients from 2013 to 2017, 2018, 2019. The years 2017, 2018, and 2019 all saw an increase in the number of people reporting emergency room visits but a decrease in the other three health outcomes. More importantly, the relationship between the health outcomes and the years 2017 – 2019 is negative, except for emergency room visits, which is positive. Considering how significant the coefficients for these years are, concerning the variable emergency room visits in comparison with the other health outcomes, there may be an issue with the data. However, since emergency room visits are related to children between the ages of 12 to 17, and the other health variables account for the adult populations, there is a possibility that children reported more emergency room visits than previous years or more data became available. While this may be possible, it would not explain why the coefficients for all the health outcome variables are so close, even when looking at different years.

Regression Results, Houston

The following regression results highlight critical findings for the city of Houston. The first table of regressions uses the independent variables of interest, no car, and one car. The second set of regressions use the variable Gap Z-Score. The relationship between the variables is as follows: for every one percentage point increase in X, there is an increase or decrease in Y by a percentage point.

Table 10: Regression Results – Houston

	(1) Emergency Room Visits – One Plus	(2) Unmet Medical Need	(3) Last Health Care Visit 2 to 5 Years	(4) Last Health Care Visit 5 or More Years
	b/se	b/se	b/se	b/se
No Car	-0.00	-0.00	-0.00***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
One Car	-0.00	-0.00	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Population Density	0.00***	0.00***	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Younger Than 18	-0.03*	0.00***	0.01***	-0.00
	(0.01)	(0.00)	(0.00)	(0.00)
Over 55	-0.01***	-0.00***	0.00***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Income Below Poverty Line	0.01***	0.00***	-0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Female	0.00	0.00*	-0.00***	-0.00
	(0.01)	(0.00)	(0.00)	(0.00)
Unemployed	0.01***	0.00***	0.01***	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian and Alaska Native	0.00	0.00*	-0.00**	-0.00
	(0.01)	(0.00)	(0.00)	(0.00)
Hispanics	-0.01***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	-0.04***	-0.00***	-0.00***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Black	0.02***	0.00***	-0.01***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Uninsured	1.74***	0.22***	0.05***	0.97***
	(0.05)	(0.00)	(0.01)	(0.01)
Health Status Fair or Poor	0.07***	0.04***	0.08***	-0.10***
	(0.01)	(0.00)	(0.00)	(0.00)
No Degree	-0.00*	-0.00	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Year=2014	0.00	-0.42***	-0.80***	-0.03***
	(.)	(0.00)	(0.01)	(0.00)
Year=2015	0.04***	-0.41***	-0.78***	-0.04***
	(0.01)	(0.00)	(0.01)	(0.01)
Year=2016	-0.03**	-0.42***	-0.80***	-0.04***
	(0.01)	(0.00)	(0.01)	(0.01)

Year=2017	4.06***	-0.23***	-0.64***	-2.59***
	(0.14)	(0.01)	(0.04)	(0.03)
Year=2018	4.08***	-0.23***	-0.64***	-2.58***
	(0.14)	(0.01)	(0.04)	(0.03)
Year=2019	3.26***	-0.36***	-0.86***	-2.98***
	(0.12)	(0.01)	(0.04)	(0.02)
Year=2012		0.00	0.00	0.00
		(.)	(.)	(.)
Year=2013		0.01***	-0.00	0.00***
		(0.00)	(0.00)	(0.00)
Constant	5.37***	0.05	0.77***	1.44***
	(0.41)	(0.03)	(0.09)	(0.08)
R-sqr.	0.82	0.98	0.84	1.00
Observations	9188.00	12254.00	12254.00	12254.00

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.00$

Regressions 1, 2, and 3 show that the variables, no car, one car, and health variables are correlated. This result is inconsistent with the overall sample, which shows that no car and one car are generally positively associated with health outcomes. Houston's 2015 initiatives to improve public transit may have decreased the gap between transit demand and supply. All four regressions indicate that the variable uninsured and health variables are positively correlated, which is consistent with prior regressions results. Regressions 1 and 2 show that American Indian and Alaska Native and Black children and adults are more likely to report emergency room visits and unmet medical needs compared to their white counterparts.

Surprisingly, none of the regressions show a relationship between the health outcomes and the variable no degree, the same was true for the regressions that used all four cities. Initially, we assumed that those with less than a high school degree or some college would report one of the health outcomes, but that was not the case. In this case, it does not seem that having or not having a degree impacts a person's ability to or likeliness to visit a doctor or health care site.

Table 11: Regression Results – Houston, Using Gap Z-Score

	(1) Emergency Room Visits One Plus b/se	(2) Unmet Medical Need b/se	(3) Last Health Care Visit 2 to 5 Years b/se	(4) Last Health Care Visit 5 or More Years b/se
Gap Z- Score	-0.01	-0.00	-0.01*	0.00
	(0.01)	(0.00)	(0.00)	(0.00)
Population Density	0.00*	0.00***	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Younger Than 18	-0.03***	0.00***	0.01***	0.00
	(0.01)	(0.00)	(0.00)	(0.00)
Over 55	-0.01***	-0.00***	0.00***	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)
Income Below Poverty Line	0.01***	0.00***	-0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Female	0.00	0.00*	-0.00***	-0.00
	(0.01)	(0.00)	(0.00)	(0.00)
Unemployed	0.01***	0.00***	0.01***	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian and Alaska Native	0.00	0.00	-0.01***	-0.00
	(0.01)	(0.00)	(0.00)	(0.00)
Hispanics	-0.01***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	-0.04***	-0.00***	-0.00***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Black	0.02***	0.00***	-0.01***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Uninsured	1.74***	0.22***	0.05***	0.97***
	(0.05)	(0.00)	(0.01)	(0.01)
Health Status Fair or Poor	0.07***	0.04***	0.08***	-0.10***
	(0.01)	(0.00)	(0.00)	(0.00)
No Degree	-0.00*	-0.00	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Year=2014	0.00	-0.42***	-0.80***	-0.03***
	(.)	(0.00)	(0.01)	(0.00)
Year=2015	0.04***	-0.41***	-0.78***	-0.04***
	(0.01)	(0.00)	(0.01)	(0.01)
Year=2016	-0.03**	-0.42***	-0.80***	-0.04***
	(0.01)	(0.00)	(0.01)	(0.01)
Year=2017	4.06***	-0.23***	-0.64***	-2.60***
	(0.14)	(0.01)	(0.04)	(0.03)
Year=2018	4.08***	-0.23***	-0.64***	-2.59***

	(0.14)	(0.01)	(0.04)	(0.03)
Year=2019	3.26***	-0.36***	-0.86***	-2.98***
	(0.12)	(0.01)	(0.04)	(0.03)
Year=2012		0.00	0.00	0.00
		(.)	(.)	(.)
Year=2013		0.01***	-0.00	0.00***
		(0.00)	(0.00)	(0.00)
Constant	5.36***	0.05	0.78***	1.40***
	(0.41)	(0.03)	(0.08)	(0.08)
R-sqr.	0.82	0.98	0.84	1.00
Observations	9188.00	12254.00	12254.00	12254.00

Given that a positive Gap Z-Score is indicative of a smaller Gap between transit demand and supply, and that a negative Z-Score represents a more significant gap, these results are consistent with previous assumptions and results. Investigating the Gap Z-Score, we see that for every one percentage point increase in the Z-Score, away from zero and in a positive direction, there is a decrease in the health outcomes variables, except for Last Health Care Visit 5 Years or More. However, these findings are not significant at an alpha of 0.05, so while the relationship exists. Nevertheless, from both the LINK Houston report and Professor Jiao's research, we know that Houston does lack transit supply and infrastructure. Perhaps, the relationship is not significant due to the changes in years (different years), or because the dataset (number of observations) is small.

Lagging, The Story of Texas

This section aims to explain why insurance coverage and income play a significant role in a person's or household's ability to access health care. Despite an effort to increase health care accessibility with the Affordable Health Care Act, more than 27 million people do not have access, mostly due to the high cost of insurance and the high price of visiting a health care site without insurance. The Kaiser Foundation found that those who are not insured are more likely

to pay a third of their income to pay for medical care, more likely to delay care until the issue worsens, and more likely to take on health care debt to pay for primary health access—not having insurance effects, the most vulnerable populations, specifically those under the age of 18 and the elderly. The Kaiser Foundation states, "significant increases in premiums in the individual market in 2017 and 2018 made that coverage much less affordable and led to declines in coverage among those who did not receive subsidies (Tolbert, Orgera, Singer, & Damico, 2019). Though the ACA expanded coverage for many, it also had unintended consequences, like the fact that states did not or have not adapted to meet local needs, and that companies changed their policies to not meet care for those with a history of illness.

One such state was Texas, which has not expanded Medicaid coverage. Texas ranked 49th out of 50 states on Health Care Access and Affordability. Texas' unwillingness to expand Medicare is a big part of the reason why many are still uninsured and why many go without much-needed care. According to the *2019 Scorecard on State Health System Performance*, the communities most affected are black, Hispanic, and low-income groups. As a response, many local health departments have adopted a "pay what you can" or "sliding scale" for those who would otherwise not be able to afford care. The Houston Health Department is one of those departments which has incorporated a philosophy of providing care to all patients, regardless of their ability to pay. However, despite those efforts, about 1.87 of the Houston population still reports unmet medical need, and 6.63 of the community is uninsured.

Conclusion

Regression results show that while vehicle availability has a small impact on access to health, most of the population suffers from a lack of insurance and or inability to pay. Thus, efforts to increase access to health care should primarily focus on reducing the cost of care and decreasing the number of uninsured people. However, since not owning a vehicle still represents a problem for some, even if it is only 9.4% of the Houston population and 9.33% of the sample population, it is vital to address how that impacts a household's ability to access health care resources. Regression results show that in some cases, not owning a car does have an impact on a person's ability to access health care; this is especially true for children and those over the age of 55. However, the results also show that not owning a car is correlated with having income below the poverty line, and it is unclear which variable is the cause and the other the effect. Female children and adults are also more likely to report emergency room visits and unmet medical needs compared to their male counterparts.

Black and American Indian and Alaskan children and adults generally are more likely to report some health access issues compared to their white peers. Still, it is possible that Asians and Hispanics also need care and do not report it due to cultural or language barriers. Despite what might be a commonly held view, not having a degree did not impact whether a person reported health care access issues. In all regressions, including Houston and the ones using the variable Gap Z-Score, income and lack of insurance were consistently affecting whether a person reported health care access issues. From the regressions, we know that the two variables are highly correlated, but research findings suggest that a person or household may lack insurance coverage but not be below the poverty line. These results indicate that there are other groups of people, with income above $24,999 who do not have insurance and are likely unable to afford it, or medical services. Having an income above $24,999 does not mean that a household can afford

or access health care, it means that those who are below that income level are most affected but that others are as well, just not to the same extent.

Houston regression results do not show that the variable no car or one car significantly impacts a person's or households' ability to access health care. From the summary statistics, however, we can assume that other cities like Dallas and San Antonio do experience some health care access issues. It is unclear at this point why Houston results are not significant and do not coincide with previous research done by the nonprofit LINK Houston or Professor Jiao. These results could suggest that Houston has better public and private transit than previously thought or that Houstonians who lack private transit have access to public transit. Since the variable Gap Z-Score measured public and private transit, Houston public transit infrastructure may meet demand and or is accessible to the populations that most need it. However, considering that the data for the health data is from 2013 to 2019, it is unlikely that this is the case.

Important to note is that the regressions that used the Gap Z-Score variable did not show a significant relationship between the control and outcome variables. As previously stated, the Gap Z-score used data from 2012, and was a benchmark for this study, since the health data used was not available for the years before 2013. Enough changes within the transportation sector could have made the variable irrelevant in this research.

It is clear from the research findings that income and a lack of insurance are the most significant factors affecting a person's or households' ability to access health care. Of course, the two variables are related, in the sense that those who have lower levels of income are usually unable to afford insurance and vice versa. Furthermore, while the findings do suggest that there is a relationship between the health outcome variables and the measures of transportation, it is not the most significant barrier to health care access. From this research, we cannot conclude that

transit availability is the most significant barrier to health care access, as many of the regression results were not significant, perhaps because of measurement errors, a relatively small sample size, or some other reason. Still, we know that transit does pose a barrier for many of the most vulnerable, like the elderly, those with lower levels of income, and minority communities.

Furthermore, we also know that those who do not own a car are often living in households below the poverty line; it is possible that if their income increased, their ability to buy or afford a car would also increase. Transit solutions at the city, state, or national level should likely focus on these populations' needs to ensure that at the very least, transit barriers are not a reason for people's inability to access health care. However, further research on transit solutions, and on the number of people who do not have insurance is needed to determine what other health care access barriers exist and how to reduce them. For now, we can only conclude that not owning a vehicle does pose a barrier for some populations and that income and a lack of insurance play a role in why people are more likely to report an adverse health outcome or lack of access.

Appendix

Selected Summary Statistics.

Table 12: Variables

Variable Name
% American Indian and Alaska Native
% Asian
% White
% Hispanic
% Black
Population Density (per square mile)
Population
% Male
% Female
% Education Attainment, Associate Degree (Pop 25+)
% Education Attainment, Bachelor's Degree (Pop 25+)
% Some College (Pop 25+)
% Education Attainment, Doctorate Degree (Pop 25+)
% Education Attainment, High School (Pop 25+)
% Education Attainment, Master's Degree (Pop 25+)
% Households w/ Income $200,000 and Over
% Households w/Income $100,000 and Over
% Households w/ Income $75,000 to $99,999
% Households w/ Income $50,000 to $74,999
% Households w/ Income $35,000 to $49,999
% Households w/ Income $25,000 to $34,999
% Households w/ Income $15,000 to $24,999
% Households w/ Income Less than $15,000
% Household w/ No Vehicles
% Households w/ 1 Vehicle
% Households w/ 2 Vehicles
% Households w/ 3 Vehicles
% of Households w/ 4+ Vehicles
% Population Aged 12 to 17 Years
% Population Aged 18 to 24 Years
% Population Aged 25 to 34 Years

% Population Aged 35 to 44 Years
% Population Aged 45 to 54 Years
% Population Aged 55 to 64 Years
Population Aged 65 to 74 Years
Population Aged 75 to 84 Years
Population Aged 85 Years and Older
Uninsured for Health Care
Unmet Medical Need
Emergency room visits in the past 12 months for children under 18 – None
Emergency room visits in the past 12 months for children under 18 - One
Emergency room visits in the past 12 months for children under 18 -Two or more
Health Status Excellent
Health Status Good
Health Status Fair or Poor
All persons without a usual place of health care
All persons with a usual place of health care
Last health care professional visit - 6 months or less
Last health care professional visit - more than six months but less than 1 year
Last health care professional visit - more than one year, but not more than two years
Last health care professional visit - more than two years, but less than five years
Last health care professional visit - more than five years

Table 13: Summary Statistics for the Population Aged 12 to 17 Years of Age, Observations from 2010 – 2019

Statistic	All	Austin	Dallas	Houston	San Antonio
Mean	7.48	5.95	7.22	7.61	8.39

Table 14: Summary Statistics for the Percentage of the Population who reported Emergency Room Visits in the past 12 Months for Children under 18 - One or More, Observations from 2010 – 2019

Statistic	All	Austin	Dallas	Houston	San Antonio
Mean	17.71	17.32	17.96	17.68	17.71

Table 15: Summary Statistics for the Percentage of the Population who reported their Last Health Care Professional Visit - More Than 2 Years, but Less Than 5 Years, Observations from 2010 – 2019

Statistic	All	Austin	Dallas	Houston	San Antonio
Mean	1.06	1.11	1.00	1.02	1.17

Table 16: Summary Statistics for the Percentage of the Population who reported their Last Health Care Professional Visit - More than 5 Years Ago, Observations from 2010 – 2019

Statistic	All	Austin	Dallas	Houston	San Antonio
Mean	5.36	5.30	5.40	5.32	5.44

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