

Article

Access to Healthcare: How Transportation Challenges Affect Chronically Ill Populations in Dallas, TX, and Detroit, MI

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Abstract

Transportation is essential for ongoing healthcare needs and access to medication, particularly for individuals managing chronic illnesses. Without reliable transportation, delays in care can happen, leading to missed treatments, worsening health problems, and unmet needs, which can make health outcomes worse over time. This study examines the relationship between transportation insecurity and health status, with a specific focus on individuals with chronic health conditions. The central research problem addressed in this study is how the perception of transportation-related barriers affect access to healthcare among the residents in Dallas, TX, and Detroit, MI, with a focus on those with chronic health conditions. Statistical analyses, including logistic regression and independent-samples *t*-tests, were conducted to assess differences between people with and without chronic health conditions. The Transportation Security Index (TSI) was used as a key metric to quantify levels of transportation insecurity. In both Detroit and Dallas, the chronically ill population exhibits a greater concentration in the “high insecurity” and “marginal insecurity” categories, while the population without chronic health condition is more likely to fall within the “no insecurity” category. The regression results are statistically significant, indicating that respondents with chronic health conditions are more likely to experience marginal or high transportation insecurity compared to those who do not have chronic conditions. Moreover, the cost of transportation, service delays, and limited ride availability are key transportation challenges affecting public transit users when accessing healthcare services in Dallas and Detroit. The findings of this study can support transportation planners, healthcare providers, and policymakers in developing targeted mobility interventions, improving transit accessibility, and designing equitable healthcare access strategies for populations experiencing transportation insecurity.

Keywords: transportation insecurity; healthcare accessibility; chronic health conditions; public transit; health equity



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1. Introduction

Ensuring people’s health and well-being falls under the purview of various levels of government and agencies, ranging from the global level with the United Nation’s Transforming our world: the 2030 Agenda for sustainable development (hereafter referred to as the 2030 Agenda), to the local level with planning departments and local governments dealing with various aspects of community development. The UN’s 2030 Agenda has 17 sustainable development goals (SDGs), of which Goal 3: is to “Ensure healthy lives and promote well-being for all at all ages”, and Goal 11 is to “Make cities and human settlements

inclusive, safe, resilient and sustainable” are most related to ensuring optimal health and well-being for all people, especially the vulnerable population, within the communities they live in [1]. Essential to these goals is the need to have sustainable transportation and mobility systems that enhance accessibility and improving social equity, health, and resilience of cities [2].

Access to healthcare systems is paramount to people living healthy lives, especially those living with chronic health conditions. Effective care for chronic diseases depends on regular provider visits, timely access to medications, and adjustments to treatment plans in line with clinical guidelines. In addition, people with lower socioeconomic status often face more transportation challenges in accessing healthcare compared to those with higher incomes [3]. Consequently, low-income individuals rely on public transportation, which may be unreliable or inaccessible, making it harder to reach medical appointments, pharmacies, and grocery stores [4].

A combination of safety concerns and limited access to healthy activities can worsen existing health disparities in any big city. A lack of physical activity can lead to various health issues, including obesity, cardiovascular disease, and mental health disorders such as anxiety and depression [5]. A study led by the University of Michigan found that 36% of Detroit residents experience transportation insecurity, meaning they cannot reliably get where they need to go in a safe or timely manner. Detroit’s transportation insecurity is more than twice the national average of 17% [6]. An Urban Institute analysis found that approximately 5% of non-elderly US adults reported forgoing needed healthcare in the past 12 months specifically because of difficulty finding transportation; this figure rose to 14% among low-income adults, and 17% among those with disabilities [7]. Another study using mobile-based trajectory data in Dallas found that longer transit and drive times, higher travel cost burdens, and lower pedestrian-road network densities are strongly associated with fewer healthcare visits. It also found that transportation barriers amplify racial inequities in healthcare use [8].

This study is significant because it addresses the persistent and growing challenge of healthcare accessibility for chronically ill and low-income populations in two urban United States (US) cities.

1.1. Transportation Challenges for Residents with Chronic Illnesses

Chronic diseases are generally defined as conditions that persist for one year or longer and require continuous medical care, restrictive daily activities, or both [5]. These conditions represent the primary contributors to the nation’s annual healthcare expenditures, which total approximately \$4.1 trillion [9]. Patients with chronic illnesses must regularly attend medical appointments and obtain prescribed medications to effectively manage their conditions. Transportation barriers have a disproportionate impact on society’s most vulnerable populations who often experience higher rates of chronic illness [8]. Therefore, identifying effective strategies to improve transportation access for these groups is essential. Transportation challenges for chronically ill patients include a lack of personal vehicles, transit cost, distance from home, inadequate public transportation, inflexible public transit schedules, inaccessibility to public transportation, and limited caregiver support [10]. Effective management of chronic diseases depends on consistent access to medical centers and timely adjustments to treatment plans based on clinical guidelines. However, limited transportation can delay these essential interventions leading to inadequate medical care and worsening of chronic conditions that contribute to poorer health outcomes [11].

This research study considers the top chronic diseases and uses a survey questionnaire to collect data from participants. Chronic conditions include cardiovascular disease or a heart condition (such as high blood pressure, heart failure, heart attack, or stroke), high-risk

pregnancy, neurological condition (such as Alzheimer's disease, epilepsy, or Parkinson's), mental health condition (such as depression, anxiety, or bipolar disorder), human immunodeficiency virus or acquired immunodeficiency syndrome, chronic obstructive pulmonary disease, asthma, emphysema, diabetes, cancer, kidney problems, low back pain, headaches or arthritis. About three out of four American adults live with at least one chronic condition, and more than half have two or more [12]. In 2023, 76.4% (representing 194 million) of US adults reported 1 or more chronic conditions [13].

Most transportation interventions aimed to increase healthcare use were measured by the number of emergency visits, outpatient appointments, hospital admissions, and access to care or social services [10]. Studies found that transportation-related interventions have a stronger positive impact on healthcare utilization among older adults who are suffering from chronic diseases [14,15]. The follow-up screenings, which are important to control chronic illness, also increased when patients received bus tickets, taxi vouchers, or free shuttles along with education and social services [16].

1.2. Challenges to Accessing Healthcare Services for Low-Income Individuals

Socially disadvantaged groups often experience reduced access to healthcare services, which is associated with poorer health outcomes and shorter life expectancy. There is noteworthy evidence that links health disparities to socioeconomic inequities in terms of income, education, employment position, gender, and ethnicity [17]. To better understand how lower-income residents feel and perceive healthcare accessibility, Hawthorne and Kwan [18] conducted an inquiry in the greater Columbus, Ohio area. The authors found that low-income people did not see healthcare professionals regularly as they should have, indicating a problem with the relationship between people with low incomes and healthcare providers. Another research result revealed that disadvantaged people may not go to the nearest healthcare center because of limited resources and time [19].

To understand how the low-income communities gain access to healthcare services, Thiago et al. [20] performed a qualitative study in São Paulo, Brazil. The study concluded that the primary obstacles to healthcare accessibility are grouped into five emerging themes: walking safety, public transportation, personal security concerns, distance, and quality of healthcare services. Based on the National Health Interview Survey (NHIS) (1997–2017), Wolfe et al. [3] found that Hispanic people, those living below the poverty threshold, Medicaid recipients, or those with a functional restriction were more likely to report a mobility barrier. Functional restriction status includes walking difficulty or performing daily activities due to chronic health conditions or disability. This correlation indicates that people with functional restrictions were 2.6 times more likely to report that transportation delayed their access to healthcare compared to those without functional restrictions.

1.3. Structural Barriers in Public Transit and Their Impact on Health Equity

Transportation limitations, closely linked to socioeconomic disadvantage, contribute to elevated stress. Therefore, it is crucial to understand the connection between health and mobility constraints to address the most vulnerable individuals' health issues [21]. Access to healthcare is frequently stated as being significantly restricted by a lack of transportation facilities [10]. Individuals with disabilities frequently mention deficiencies in public transit systems as one of the primary obstacles to accessible transportation. Some of these deficiencies involve restricted operating hours, inconsistent arrival and departure timings, insufficient details regarding the transportation program, and possible problems with accessibility [14]. Thatcher et al. [22] also noted that obstacles include inconsistent stop announcements, unreliable bus stoppages, complications in the pedestrian movement facilities, including cracked sidewalks or lengthy walking distances to the bus stop. To

get access to healthcare, several disabled riders have complained they were unable to use public transportation, generally because they were not eligible for paratransit services, even though their disability prevents them from using public transportation.

1.4. Transportation Mobility Challenges and Their Impact on Healthcare Access

Several studies were conducted to identify the transportation mobility challenges faced by chronically ill and low-income people in accessing healthcare providers. Pesata et al. [23] conducted a telephone interview about the reasons behind missed hospital appointments in a Midwestern metropolitan area. In total, 51% of respondents said that transportation (no ride or car) was the primary reason for missed appointments. In addition, a Houston, Texas-based research study observed that people without private transportation, excessive traffic, insufficient parking, bus difficulties, and excessive construction on roadways are the five main factors for frequently missed medical appointments [24]. In another study, limited access to private transportation, long distances to providers, high transit costs, and lack of public transportation were major obstacles to healthcare access for low-income chronically ill patients [25]. Wheeler et al. [26] investigated transportation barriers affecting low-income African American diabetic patients' ability to attend post-discharge follow-up appointments. They noted that 60% of all diabetic patients who responded to the study reported having trouble finding transportation to follow-up appointments, while another 34% were unable to afford to visit, and 24% had a lack of health insurance. In addition, research on active travel promotion has demonstrated that supportive environments and safe mobility infrastructure can encourage healthier behaviors and improve population well-being, suggesting that active transportation strategies may complement broader efforts to reduce transportation barriers and promote equitable access to essential services [27].

Most existing studies focus on general populations or specific health outcomes without adequately exploring how transportation barriers uniquely affect low-income individuals and patients with chronic illnesses, who often require frequent medical visits. Furthermore, existing research lacks comparative studies, leaving a gap in understanding how urban transportation systems affect healthcare accessibility. Importantly, there are no current studies that have investigated the relationship between the Transportation Security Index (TSI) and healthcare accessibility among people suffering from chronic diseases. This research study seeks to fill these gaps by analyzing how transportation insecurity and socioeconomic factors influence access to healthcare for low-income and chronically ill populations in large urban areas.

The remainder of this paper is organized as follows. Section 2 presents the Materials and Methods, including the study areas, survey instruments, data collection procedures, Transportation Security Index (TSI) development, research questions, hypotheses, and statistical analysis approaches. Section 3 presents the research findings, including the relationships between socioeconomic characteristics, chronic health conditions, transportation insecurity, and healthcare access challenges. Section 4 discusses the study findings in relation to previous research, provides policy implications for improving transportation and healthcare accessibility, and identifies limitations of the study. Finally, Section 5 summarizes the major conclusions, emphasizing the role of transportation insecurity as a structural barrier influencing healthcare access among vulnerable urban populations.

2. Materials and Methods

This study uses a quantitative, cross-sectional survey framework of analysis. To examine the perception of transportation-related barriers affecting healthcare access among low-income and chronically ill populations, this research used two questionnaire surveys. A total of 1600 participants, with 800 participants from each city, were recruited in this

study. This section begins with an introduction to the study areas. Subsequently, the study presents the data collection procedures and survey instruments, followed by the Transportation Security Index, research questions, hypotheses, and the regression models applied in the analysis. This research also shows the locations of all healthcare centers, participants' selected primary healthcare, and specialty healthcare centers in both cities, and transit availability in the study areas using the ArcGIS Pro 3.1 software.

2.1. Study Areas

To investigate how perceived transportation-related barriers have an impact on low-income and chronically ill people's accessibility to health care providers, this research considers the cities of Dallas, Texas, and Detroit, Michigan. The healthcare communities in these areas acknowledged that multiple factors exacerbate health disparities, including safety concerns, limited access to personal vehicles, and a poorly functioning public transportation system for disabled older adults [28,29]. In Dallas, nearly 221,000 people out of 1.29 million live below the federal poverty line. This represents 17.2% of the population for whom poverty status is determined, which is higher than the national average of 12.4%. In the case of Detroit, approximately 197,000 residents out of 637,000 live below the federal poverty line. This accounts for 31.5% of the population for whom poverty status is determined, which is considerably higher than the national average of 12.4% [30].

2.2. Survey Instruments and Data Collection

The data collection instruments consist of two structured questionnaires that were developed on the Qualtrics survey platform. This research was determined to be exempt by the MSU IRB (study number 00011399). This study used two panels to collect data responses. A Qualtrics research panel was used to collect survey respondents from both cities (400 responses from each city). More information on the Qualtrics panel and recruitment is posted on their site [31]. A panel from Cloud Research was then used to gather responses from those people who had some form of chronic health condition (400 responses from both cities). More information on the Cloud Research prime panel can be found on their website [32]. Using two panels from different companies helped mitigate a common respondent pool that might introduce a bias. However, both survey questionnaires were very similar in content and used census characteristics for respondent quotas. To focus on specific population groups in this study, we asked for even sampling for gender (50% each), age distribution (one-third from 18–30 years, one-third from 30–50, and one-third over 50 years), race (to try and mimic the non-white population in Detroit and the Hispanic population in Dallas) and most importantly, to aim for oversampling of the population earning less than \$30,000 annually in household income from both cities), therefore the respondent pool would not reflect the general population in both cities. Data from both surveys were combined to get 800 surveys from each city, resulting in a total of 1600 survey responses.

The survey instruments are divided into six major sections:

- (a) Demographic and Socioeconomic Characteristics: Questions gather information on participants' age, gender, income, educational attainment, employment status, race/ethnicity, and marital status.
- (b) Transportation Security Index (TSI): TSI is a survey-based tool developed by researchers at the University of Michigan, measuring transportation security symptoms and severity [33]. This research will use the abbreviated 6-item version (TSI-6 questions) to measure an individual's experience with transportation insecurity. The TSI scale used a three-point Likert format (Never, Sometimes, Often) to quantify the degree of transportation insecurity experienced by respondents. Participants re-

spond to questions measuring transportation security-related experience in the past 30 days [33].

- (c) **Transportation Access and Mobility Patterns:** Survey questions assess the primary mode of transportation, travel frequency, transportation cost, difficulty in using public transportation, and the availability of accessible options.
- (d) **Healthcare Access:** Questions evaluate the frequency of healthcare visits, including primary care, hospital emergency room, urgent care, receiving homecare visits, access to specialist care, appointment delays, and missed or rescheduled appointments due to transportation barriers.
- (e) **Transportation Related Barriers and Challenges:** Participants report their experience with personal and public transit barriers, such as distance to healthcare facilities, high fares, lack of public transit routes, language barriers, safety, cleanliness, waiting times, and accessibility issues for individuals with physical limitations.
- (f) **Health Condition:** This section assesses participants' overall health status, physical activity, and access to community resources. Participants are asked to evaluate their physical and mental health, their sense of community safety, and walkability/bikeability. Participants used a five-point Likert scale ranging from completely disagree to completely agree. Additional questions examine participants' presence of chronic health conditions.

2.3. Transportation Security Index (TSI)

The six Transportation Security Index (TSI) items assessed the frequency of transportation-related barriers experienced by respondents within the past 30 days, including missed or rescheduled appointments, inability to travel, and unmet mobility needs. These questions described the functional, emotional, and social impacts of transportation constraints, reflecting how mobility limitations affect healthcare access, daily activities, and interpersonal relationships. Each survey respondent received a composite score representing the severity of transportation insecurity. The full distribution of summed TSI scores (ranging from 0 to 12) was analyzed. To analyze the TSI score:

- (a) Each possible TSI sum score was tabulated;
- (b) The number and percentage of respondents at each TSI score level were calculated;
- (c) Scores were then grouped into the three insecurity categories [33]:
 - ✓ No insecurity: It reflects minimal or no reported transportation barriers (lowest score range 0 to 3).
 - ✓ Marginal insecurity: It indicates a moderate level of transportation constraints (score range 4 to 8).
 - ✓ High insecurity: It represents frequent and severe transportation-related barriers reflecting structural mobility disadvantage (score range 9 to 12).

This three-level classification of transportation insecurity captures distinct levels of transportation insecurity and makes it easier to compare groups and conduct statistical analysis. For further logistic regression analysis, the marginal and high insecurity groups were combined into one category to create a binary variable (0 = No insecurity; 1 = Marginal/High insecurity).

2.4. Research Questions and Hypotheses

This research study is guided by the following four research questions and hypotheses to support the research objectives.

- **Research Question 1:** How do socioeconomic characteristics (e.g., income, employment status, education) relate to the Transportation Security Index (TSI)?

- ✓ Hypothesis 1: Socioeconomic characteristics are significantly associated with the transportation security index, such that lower socioeconomic characteristics predict higher transportation insecurity.
- Research Question 2: Is the TSI significantly different for those with chronic health conditions than the general adult population?
 - ✓ Hypothesis 2: Individuals with chronic health conditions are more likely to be transportation insecure compared to those with no chronic conditions.
- Research Question 3: How is the TSI score related to access to healthcare?
 - ✓ Hypothesis 3: Higher levels of transportation insecurity, as indicated by elevated TSI scores, are significantly associated with greater barriers to accessing healthcare services.
- Research Question 4: Is the TSI score more indicative of access challenges, or are those with chronic conditions more indicative of access challenges?
 - ✓ Hypothesis 4: Individuals suffering from chronic illness are expected to have higher odds of experiencing healthcare access challenges compared to those with higher TSI scores.

2.5. Analysis

To test the proposed hypotheses, this research applied binary logistic regressions and an independent-samples *t*-test. Binary logistic regression was employed in this study due to the statistical structure of the outcome variables. The research questions focus on the likelihood of experiencing healthcare access challenges, the likelihood of transportation insecurity, and how the TSI predicts healthcare access barriers. The dependent variables, perceived challenges with access to healthcare and transportation security index, were operationalized as dichotomous measures (e.g., no transportation insecurity vs. marginal/high insecurity, presence vs. absence of healthcare access challenges). Participants were categorized into mutually exclusive groups based on self-reported chronic health condition status. Chronic health status was treated as a dichotomous categorical variable derived from questionnaire responses and used to define independent comparison groups.

For hypotheses 1 and 2, the dependent variable is the level of transportation insecurity by TSI values. Socioeconomic factors (income, employment status, household vehicles, and education) are the independent variables for hypothesis 1. For hypothesis 2, the independent variable is the chronic health condition status (has chronic condition, does not have chronic condition). For hypotheses 3 and 4, the dependent variable is the healthcare access challenges status (has healthcare access challenges, no healthcare access challenges). Level of transportation insecurity, defined as TSI binary (0 = no insecurity, 1 = marginal/high insecurity), is the independent variable for hypothesis 3. For hypothesis 4, chronic health condition status and TSI binary are the independent variables. These hypotheses were examined independently for participants in Detroit and Dallas, as well as for the sample including respondents from both cities.

In addition, the independent-samples *t*-test was applied to assess whether statistically significant differences in mean TSI scores existed between respondents with and without chronic health conditions. Survey respondents were classified into two independent groups according to whether they reported having a chronic health condition (1 = yes; 0 = no), forming the categorical grouping variable for the analysis. Here, TSI values were considered as a continuous variable. Comparing average TSI scores between people with and without chronic conditions helps determine whether chronic health condition is linked to higher transportation insecurity.

3. Results

The hypotheses were examined in SPSS version 29 using a combination of inferential statistical techniques to determine whether significant relationships and differences exist among the key variables related to transportation mobility, security, and healthcare accessibility. The results of these statistical tests are presented in the following subsections, in which each hypothesis is examined for Dallas, Detroit, and the combined datasets (Dallas and Detroit together).

3.1. Socioeconomic Characteristics Associated with TSI (Hypothesis 1)

Based on the Dallas dataset, participants who have income less than \$5000; \$5000 to \$9999; and \$15,000 to \$24,999 are more likely to have a marginal or high transportation insecurity level compared to those who have no income. An income level of more than \$25,000 is not significantly associated with their transportation insecurity level (see Table 1).

Table 1. Logistic regression results for socioeconomic determinants of TSI for Dallas.

Independent Variables	Wald	Exp (B)
No Income (ref.)	45.501	
Less than \$5000	4.466	4.087 *
\$5000 to \$9999	4.769	5.808 *
\$10,000 to \$14,999	1.381	2.101
\$15,000 to \$24,999	6.675	4.386 *
\$25,000 to \$34,999	0.048	1.148
\$35,000 to \$49,999	0.010	1.061
\$50,000 to \$74,999	0.369	1.420
\$75,000 to \$99,999	0.410	0.681
\$100,000 to over	0.15	0.930
No HH vehicle (ref.)	23.12	
1 HH vehicle	5.931	0.480 *
2 HH vehicles	13.836	0.321 ***
3 or more HH veh.	19.222	0.212 ***
Working Full-time (ref.)	18.908	
Working Part-time	0.50	0.924
Self-employed	0.015	1.045
Student	0.004	0.960
Homemaker	1.844	2.268
Unemployed	2.240	0.611
Retired	14.614	0.372 ***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. [Logistic regression testing for the likelihood of having marginal/high insecurity].

Those participants in Dallas who have one, two, three, or more vehicles are less likely to have marginal or high transportation insecurity compared to those who have no vehicle. It means that the participants who have no vehicle are facing high transportation insecurity in their communities. Dallas participants who are retired are less likely to have marginal or high transportation insecurity compared to those who are full-time workers. It means that full-time workers have faced more marginal or high transportation insecurity. Overall,

the binary logistic regression results for the Dallas sample indicate that vehicle ownership, employment status, and lower household income levels are significantly associated with transportation insecurity.

Participants in Detroit who have one, two, three, or more vehicles are less likely to have marginal or high transportation insecurity compared to those who have no vehicle. It means that the participants who have no vehicle are facing high transportation insecurity in their communities. Participants who are working as self-employed are less likely to have marginal or high transportation insecurity compared to those who are full-time workers. It means that full-time workers have faced more marginal or high transportation insecurity. The logistic regression output does not show any significant relationship between the participants' income and educational attainments with their transportation insecurity level (see Table 2).

Table 2. Logistic regression results for socioeconomic determinants of TSI for Detroit.

Independent Variables	Wald	Exp (B)
No Income (ref.)	14.290	
Less than \$5000	1.660	1.965
\$5000 to \$9999	1.873	2.140
\$10,000 to \$14,999	1.360	1.877
\$15,000 to \$24,999	1.290	1.795
\$25,000 to \$34,999	0.601	1.508
\$35,000 to \$49,999	0.033	0.906
\$50,000 to \$74,999	0.125	1.205
\$75,000 to \$99,999	2.592	2.421
\$100,000 to over	2.099	2.348
No HH vehicle (ref.)	40.806	
1 HH vehicle	25.398	0.248 ***
2 HH vehicles	30.087	0.210 ***
3 or more HH veh.	25.103	0.182 ***
Working Full-time (ref.)	9.370	
Working Part-time	0.310	0.861
Self-employed	7.376	0.450 **
Student	0.910	1.628
Homemaker	0.044	0.922
Unemployed	1.048	0.755
Retired	0.182	0.905

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. [Logistic regression testing for the likelihood of having marginal/high insecurity].

Overall, the findings indicate that access to private vehicles plays an important role in reducing transportation insecurity among Detroit respondents, whereas income, education, and most employment categories do not demonstrate significant relations within the model.

For the combined dataset, those participants who have income less than \$5000; \$5000 to \$9999; \$10,000 to \$14,999, and \$15,000 to \$24,999 are more likely to have marginal or high transportation insecurity compared to those who have no income. In addition, those participants who have one, two, three, or more vehicles are less likely to have marginal

or high transportation insecurity compared to those who have no vehicle. It means that the participants who have no vehicle are facing high transportation insecurity in their communities. Those participants who are working as self-employed or retired are less likely to have marginal or high transportation insecurity compared to those who are full-time workers (see Table 3). However, the logistic regression output does not show any significant relationship between the participants' educational attainments and their transportation security level. In response to the research question, the regression results indicate that socioeconomic characteristics have varying relationships with the TSI. Among the variables examined, vehicle ownership shows the most consistent and statistically significant relationship with transportation security in both cities, while income and employment status demonstrate city-specific effects.

Table 3. Logistic regression results for socioeconomic determinants of TSI for both cities.

Independent Variables	Wald	Exp (B)
No Income (ref.)	35.079	
Less than \$5000	5.995	2.60 *
\$5000 to \$9999	6.162	2.875 *
\$10,000 to \$14,999	3.975	2.213 *
\$15,000 to \$24,999	8.113	2.875 **
\$25,000 to \$34,999	0.733	1.396
\$35,000 to \$49,999	0.007	1.032
\$50,000 to \$74,999	0.920	1.436
\$75,000 to \$99,999	1.168	1.524
\$100,000 to over	0.624	1.372
No HH vehicle (ref.)	56.893	
1 HH vehicle	32.201	0.321 ***
2 HH vehicles	44.054	0.257 ***
3 or more HH veh.	42.275	0.213 ***
Working Full-time (ref.)	13.934	
Working Part-time	1.038	0.809
Self-employed	4.431	0.633 *
Student	0.422	1.292
Homemaker	0.191	1.146
Unemployed	3.695	0.634
Retired	7.829	0.634 **

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. [Logistic regression testing for the likelihood of having marginal/high insecurity].

3.2. Transportation Insecurity Associated with Chronic Health Conditions (Hypothesis 2)

In Dallas, the relationship between chronic health status and transportation insecurity was not statistically significant. The odds ratio ($\text{Exp}(B) = 1.260$) suggests a higher likelihood of transportation insecurity among respondents with chronic conditions. In contrast, the Detroit model shows a statistically significant relationship between chronic health conditions and transportation insecurity. The regression results are statistically significant ($\text{Wald} = 12.259$, $p < 0.001$), with an odds ratio of 1.750, indicating that respondents with chronic health conditions are 1.75 times more likely to experience marginal or high

transportation insecurity compared to those who do not have chronic conditions. For the combined sample of both cities, the regression results show a statistically significant association between chronic health conditions and transportation insecurity (Wald = 12.143, $p < 0.001$). The odds ratio ($\text{Exp}(B) = 1.490$) suggests that respondents with chronic health conditions are 1.49 times more likely to experience marginal or high transportation insecurity compared to those without chronic conditions (see Table 4).

Table 4. Logistic regression outcomes for the effect of chronic health status on TSI.

Study Area	Independent Variables	Nagelkerke R Square	Wald	Exp (B)
Dallas	Chronic	0.003	1.976	1.260
Detroit	Chronic	0.020	12.259	1.750 ***
Both cities	Chronic	0.010	12.143	1.490 ***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. [ref: Does not have a chronic condition]. [Logistic regression testing for the likelihood of having marginal or high insecurity].

Transportation insecurity may be more strongly intertwined with existing structural disadvantages in Detroit, including lower household income levels, limited transportation options, neighborhood disinvestment, and potential barriers to accessing healthcare resources. A larger proportion of Dallas respondents reported annual household incomes above \$35,000 (56%) compared with Detroit respondents (44%), suggesting differences in economic resources that may influence transportation availability and healthcare mobility. Additionally, among respondents with chronic conditions, a greater proportion of Dallas participants reported driving themselves to healthcare appointments (44%) compared with Detroit participants (38%), indicating potentially greater access to private transportation among chronically ill individuals in Dallas. These differences suggest that in Dallas, access to personal vehicles and relatively higher income levels may reduce the extent to which chronic health conditions contribute to transportation insecurity. Conversely, in Detroit, where fewer individuals may have access to reliable transportation resources, chronic conditions may create additional transportation burdens by increasing healthcare-related travel needs.

Overall, the findings signify that transportation insecurity differs between individuals with chronic health conditions and the general adult population. Transportation insecurity tends to be higher among populations with chronic illnesses, although the strength of this relationship varies by study area.

Application of the Independent-Sample *t*-Test

An independent-samples *t*-test was conducted to examine differences in TSI scores between individuals with and without chronic health conditions. Survey respondents were classified into two independent groups according to whether they reported having at least one chronic health condition. After running an independent-sample *t*-test, the results indicated that individuals with chronic conditions reported significantly higher TSI scores (mean = 5.23) compared to those without chronic conditions (mean = 4.29). To conduct the independent-samples *t*-test, respondents' scores across all six TSI items were summed to generate an aggregate TSI score for each individual. The degrees of freedom of the *t*-test was 1597. The effect size was small but meaningful (Cohen's $d = 0.251$, Hedge's correction = 0.251) for the aggregated TSI score, suggesting that chronic illness status is associated with higher levels of transportation insecurity.

In addition, the difference in aggregated TSI scores between the two study groups was statistically significant, $t = 4.603$ ($p < 0.001$). This implies that there is a significant difference between the TSI scores of those with and without chronic health conditions. The

findings indicate that adults with chronic health conditions experience significantly higher transportation insecurity than those without chronic conditions.

3.3. Transportation Insecurity Associated with Perceived Barriers to Accessing Healthcare (Hypothesis 3)

To examine the relationship between transportation insecurity and perceived barriers to healthcare access, a binary logistic regression analysis was conducted. When examining the cities separately, the relationship remains statistically significant in both locations. In Dallas, the regression results show a significant relationship between transportation insecurity and healthcare access (Wald = 137.637, $p < 0.001$), with an odds ratio, $\text{Exp}(B) = 0.071$. Similarly, in Detroit, transportation insecurity is significantly associated with healthcare access barriers (Wald = 138.844, $p < 0.001$), with an odds ratio, $\text{Exp}(B) = 0.097$. In both cities, the odds ratios below one indicate that individuals experiencing transportation insecurity perceive considerably more access challenges compared to those with no transportation insecurity. For the combined dataset of respondents from Dallas and Detroit, the regression results show a statistically significant relationship between transportation insecurity and healthcare access (Wald = 277.681, $p < 0.001$). The odds ratio ($\text{Exp}(B) = 0.084$) indicates that respondents experiencing marginal or high transportation insecurity are substantially more likely to report having healthcare access challenges compared to those with no transportation insecurity (see Table 5).

Table 5. Logistic regression results for healthcare access challenges across transportation insecurity.

Study Area	Independent Variables	Nagelkerke R Square	Wald	Exp (B)
Dallas	TSI Binary	0.307	137.637	0.071 ***
Detroit	TSI Binary	0.263	138.844	0.097 ***
Both Cities	TSI Binary	0.283	277.681	0.084 ***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ [ref: no insecurity]. [Logistic regression testing for the likelihood of not having access challenges].

In general, marginal or high transportation-insecure Dallas and Detroit residents perceived more challenges with access to healthcare. This suggests that a higher transportation insecurity score is strongly associated with increased perception of barriers to accessing healthcare services. These findings provide strong support that the transportation security index score is significantly associated with access to healthcare services. The regression results consistently demonstrate that respondents with marginal or high transportation insecurity perceive significantly greater healthcare access challenges.

3.4. Chronic Health Conditions Associated with Healthcare Access Challenges (Hypothesis 4)

To evaluate the relationship between transportation insecurity, chronic health status, and perceived healthcare access challenges, a multinomial logistic regression analysis was conducted. When the cities are analyzed separately, similar patterns emerge. In Dallas, both chronic health status (Chi-square = 13.703 ***, Wald = 13.521, $\text{Exp}(B) = 1.951$ ***) and transportation insecurity (Chi-square = 203.905 ***, Wald = 137.079, $\text{Exp}(B) = 0.070$ ***) are significantly associated with healthcare access challenges, with transportation insecurity showing a stronger effect, as reflected in its higher Chi-square value. Participants in Detroit with chronic health conditions are significantly more likely to perceive no access challenges ($\text{Exp}(B) = 1.951$ ***) than those without chronic conditions. In addition, participants with marginal or high transportation insecurity are significantly less likely ($\text{Exp}(B) = 0.100$ ***) to perceive no access challenges than those with no transportation insecurity.

For the combined dataset of respondents from Dallas and Detroit, the regression results show that both transportation insecurity and chronic health status are significantly associated with healthcare access challenges. Chronic health status demonstrates a significant relationship (Chi-square = 31.001 ***, Wald = 30.484, Exp(B) = 2.021 ***), indicating that individuals with chronic conditions are more likely to report having no healthcare access challenges compared to those without chronic conditions. In addition, participants with marginal or high insecurity are significantly less likely to report no access challenges (Chi-square = 381.062 ***, Wald = 271.681, Exp(B) = 0.085 ***) than those with no transportation insecurity. It means that those who have some or high insecurity are facing more access challenges to healthcare (see Table 6). Across the combined dataset and the separate city models, chronically ill respondents experiencing marginal or high transportation insecurity were consistently more likely to report difficulties accessing healthcare services.

Table 6. Logistic regression results for the effects of TSI and chronic status on healthcare access.

Study Area	Independent Variables	Nagelkerke R Square	Chi-Square	Wald	Exp (B)
Dallas	Chronic status	0.324	13.703 ***	13.521	1.951 ***
	TSI Binary		203.905 ***	137.079	0.070 ***
Detroit	Chronic status	0.285	17.726 ***	17.349	2.112 ***
	TSI Binary		177.790 ***	133.023	0.100 ***
Both Cities	Chronic status	0.303	31.001 ***	30.484	2.021 ***
	TSI Binary		381.062 ***	271.681	0.085 ***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. [ref: does not have a chronic condition; ref: no insecurity]. [Logistic regression testing for the likelihood of not having access challenges].

To address research question 4, the logistic regression analysis indicates that both transportation insecurity and chronic health conditions are significantly associated with healthcare access challenges. Overall, although chronic health conditions are significantly associated with the perception of healthcare access challenges, the higher chi-square values indicate that transportation insecurity is a stronger statistical influence than chronic health status on healthcare access barriers across both cities.

3.5. Distribution of the TSI Based on Chronic Health Status

This study considered the most disadvantaged groups to compare the TSI values. In Dallas, the distribution of transportation insecurity among chronically ill respondents shows that marginal insecurity is the most dominant condition across all groups, followed by either high or no insecurity, depending on the subgroup. Among all respondents, 44% experience marginal insecurity, compared to 21% high insecurity and 35% no insecurity, indicating that a majority of respondents face moderate transportation challenges rather than extreme or no difficulties. A similar pattern is evident among economically vulnerable groups, where low-income respondents were primarily concentrated in the marginal insecurity category. Transit users in Dallas also exhibit elevated levels of transportation vulnerability, with 52% reporting marginal insecurity and 28% high insecurity. This distribution suggests that reliance on public transit is associated with greater transportation-related challenges. In contrast, older adults in Dallas experience comparatively higher levels of transportation security relative to other subgroups (see Table 7).

In Detroit, the TSI distribution pattern similarly shows that marginal insecurity is the most common condition, although the distribution across categories is more balanced than in Dallas. Low-income respondents and Black respondents were concentrated (45%) in the marginal insecurity category, with fewer experiencing severe insecurity. Older adults

showed a relatively even spread across insecurity levels, indicating continued transportation challenges for many. Transit users were the most vulnerable group, with a high concentration in both marginal (48%) and high insecurity (33%) categories.

Table 7. Transportation Security Index among chronically ill respondents.

Study Area	Respondents Categories	High Insecurity	Marginal Insecurity	No Insecurity
Dallas	All respondents	21%	44%	35%
	<\$25,000 income	25%	53%	21%
	Hispanic	26%	50%	24%
	Older adults	6%	32%	62%
	Transit users	28%	52%	20%
Detroit	All respondents	26%	41%	33%
	<\$25,000 income	26%	45%	30%
	Black	20%	45%	34%
	Older adults	27%	34%	39%
	Transit users	33%	48%	18%

3.6. Distribution of the TSI Based on Non-Chronic Health Status

In Dallas, transportation insecurity among non-chronically ill respondents is characterized by an apparent majority of marginal insecurity, accompanied by comparable levels of no insecurity and relatively low levels of high insecurity across all subgroups. Among all respondents, marginal insecurity (45%) slightly exceeded no insecurity (44%), indicating that severe transportation challenges are comparatively limited in this population. Low-income respondents showed the greatest concentration in marginal insecurity, suggesting that economic disadvantage strongly influenced transportation vulnerability. Transit users also experienced high levels of marginal insecurity (52%), reflecting the challenges associated with reliance on public transit.

In Detroit, non-chronically ill respondents were more likely to report no transportation insecurity than marginal or high insecurity, showing comparatively better transportation security than Dallas. However, less than half of respondents were fully secure, indicating that transportation concerns remained noteworthy. Older adults and transit users in Detroit appeared more vulnerable, as the majority experienced marginal or high transportation insecurity (see Table 8).

Table 8. Transportation Security Index among non-chronically ill respondents.

Study Area	Respondents Categories	High Insecurity	Marginal Insecurity	No Insecurity
Dallas	All respondents	11%	45%	44%
	<\$25,000 income	10%	60%	31%
	Hispanic	16%	46%	38%
	Older adults	17%	51%	31%
	Transit users	14%	58%	28%
Detroit	All respondents	20%	33%	47%
	<\$25,000 income	18%	38%	44%
	Black	15%	30%	54%
	Older adults	29%	29%	42%
	Transit users	25%	42%	33%

In general, people with chronic health conditions face higher transportation vulnerability, with more in the high insecurity category and fewer with no insecurity compared to those without such conditions. Both Dallas and Detroit see the chronically ill population more often in the marginal and high insecurity categories, whereas those without chronic conditions mostly report no insecurity. These findings highlight that chronic health issues are associated with greater transportation disadvantages, underscoring the link between health vulnerability and transportation insecurity.

3.7. Spatial Depiction of Transportation Access to Healthcare in Detroit and Dallas

This section presents a spatial depiction of transportation access to healthcare facilities in Detroit and Dallas. The analysis overlays the spatial distribution of survey participants, their reported primary and specialty healthcare locations, and the cities' healthcare infrastructure with the transit network. The transit networks include bus routes, bus stops, rail routes, and rail stations. By examining the geographic alignment between participants' residential locations, healthcare destinations, and transit services, this depiction aims to identify spatial patterns of accessibility and potential disparities that may contribute to transportation insecurity.

3.7.1. Spatial Distribution of Participants, Healthcare Facilities, and Transit Network in Detroit

The spatial distribution shown in Figure 1 highlights key geographic patterns related to healthcare access and transportation infrastructure in Detroit. Participants are mainly concentrated in the western and southern parts of the city, suggesting these areas form the main residential hubs of the study group. Similarly, many primary and specialty healthcare facilities that participants regularly visit are also located in these regions. In contrast, healthcare facilities throughout the city are more spread out, with visible clusters in the central and eastern parts of the city. The Detroit Department of Transit (DDOT) network, including bus routes and stops, is heavily concentrated in central Detroit and extends into the western neighborhoods, offering good coverage where many participants live. However, coverage appears less dense in some southern and southeastern areas, which may create transportation gaps for residents there. Differences in transit coverage and the widespread availability of healthcare facilities suggest possible disparities, which make it harder for some participants, particularly those in southern areas, to access healthcare.

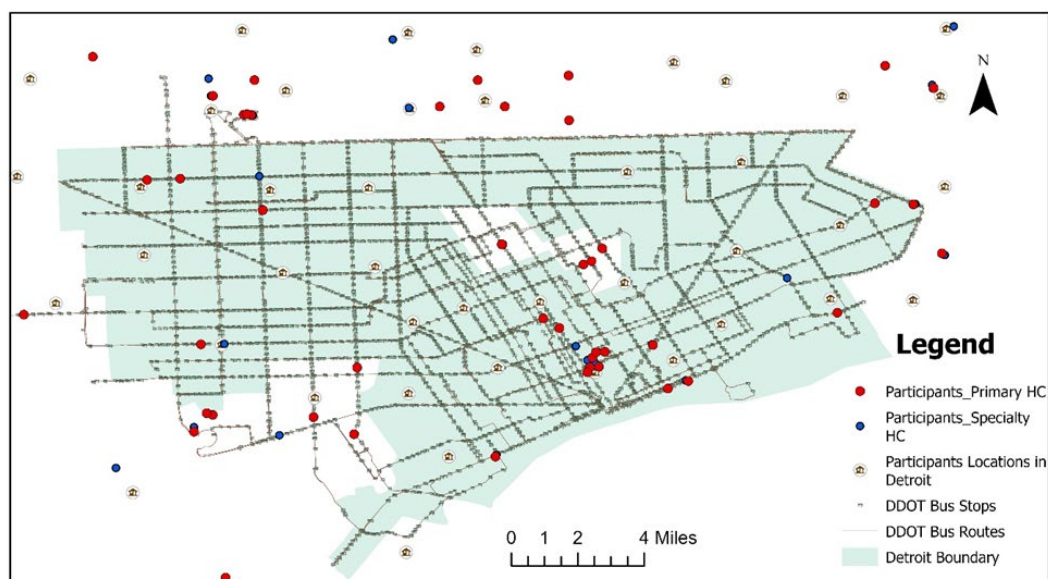


Figure 1. Spatial distribution of participants, healthcare facilities, and DDOT transit network in Detroit.

The spatial distribution shown in Figure 2 highlights key relationships between all healthcare locations and neighborhood median household income across Detroit. When compared with median household income patterns across block groups, additional disparities become clear. The map indicates that many participant clusters are situated in lower to middle-income neighborhoods, especially in the southern and western parts of Detroit, where median household incomes are generally below \$40,000. Conversely, higher-income areas appear more often in certain outer and northeastern sections of the city, where there are fewer healthcare facilities. Healthcare facilities are distributed throughout the city, including in wealthier areas. However, most participants seek healthcare in lower-income neighborhoods, likely because these locations are closer to their homes or easier to access than those in higher-income areas.



Figure 2. Spatial distribution of all healthcare locations and Household income in Detroit.

3.7.2. Spatial Distribution of Participants, Healthcare Facilities, and Transit Network in Dallas

Figure 3 illustrates the spatial relationships between healthcare facilities (primary and specialty), survey participants' locations, and the Dallas Area Rapid Transit (DART) network within the Dallas city boundary. A clear clustering pattern is visible, with most of the survey participants' primary and specialty healthcare locations concentrated in the central and southern portions of Dallas. These areas also show a higher density of participant residences, indicating that many respondents both live and seek care within or near these zones. The DART rail lines and bus routes are primarily concentrated in and around central Dallas, extending outward toward western and eastern Dallas. Many participants and healthcare locations are located close to these transit routes and stops. This suggests that people in these areas may have better access to healthcare using public transportation. In contrast, the northern and outer areas of Dallas have fewer participants and fewer healthcare facilities. Transit routes are also less dense in these areas. This may make it harder for people living there to access healthcare, especially if they depend on public transportation.

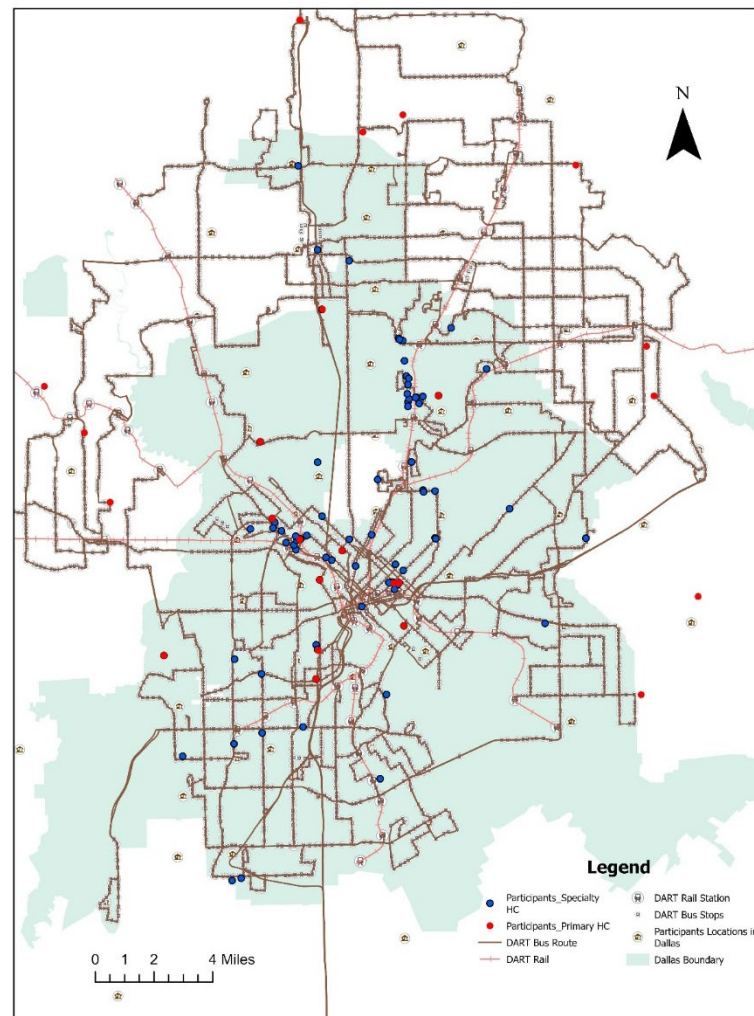


Figure 3. Spatial distribution of participants, healthcare facilities, and DART transit network in Dallas.

Figure 4 illustrates the relationship between all healthcare facilities and median household income across Dallas City block groups. Higher-income neighborhoods are mainly located in the northern part of the city, while lower-income areas are more frequent in the southern and some central regions. Dallas's healthcare facilities tend to be more clustered in central Dallas, where various income levels mix. The figure also suggests that central Dallas serves as a key hub for healthcare services, with many facilities located there, making it a critical destination for patients from across the city. Some healthcare facilities are in higher-income areas in the northern part of Dallas, but fewer participants reside in those areas. Lower-income neighborhoods, mostly in southern Dallas, have fewer healthcare facilities compared to central spots. This implies that residents in these areas may need to travel longer distances to access healthcare. Although some participants seek care in central Dallas, the distance from their homes to healthcare locations can create transportation challenges. Primary care sites are more widespread than specialty care, but they are still less accessible in some lower-income neighborhoods. This uneven distribution may increase travel time and transportation costs for residents of those areas. Overall, the map highlights spatial disparities in income and healthcare access in Dallas. Lower-income populations are more likely to face longer travel distances and transportation barriers when seeking healthcare.

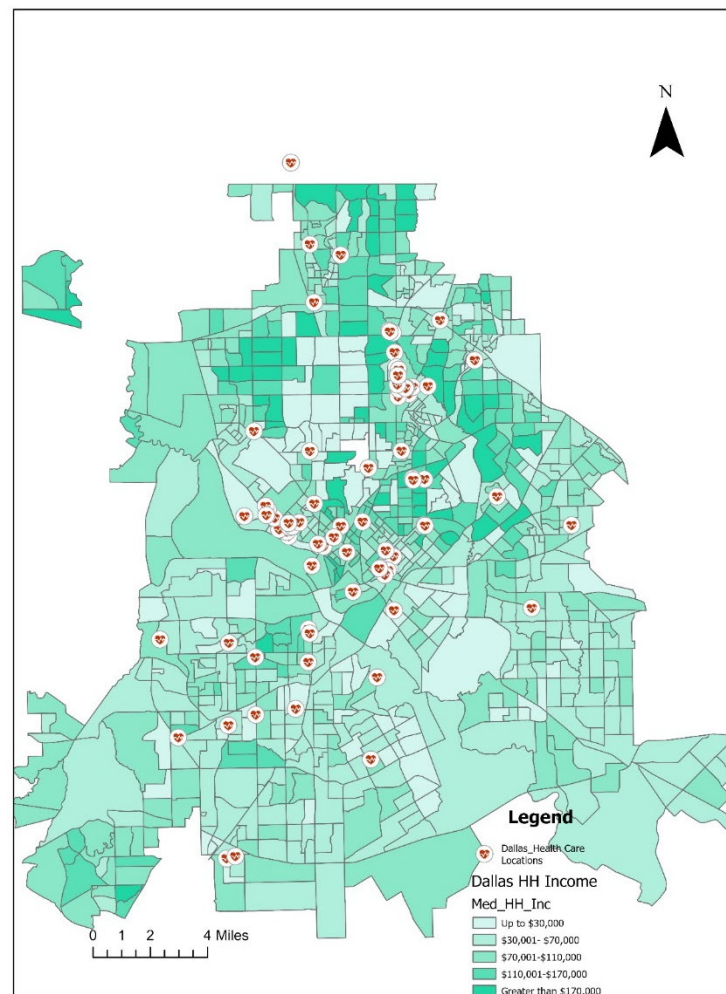


Figure 4. Spatial distribution of all healthcare locations and Household income in Dallas.

4. Discussion

The primary objective of this research was to examine how transportation insecurity influences the perception of access to healthcare services among low-income and chronically ill populations in two major U.S. cities, Dallas, Texas, and Detroit, Michigan. Results from the first research question demonstrated that individuals with lower income levels experienced lower transportation security compared with higher income respondents and living in households with fewer vehicles experienced greater transportation insecurity than those in households with more vehicles. Prior studies have repeatedly found that low-income populations face greater transportation burdens, including longer travel times, fewer modal choices [34], and reduced access to employment and healthcare opportunities [23]. Lower-income individuals may need to rely on fragmented or time-consuming transit networks, increasing the likelihood of missed appointments, delays, or skipped medical care [10]. In addition, a study indicates that 42% of people without a car experience insecurity, compared to only 18% of car owners, often resulting in skipping medical, work, or school trips due to unreliable transportation [35]. This study's results show that self-employed, unemployed, or retired participants are less likely to have marginal or high transportation insecurity compared to those who are full-time workers using the combined datasets. However, students and homemakers are more likely to experience marginal or high transportation insecurity compared to full-time workers. This finding is not always consistent with previous research. A study found that unemployed, retired, disabled, or outside the labor force generally reported higher transportation insecurity than those who

were employed full-time [36]. A longitudinal analysis found that when individuals lose employment, transportation insecurity may worsen due to reduced income, inability to maintain a vehicle, or inability to cover commuting costs [37]. In research question two, respondents with chronic health conditions were significantly more likely to experience transportation insecurity and reported higher average TSI scores (indicating increased insecurity) than adults without chronic conditions. This finding aligns with the previous research findings. Using the 2002–2018 NHIS data, Chen et al., [38] showed that transportation barriers were associated with higher emergency department utilization among chronically ill patients compared to non-chronically ill patients. According to a 2017 survey of health centers, those with disabilities, older patients, and patients with chronic illnesses were all shown to be disproportionately negatively impacted by transportation barriers [3].

The logistic regression output for hypothesis three indicates that respondents experiencing marginal or high transportation insecurity were significantly more likely to report having healthcare access challenges compared with respondents who were transportation secure. It means that individuals with transportation insecurity were far more likely to encounter difficulties in accessing healthcare services. These findings are highly consistent with prior literature. Based on a TSI 6-item questionnaire survey study, more than half of transportation-insecure residents report having deferred medical care due to transportation cost and barriers in the past year [33]. In addition, 2000–2018 US NHIS data demonstrated that transportation insecurity is strongly associated with insufficient healthcare access and worse health outcomes [39]. Investigation of research question four indicates that both TSI and chronic health status variables are statistically significant predictors of healthcare access barriers, but transportation insecurity demonstrated the stronger statistical influence across the combined sample and in both city-specific models. The much larger Wald statistic for transportation insecurity compared with chronic health status indicates that transportation insecurity is the more immediate barrier, preventing individuals from accessing healthcare. Transportation insecurity is a prevalent issue and is strongly associated with poor health quality and reduced access to healthcare services compared to chronic health status [35]. A study found that 17% of Americans experienced at least one form of transportation insecurity when accessing healthcare, and 44% of Americans who face this transportation insecurity report two or more transportation barriers, such as longer travel times, no public transportation options, or high fares. The study further found that transportation insecurity is a more influential determinant of healthcare access decisions than the respondents' chronic illness status alone [40].

This study's findings revealed that among public transit users, transportation-related barriers to healthcare access were primarily driven by financial and availability constraints. Considering both cities' datasets, among respondents with chronic conditions, the most frequently reported challenge was transportation cost (25%), followed by the unavailability of rides from friends or family (24%), long waiting times (17%), inconvenient pickup/drop-off locations (13%), and difficulty scheduling rides (10%). A similar pattern was observed among respondents without chronic conditions, where transportation cost represented the most common barrier (34%), followed by long waiting times (21%) and lack of available rides from social networks (17%). These findings indicate that affordability, limited informal transportation support, and transit service reliability are key barriers affecting healthcare access among public transit users, regardless of chronic health status.

4.1. Policy Recommendations

Policy implications for sustainable and reliable transportation are fostered at multiple levels. The Sustainable Transportation goal of the UN's 2030 Agenda aims to provide access to safe, affordable, accessible and sustainable transport systems by expanding public

transportation for those in vulnerable situations [2]. At the national level, the Coordinating Council on Access and Mobility (CCAM), established under the Federal Transit Administration (FTA), works to foster personal mobility by connecting people to destinations such as medical appointments [41]. At the state level, the Michigan Department of Transportation (MDOT)'s Office of Passenger Transportation (OPT) works to provide social well-being for the residents of the state by providing a network of passenger transportation services [42]. The Public Transportation Division of the Texas Department of Transportation (TXDOT) aims to provide a reliable network of transportation options to those Texans who use alternatives to driving alone [43]. While there is a will and aim to strengthen accessibility for those with vulnerable conditions at various government and agency levels, an effective and efficient transit system comes down to the local jurisdiction to ensure everyone has access to various transportation modes and no one suffers from transportation insecurity.

Policy interventions are needed to improve coordination between transportation infrastructure, healthcare service locations, public transit accessibility, and healthcare affordability. Policy makers should prioritize transit-oriented healthcare development strategies that intentionally locate healthcare facilities along major public transit corridors, bus rapid transit systems, and rail transit routes [44]. Integrating hospitals, clinics, pharmacies, and community health centers within high-frequency transit corridors can reduce transportation insecurity and increase healthcare accessibility for underserved urban populations. Another critical policy implication involves the coordination between Metropolitan Planning Organizations, local transit agencies, public health departments, and healthcare systems. Aligning this coordination plan with local hospital networks and health departments ensures that fixed-route transit, micro-mobility, and paratransit services directly connect low-income, chronically ill, and disabled populations to clinics and pharmacies [45].

Insurance-supported transportation policies could include subsidized rideshare services, public transit vouchers, mileage reimbursements, paratransit services, and coordinated non-emergency medical transportation systems. Policy makers should also encourage partnerships between healthcare providers and mobility service companies such as rideshare providers, community transportation organizations, and transit agencies. Such partnerships could be expanded through federal grants, Medicaid waivers, and value-based healthcare reimbursement models. Another important policy implication concerns the need for transit agencies to prioritize direct and on-demand transportation services specifically designed for healthcare access. On-demand transit services that prioritize medical appointments may reduce missed healthcare visits and improve treatment adherence among vulnerable populations. Demand-responsive transit systems, microtransit services, and healthcare shuttle programs could substantially improve healthcare accessibility in urban communities.

4.2. Limitations of the Study

Despite the important contributions of this research to understanding transportation insecurity and healthcare accessibility among chronically ill populations in Dallas and Detroit, several limitations should be acknowledged. First, this study employed a cross-sectional research design, which limits the ability to establish causal relationships between transportation insecurity, chronic health conditions, and healthcare access barriers. Since all variables were measured at a single point in time, the study cannot determine how transportation insecurity or perceived healthcare access challenges evolve over time. Second, the study relied primarily on self-reported survey responses, which may introduce several forms of response bias. Participants were asked to report on their transportation experiences, healthcare access barriers, and mobility challenges based on personal perceptions and memory. Consequently, the data may be affected by recall bias, where respondents may

not accurately remember missed appointments, transportation delays, or the frequency of healthcare visits within the specified period. In addition, some participants may have underreported or overreported their transportation difficulties. Individuals experiencing severe transportation insecurity, limited internet access, language barriers, limited digital literacy, greater socioeconomic disadvantage, or severe health limitations may have been less likely to participate in the survey process. As a result, the study may underrepresent the most vulnerable populations who experience the greatest transportation and healthcare accessibility challenges.

5. Conclusions

This study examined how perceived transportation-related barriers affect healthcare accessibility among residents in Dallas, Texas, and Detroit, Michigan, with particular attention to individuals experiencing chronic health conditions and transportation insecurity. The study was developed in response to growing concerns regarding transportation inequities, healthcare accessibility, and the increasing burden of chronic disease among lower-income urban populations in the United States. The findings provide strong evidence that transportation insecurity significantly shapes healthcare access outcomes among urban residents and disproportionately affects individuals with chronic illnesses, lower-income households, transit-dependent populations, and residents without access to private vehicles.

The findings also reveal important socioeconomic dimensions of transportation insecurity. Lower-income respondents, particularly those earning less than \$25,000 annually, were significantly more likely to experience marginal or high transportation insecurity. One of the major findings of this study is that household vehicle ownership emerged as the strongest and most consistent predictor of transportation security across both study areas. The study findings further suggest that transportation insecurity is more strongly associated with healthcare access challenges than chronic illness status alone. Respondents with chronic illnesses reported significantly higher Transportation Security Index (TSI) scores and were more likely to experience marginal or high transportation insecurity compared with individuals without chronic conditions. This relationship emphasizes that individuals requiring frequent medical visits, medication access, and continuous healthcare management may face additional transportation burdens. Even individuals without chronic conditions may encounter substantial healthcare access challenges when transportation systems are unreliable, unaffordable, inaccessible, or unsafe. The study further demonstrates that transportation insecurity is not only a mobility issue but also a significant structural determinant of health equity within urban communities. The findings also demonstrate that public transit users experience specific mobility barriers when accessing healthcare services. Transportation cost, limited availability of rides, long waiting times, inconvenient pickup and drop-off locations, and difficulty scheduling transportation were identified as major challenges. These results suggest that transportation interventions should focus not only on expanding transit availability but also on improving affordability, reliability, and direct connections to healthcare destinations.

Collectively, this study concludes that transportation insecurity is a major structural barrier affecting healthcare accessibility among urban populations in Dallas and Detroit. The findings reinforce the broader conclusion of this study that chronic illness, transportation insecurity, and socioeconomic conditions are deeply interconnected factors shaping healthcare accessibility and quality of life among vulnerable urban populations.

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Abbreviations

The following abbreviations are used in this manuscript:

DART	Dallas Area Rapid Transit
DDOT	Detroit Department of Transit
NHIS	National Health Interview Survey
TSI	Transportation Security Index

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