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EXPLORATION OF OLDER ADULTS' TRAVEL BEHAVIOR AND THEIR TRANSPORTATION BARRIERS

by

Hamideh Moayyed

A Dissertation Submitted in

Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy

in Urban Studies

at

The University of Wisconsin-Milwaukee

December 2022

ABSTRACT

EXPLORATION OF OLDER ADULTS' TRAVEL BEHAVIOR AND THEIR TRANSPORTATION BARRIERS

by

Hamideh Moayyed

The University of Wisconsin-Milwaukee, 2022
Under the Supervision of Professor Robert James Schneider

Both the number of older adults and their proportion of the population are increasing rapidly in the United States. By 2040, about 20.7% of the U.S. population will be 65 and older (Harrison & Ragland, 2003a). These dramatic changes in the composition of the population will bring new challenges to the provision of transportation services. This is because the travel patterns and needs of older adults are likely to become more complicated. A growing number of people will find it increasingly difficult to meet their transportation needs. As the life expectancy of older adults is likely to continue to increase, a greater number of older people will face mobility issues alone (Alsnih & Hensher, 2003).

Researchers widely agree that the aging population in the U.S. relies heavily on cars (as drivers or passengers) because they are convenient, flexible, and allow them to live independently and participate in normal daily activities (Haustein, 2012; Rosenbloom, 2005). However, dispersed land use patterns in the United States, the growing number of older adults living in suburban areas, and the current transportation infrastructure in the country make the use of a car a necessity rather than an option for a large proportion of older adults. However, as they age, their physical and mental health deteriorates, making driving dangerous for them. Therefore, it is of great importance

to understand the transportation problems of older adults and provide them with reliable and acceptable alternative modes of transportation to help them meet their transportation needs.

The study presented here aims to examine the transportation problems of older adults living in urban and suburban areas, make policy recommendations, and identify effective strategies to help them meet their mobility needs. To this end, the study used a mixed-method approach to identify the factors that influence older adults' travel behavior and the issues they face when walking, biking, and using transit. In-depth, one-on-one surveys were conducted in three counties in southeastern Wisconsin with 178 English-speaking older adults aged 65 and older living independently in institutionalized senior housing (i.e., subsidized housing and retirement communities) and in noninstitutionalized buildings.

The first main chapter of the thesis (Chapter 4) examines the factors that influence older adults' mode choice for grocery shopping and aims to predict older adults' travel behavior for going to the grocery store. A quantitative analysis involving statistical and machine learning techniques was conducted with older adults who traveled to the grocery store by car, carpool, walking, or public transit (N=153). The results of the study show that household car ownership and having a valid driver's license are the most important factors influencing travel mode choice by older adults. However, age group (65-74 or 75+) and physical disability were not significant factors influencing older adults' choice of transportation mode for grocery shopping.

The second main chapter of this study (Chapter 5) examines the reasons why older adults who hold a valid driver's license intend to renew their license when it expires (yes), or whether they do not intend to do so or are hesitant (no/not sure). Using a mixed-method approach including binomial logit regression and qualitative analysis, 116 older adults were surveyed. Results suggest that being 75 years of age and older, having a physical disability, and having a lower level of

education (high school and below) negatively influence older adults' decision to renew their driver's license. Older adults who drive frequently and indicate that they "would like to be able to drive to destinations easily" are more likely to renew their driver's license after it expires.

The third main chapter of this thesis (Chapter 6) aims to examine the barriers and challenges older adults face when using modes of transportation other than the personal automobile, such as walking, bicycling, public transit, and ride-hailing. A qualitative content analysis of the 103 open-ended responses was used to fit the results into an ecological model. The study recommends four main actions to help policymakers and city governments overcome these barriers: (1) implement transportation education and outreach programs, (2) improve accessibility to services and facilities through land use policies, (3) improve transportation infrastructure and services, and (4) help for-profit and nonprofit organizations organize informal groups to walk, bike, or carpool together.

This thesis has important implications for policy makers and urban practitioners to meet the transportation needs of older adults. Improving transportation infrastructure and providing older adults with reliable and high-standard non-automobile transportation alternatives, managing future land use dynamics and investing in sustainable land use patterns, and coordinating with organizations to support social networks (such as informal clubs and local groups) that help older adults meet their travel needs are among some of these important implications.

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To my parents for their love, support and encouragement,

and

to my brother Hamed and my best friend Ali for all their invaluable assistance along the way

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1 Introduction

This chapter contains a brief description of the background that motivated me to conduct this study. I also introduce the purpose of this study and present the main research question and three sub-research questions, and finally outline the content of the rest of the document.

1.1 Research Motivation

The population of older adults will increase substantially over the next thirty years worldwide. Statistics show that by 2050, 1 in 6 people in the world will be over 65, an increase from 1 in 11 in 2019 (United Nations et al., 2020). The United States in not an exception. The country is facing a population transformation due to the rapid growth of aging population. For the first time in the United States history, older adults are projected to outnumber children by 2034. It is expected that the number of older Americans 65 and above will be one in four, and the number of older adults 85 and above will triple by 2060 (Bureau, 2018).

Given the rapid increase in the number of older adults in the United States, the country will face greater demands to meet the mobility needs of the aging population. This scenario will require urban practitioners and policy makers to implement strategies to meet the mobility needs of the aging population. While the health status of older adults deteriorates with age, most older adults live in sparsely populated suburban areas with limited access to sustainable transportation. Even older adults living in urban areas have many problems walking and accessing ride-hailing and public transportation services.

The motivation of this research is to identify planning, engineering, and design strategies that will improve transportation services for older adults and help them achieve a higher quality of life as they age. To do this, it is necessary to understand the individual, travel, and environmental factors

associated with older adults' travel behavior. It also involves understanding the reasons that lead older adults use automobile as their main mode of transportation.

1.2 Research Purpose

The main purpose of this dissertation is to provide policy makers and urban planners with a better understanding of the travel behavior of older adults and the main barriers that discourage them from using non-automobile modes of transportation. This information will help them make better decisions and implement strategies to help older adults manage their mobility needs. Specifically, this study aims to:

- Understand the reasons why older adults choose the car (as driver or passenger) for grocery shopping
- Develop predictive models using AI (machine learning) techniques that examine older adults' current grocery shopping driving behaviors to predict their future driving behaviors
- Identifying the factors that make licensed older adults with driver's licenses to renew or not renew their driver's licenses as they age
- Compare older adults living in urban and suburban areas with different socioeconomic statuses in their decision to renew or surrender their driver's licenses at expiration
- Identify the reasons older adults choose to stop driving while still renewing their driver's licenses
- Examine the challenges and barriers older adults face when using sustainable modes of transportation other than their own cars

- Propose policy recommendations to help older adults overcome their transportation barriers

1.3 Research Questions

The main research question explored throughout this thesis is:

How do older adults' socioeconomic characteristics and residential location choice (urban versus suburban) influence their travel behavior?

Sub-research Questions

The main research question of the study led to specific sub-research questions. These questions are discussed in detail in the main body of this dissertation:

- Chapter 4: How do older adults' socioeconomic status, transportation access characteristics, and grocery shopping trip characteristics influence their travel mode choice to the grocery store?
- Chapter 5: What are the reasons licensed older adults decide to renew their driver's licenses when they expire? What are the main reasons older adults with valid driver's licenses decide to stop driving?
- Chapter 6: What are the barriers older adults face in using transportation modes besides personal automobiles, such as walking, bicycling, public transportation, and ride-hailing? What policy recommendations could help overcome these barriers for older adults?

1.4 Thesis Organization

This study consists of eight chapters. Following this introduction, Chapter 2, "Literature Review," provides a broad review of the literature on the travel behavior of older adults and how place of residence influences their mode choice. Chapter 3, "Method," provides a detailed overview

of the study area, the locations of the survey sites, and the data collection procedure. Chapter 2 provides a general overview of the relevant literature and Chapter 3 focuses on the data collection method. However, Chapters 4, 5, and 6 provide a detailed overview of the literature related to each sub-question and the specific method of data analysis used in this study.

The main chapters of this document include: Chapter 4, "Modelling travel mode choice of older adults: A case study of grocery store trips," Chapter 5, "Exploring Reasons Behind Older Adults' Decision whether to Renew their Driver's License using a Mixed Method," and Chapter 6, "Understanding and Overcoming Barriers to Walking, Bicycling, and Transit Among Older Adults." Chapter 7, "Discussion," presents the findings of this study from a broader perspective, and Chapter 8, "Limitations and Future Directions," presents the important areas that were not addressed in this study and are open to future researchers.

2 Literature Review

2.1 Older Adults' Travel Behavior

Researchers point out that older adults are not a homogeneous group in terms of their travel characteristics. Not only are there significant differences between different age subgroups, e.g., "young" elderly (65-75 years) and "old" elderly (75 years and older), but other characteristics such as place of residence, time of retirement, income, culture, race, gender, living with friends/family, etc., distinguish their travel needs, habits, and perceptions from one another.

In addition, the travel behavior of the current generation of older adults has changed compared to previous generations, and this change is likely to continue in future generations. A number of reasons contribute to this change, including better health, higher income and education levels, and the preference of younger generations of older adults for mobility by car (Schwanen & Páez, 2010).

Numerous studies have shown that older adults prefer cars as their primary mode of transportation (Cobb & Coughlin, 2004; Hansen et al., 2020). The increasing ownership of a driver's license among older adults and the increasing number of trips they take by car indicate their heavy reliance on cars (Cobb & Coughlin, 2004). A study by Coughlin (2001), who conducted focus group research and conducted interviews with urban nondrivers and suburban drivers and nondrivers aged 75 and older, found that in many cases participants viewed the automobile as equivalent to transportation. According to the study results, older adults explicitly and implicitly attributed positive attributes to cars, such as availability, reliability, flexibility, safety, convenience, and spontaneity. For study participants who still drive, the idea of no longer being able to drive was synonymous with a "scary thought" or feeling restricted in their homes.

Some researchers have pointed to loss of personal independence, social isolation, and limited or no access to essential services as consequences of older people stopping driving (Feng & Meuleners, 2020; Mollenkopf et al., 1997). Harrison and Ragland (2003) who examined 19 studies of driving reduction or cessation, found that there is a relationship between the inability of older adults to drive and their mobility and mental health. In terms of mobility, former drivers maintained their activities but had difficulty meeting their needs. Not only were they less likely to participate in community activities such as volunteering, going to the movies, etc., but their activities were dependent on where they lived and their support network (family and friends). In terms of mental health, the former drivers suffered from loss of independence, loss of personal identity, and depressive symptoms.

The literature suggests that older adults who continue to drive limit or modify their driving activities (Coughlin, 2001; Harrison & Ragland, 2003). According to Smiley (2004) older adults, especially those with vision or attention problems, adapt to aging by limiting their driving in a variety of ways, including driving in daylight, on familiar roads at low speeds, and in good weather. In addition, Freund (2004) explains that older drivers avoid "merging traffic, busy intersections, and unprotected turns."

While some studies consider walking to be the second most important mode of transportation for older adults (Lyman et al., 2002; Rosenbloom, 2004; Suen & Sen, 2004), others argue that ridesharing by family or friends is the most commonly used mode of transportation in this age group after driving (Cobb & Coughlin, 2004; Coughlin, 2001; Freund, 2004). Study findings suggest that suburban older adults generally view walking as a health-promoting activity, but not necessarily as a practical option for getting around (Coughlin, 2001). Physical condition, long distance between home and stores and services, poor weather conditions (especially fear of icy

sidewalks), lack of shelter and places to rest, and personal safety concerns were among the reasons that made walking less attractive as a mode of transportation for older adults (Coughlin, 2001; Suen & Sen, 2004).

Researchers disagree on whether public transit can meet the mobility needs of older adults. Study findings show that while public transit makes some older adults independent and they do not have to ask anyone for a ride, they are still dissatisfied with public transit in terms of the schedule, personal safety, the inconvenience of riding on a crowded bus, waiting in bad weather, and waiting time (Coughlin, 2001). The literature suggests that the lack of accessibility to transit services makes this mode impractical and unattractive for older adults. Using data from four "traditional" and four "suburban" neighborhoods in Northern California, Cao et al. (2010) argue that public transit is not a preferred mode of transportation for older people who own a car and a driver's license. Similarly, Bailey (2004) discussed that for many older adults who do not drive, public transit is the only alternative to asking for a ride when they want to do something outside their immediate neighborhood. Although older adults who do not drive rely primarily on their friends and family, their use of public transportation is significantly higher compared to older drivers, and about 60 percent of their trips are made by public transportation (Weaving It Together, 2013).

There is no consensus in studies on whether built environments provide higher levels of accessibility and encourage people to use sustainable travel modes. Cao et al. (2010) suggest that neighborhood design plays an important role in facilitating or limiting transportation choices for older adults. They argue that the car dependency of this age group is due to the U.S.'s "car-oriented development," which makes trips by car a "necessity" rather than a "choice". However, traditional neighborhood design that emphasizes accessibility and facilitates walking and public transit to daily

activities has the potential not only to reduce car dependence, but also to ensure access for those who do not (cannot) drive.

In recent decades, Transit-Oriented developments (TODs) have been proposed to meet the transportation needs of the growing aging population (Duncan et al., 2021; Wood et al., 2016). TODs are generally defined as developments in close proximity to public transportation and offer amenities such as density, a mix of land uses, and walkable, well-connected street patterns (Kamruzzaman et al., 2015; Scheer et al., 2017). In a study conducted nationally by Wood et al. (2016) to understand the profiles of older adults living within and in close proximity to Transit-Oriented Developments (TODs), the authors found that older adults are less attracted to the benefits of living in TOD communities compared to their younger peers. In this context, the results of a survey of transit agencies and local governments indicated that practitioners are making little effort to promote TODs for the benefit of older adults in their communities. In examining barriers to providing TODs for older adults, researchers found that development costs, market issues, and lack of nearby facilities for older adults were the greatest challenges to promoting TODs for older adults (Duncan et al., 2021). Studies suggest that policymakers could potentially overcome these barriers by providing incentives for developers and older adults through mechanism such as revenue bonds, loans, property tax, and rewards (Duncan et al., 2021).

The aging population will most likely become more mobile due to changing lifestyles and better health, and this sheds light on the importance of offering more environmentally friendly alternatives to the private car (Haustein, 2012). If more reliable, affordable, and convenient alternative transportation were available to older adults, it would be beneficial not only to older adults without access to a car, but to this age group in general (Brown et al., 2018). Although these

transportation alternatives may not completely eliminate the need (or preference) for a car, they can have a noticeable impact on reducing car use among older adults (Rosenbloom, 2005).

Table 1 summarizes the literature results and highlights some of the solutions discussed in scientific articles.

Author(s) and Year	Method of Data Collection and Study Purpose	Main Findings	Study Implications/Possible Solutions
Harrison and Ragland (2003)	A comprehensive literature review for studies that included information on driving by older adults and their driving reduction or cessation (19 studies)	Driving reduction or cessation has been found to be associated with reduced mobility among older adults	• Because solutions such as driving cession or reduction are not feasible for older adults, planning and education programs are needed to limit the potential negative consequences.
Nagel et al. (2008)	Examining the relation between objectively measured characteristics of the local neighbourhood and walking activity among a sample of 546 community-dwelling older adults in Portland, Oregon	Association between built environment and the likelihood of walking or not walking was only observed in people who reported some degree of walking	• Solutions such as promoting mixed land-use and pedestrian friendly neighbourhood could encourage walking among "moderately active elderly people".
Suen and Sen (2004)	Historical and content analysis	The growing number of older adults aged 80 and over and their physical disabilities leads to a	• Improve public transportation services • Providing a broader range of services, including "accessible fixed route, flex route, service route, dial-a-ride, and taxis, can provide seniors with alternatives to driving" • Providing personal vehicles that do not require driving licenses such as "electric bicycles, powered wheelchairs, scooters, and golf carts"

		greater "pressure for alternatives to the car and for accessible transportation"	• Developing the appropriate criteria for the accessibility that seniors need to sustain independent living • Mobility counselling and training
Kim (2011)	Using AARP national telephone survey among Americans ages 50 and older to analyse subjective transportation deficiency of older adults aged 65 and over in the U.S.	Lower income older adults, the ones with lower personal automobile accessibility, minority females, and suburbanites are more likely to experience transportation deficiency.	• Focus on interventions to help the older population keep driving as long as they can • Help communities with high concentrations of older minority females • Developing activity clusters (containing commercial and social service facilities) in suburban areas with high concentrations of older populations • Public transit availability within walking distance do NOT affect older adults' transportation deficiency considerably
Michael et al. (2006)	Conducted Nine focus groups in 2002 and 2003 with residents (N = 60) aged 55 and over living in Portland, OR, USA to study how neighbourhood design encourages active aging	Local shopping and services, traffic and pedestrian infrastructure, neighbourhood attractiveness, and public transportation influence activity among older adults	• Making policy recommendations relating to land use planning and transportation • Designing "effective senior health interventions with an emphasis on neighbourhood design influences"

Lee et al. (2014)	Using data from two surveys implemented in 2008 and 2010 to compare the travel behavior of urban versus suburban aged 55-64 (baby boomers) in the Boston metropolitan area	Urban residents tend to be less automobile-dependent than suburbanites Urban residents also make more recreational "non-motorized transport (NMT), social, utilitarian, and transit commute trips"	• In the short to medium term, making the suburbs more "urban," in an attempt to generate some travel behavior effects seems unlikely • Closeness to desired destinations associated with urban living has an impact on trip-making especially in suburban environments • Social networks can increase walking activity, and even has a greater effect than physical settings in suburban settings

Table 1: Summary of some of the important research findings in the literature

2.2 Older Adults' Travel Behavior in Urban and Suburban Contexts

During the last two decades, research focusing on the travel behavior of older adults in different residential environments has been growing.

Consistent with the literature on general travel behavior, several studies on older adults' travel behavior suggest that living in traditional neighborhoods (Cao et al., 2010) with high population density (Kim & Ulfarsson, 2004; Hess, 2012), high building density (Böcker et al., 2017; Moniruzzaman et al., 2013; Yang et al., 2018), mixed land use (Böcker et al., 2017; Y. Yang et al., 2018), and shorter distances to services (Böcker et al., 2017) lead older adults to drive less frequently and encourage the use of public transportation. An empirical analysis in Northern California, controlling for sociodemographic and attitudes, suggests that while older adults in traditional neighborhoods reported 81.7 miles of driving, this number was 128.2 miles (i.e., more than 50%) in suburban neighborhoods (Cao et al., 2010). They indicate that older adults in urban neighborhoods

are on average less car-reliant and use alternative modes more than their suburban counterparts. Regarding public transit use, Fatmi and Habib (2016) found that older adults in denser neighborhoods had a higher tendency to own a monthly transit pass due to accessibility, convenience, and flexibility of public transit services in these areas. Likewise, the results of a study on leisure trips of older adults in the Netherlands show that older adults in big and medium-sized cities used public transportation more often than older adults in suburban and rural areas (Schwanen et al., 2001).

Previous research has also shed light on the impact of the built environment on older adults' walking behavior. Studies indicate that features of the built environment including high population density, high employment density (Moniruzzaman et al., 2013), high building density and land use mix (Y. Yang et al., 2018) increase walking among older adults. Studying the 2009 National Household Travel Survey, Yang et al. (2018) found that active travel trips of older adults living in the most supportive built environment group--in terms of high street connectivity, high walk score, low distance to the nearest park, and low neighborhood poverty level--were more than twice that of older adults in the least supportive built environment group. Also, findings of some studies point to the importance of increasing accessibility--both accessibility of origin and accessibility of destination (Grant et al., 2010)--as a promising strategy for stimulating walking trips of older adults (Böcker et al., 2017; Cao et al., 2010; Mitra et al., 2015). Kim (2011) pointing to greater transportation deficiencies of older adults in the suburbs -with regard to missing activities due to lack of transportation- states that enhancing accessibility to activities can alleviate this problem for the ones who do not drive.

Some studies investigated attitudes and preferences of older adults towards travel options and residential environment in urban and suburban neighborhoods. Findings of these studies

indicate that older adults living in urban environments have distinct attitudes from their counterparts in suburban environments. Cao et al. (2010) found that older adults living in traditional neighborhoods were more likely to prefer access to downtown, shopping areas, and bike routes than suburbanites. However, the results of a study on eight neighborhoods in Portland and Vancouver, Chaudhury et al. (2012) found that accessibility to destinations was important to older adults regardless of differing density. Also, while older suburbanites were more in favor of driving (Cao et al., 2010), older adults living closer to activity locations such as local shops preferred not to own any cars, driver's license, or public transport season ticket (or transit pass) (Fatmi & Habib, 2016).

While several studies suggest that the impact of urban versus suburban environments on older adults' travel behavior are similar to the general population, a number of studies indicate that older adults may have different travel behavior responses to the built environment. Yang et al. (2018) indicated that the association of built environment on older adults' travel behavior is complicated, and is probably going to differ by certain environmental factors and travel modes. Studying the Danish National Travel Survey, Figueroa et al. (2014) indicated that older adults responses to density and accessibility were different from those of younger adults. In particular, they found that older adults not only did not substitute other modes for automobiles in high-density settings, but also, they did not reduce their travel distance in high regional accessibility areas and even traveled longer. On the contrary, Cao et al (2010) studying the data from Northern California discussed that improving accessibility has a much greater impact on older adults than on the younger. With this regard they found that, if all else the same, living in traditional neighborhoods lead to greater driving reductions of older adults compared with the younger ones. Barnes et al. (2016) found that neighborhood walkability had a lower impact on retired people than those not retired in terms of walking. However, the local transit environment had a greater influence on older

adults compared with younger adults. Also, Cao et al (2010), comparing walking trips of older adults with the younger, showed that while older adults (esp. suburban residents) stroll around the neighborhood more often, younger adults (esp. urban residents) walk to the store more frequently.

Some studies also identified safety and security concerns as two noteworthy mobility constraints of older adults (Chaudhury et al., 2012; Cheng, Chen, Yang, et al., 2019; Mollenkopf et al., 2004, 2005). Chaudhury et al. (2012) revealed that older adults in higher density neighborhoods of Metro Vancouver and Metro Portland reported more negative issues in terms of traffic hazards (e.g., high traffic volume and speed, dangerous intersections and crosswalks, hazardous drivers) and personal safety compared to their counterparts in lower density neighborhoods. They found these issues to negatively affect physical activity of older adults in higher density neighborhoods. They also indicated that different age groups might have potential conflicts (real or perceived) in using public spaces. Regarding this, they found that in lower density neighborhoods of Vancouver, the presence of youth at night hanging out in groups made walking intimidating and dangerous for older adults, and discouraged them from going outside at night. In addition, Cheng et al (2019) found that the number of parking lots and a high density of arterial streets in a neighborhood made older adults feel unsafe and negatively impacted their walking and biking travel time.

Studies have provided some possible reasons why older adults may have different travel behavior with respect to the built environment than younger people. Yang et al (2018) indicated that the impact of built environment on older adults might be more than on younger age groups. Older adults perceive the same environmental factors differently from younger adults (Cao et al., 2010), and their cognitive and physical limitations might make them sensitive towards certain built environment factors. For instance, factors such as lack of street crosswalks or poorly maintained sidewalks might prevent them from walking (Y. Yang et al., 2018). In terms of safety and security

issues, Mollenkopf et al (2004) stated that generally older adults feel less secure as they age. Also, having a sense of safety and knowledge of the area impact their outdoor mobility.

Figueroa et al. (2014) pointed to convenience of a private car, having fewer limiting conditions for traveling (e.g., children, and working hours) and thus having more free time, and exercising to travel independently especially through car as the reasons behind the different behavioral responses of older adults to accessibility and density compared with younger age groups. Barnes et al. (2016), in discussing the reasons why retired people are less sensitive to local walkability, stated that having more free time allows them to travel to farther places whether by car or public transit. Another reason they mentioned is that the probability of owning and driving a car is usually lower among retired people due to their lower income compared with higher income people, so they would walk regardless of how walkable the neighborhood is. Berg et al (2014) had a different viewpoint on how older adults spend their free time. They suggested that older adults have to dedicate their released free time after retirement to projects such as caring for grandchildren, household responsibilities, and volunteer work. These new activities create mobility demands and impact their transportation mode choice. For instance, one of their study's interviewees, had to make 20 trips during the diary week by car, often to help his daughter in taking the grandchildren to their activities. Siren and Hakamies-Blomqvist (2009) believed that as the physical abilities of older adults decline, they use the car as a compensatory tool, because their driving ability usually deteriorates later than their walking or biking abilities.

2.3 Differences in People's Travel Behavior between Urban and Suburban Contexts

Several studies have investigated how built environment characteristics in urban versus suburban neighborhoods are associated with travel behavior. In particular, research has indicated

that urban neighborhoods -also called 'traditional', 'neo-traditional', 'new-urbanist'- (Cao et al., 2009; De Vos & Witlox, 2013; Talen, 2001) with high densities, mix of land uses, and good public transit services are often associated with high levels of walking, biking, and using public transit. However, in suburban neighborhoods with low density, segregated land uses, and poor access to public transit, people mostly rely on automobiles (De Vos et al., 2018; De Vos & Witlox, 2013; Van Acker et al., 2007; Khattak & Rodriguez, 2005).

A debate exists among scholars regarding the extent to which the difference between the travel behavior of people in urban versus suburban neighborhoods is caused by the built environment or caused by residential self-selection (Mokhtarian & Cao, 2008). Residential self-selection refers to "the tendency of people to choose locations based on their travel abilities, needs and preferences" (Litman, 2020) and is generally a result of attitudes and sociodemographic characteristics (Mokhtarian & Cao, 2008). An example of self-selection is that people who prefer to walk deliberately self-select themselves in walking-friendly neighborhoods and thus walk more (Cao et al., 2009). Mokhtarian and Cao (2008) indicate that comparing different neighborhood types without controlling for residential self-selection leads to a biased estimate of the effects of built environment characteristics on travel behavior. Still, numerous studies confirm that after controlling for residential self-selection, the built environment has a statistically significant influence on travel behavior (e.g. a review article by Cao et al. (2009); Cao, 2009; Naess & Jensen, 2004; Næss, 2005).

In terms of travel mode choice, studies indicate that suburbanites had a higher share of car travel and a lower share of non-motorized travel than inner-city residents (Næss, 2005; Næss & Jensen, 2002). On the contrary, living in a dense area close to downtown contributed to more walking or biking and a lower share of car travel (Næss, 2005). A study of homemakers in the New York Metropolitan Area, Chen and Mcknigh (2007), found that while city dwellers made more than

70% of their trips by non-motorized modes, this number was 10% for suburbanites. City dwellers also commuted more frequently by walking and public transit than suburbanites, and conducted fewer trip chains. Interviews from 32 households relocated from a suburban environment into the city of Hamburg showed that the shortcomings of accessibility to destinations by walking, biking, or using public transit was the main reason for relocation. The suburban- urban relocators looked for opposite features in the urban environment including appropriate pedestrian and bicycle infrastructure and widespread public transit systems (Bruns & Matthes, 2019). Schneider (2013) proposed the Theory of Routine Mode Choice Decisions categorizing the factors that influence mode choice of people for routine travel. Based on this Theory, factors including high availability and low price of automobile parking, less traffic congestion, lack of awareness of pedestrian and bicycle options, and habit are among the important factors that make people in suburban areas keep driving. Findings from a meta-regression analysis on 32 studies found that changes in the five D-variables (i.e. density, land-use diversity, street design, destination accessibility, and distance to transit) in the direction of compact development make people drive less though the influence is very small (Stevens, 2017). However, Ewing and Cervero (2017) raised issues about the methods and findings of this study.

Numerous studies indicate that living in the suburbs (De Vos & Witlox, 2016; Dieleman et al., 2002; Næss, 2009; Schwanen et al., 2005) and far away from downtown (Næss & Jensen, 2002) also contribute to longer travel distances. In his study in the Copenhagen metropolitan area, Næss (2009) found that weekday travel distances by car among suburbanites was approximately four times longer than the inner-city residents.

However, the impact of built environment on travel time in urban versus suburban neighborhoods is less clear (De Vos & Witlox, 2016; Schwanen et al., 2004, 2005; Acker et al., 2007).

In suburban neighborhoods due to longer travel distances people have to use fast, motorized-modes. However, in urban neighborhoods the greater use of active travel modes, congestion, and parking problems contribute to slower travel speed (Schwanen et al., 2005). Mouratidis et al. (2019) state that the differences in travel time are usually smaller than travel distance in suburban versus central districts. Findings of an empirical study on leisure trips within the city of Ghent (Belgium) indicate that suburbanites had longer travel time than urban residents (De Vos & Witlox, 2016). However, Schwanen et al. (2004, 2005) using the 1998 and 2001 Netherlands National Travel Survey found that the travel times for all trip purposes, and maintenance purposes (non-leisure trips) were higher in the cities than less urbanized municipalities respectively.

For trip purpose, study findings indicate that urban residents made more social and recreational trips (Chen & McKnight, 2007) compared to suburban residents. They went more frequently to restaurants (Næss, 2005; Næss & Jensen, 2002), shopping (in particular groceries), cafes (Næss, 2005), and cultural events and activities (particularly theatres and cinemas) (Næss, 2005; Næss & Jensen, 2002). Urban dwellers also spent less time on maintenance activities such as dropping off/picking up, shopping and doctors/dentists versus discretionary activities such as visiting and social/recreational (Chen & McKnight, 2007).

Some studies have investigated attitudes of people towards travel and residential neighborhood type in urban and suburban neighborhoods. Survey findings from three neighborhoods in the San Francisco Bay area showed that people may choose to live in a high-density urban location because of their willingness to reduce car use to protect the environment, and/or because living in an urban environment facilitates using other modes efficiently. On the other hand, people may choose to live in a low-density suburban location because it is better built around the car, which makes car travel fast, flexible, and comfortable, and it is also easier for them

to display their car(s) as a commodity of status and prestige (Schwanen & Mokhtarian, 2007). A survey study of 185 people in a northern suburb of Dallas, Texas showed that about 75% of suburbanites said they preferred "low-density development in almost all cases, even if it meant longer distances to work, shopping and other services." They also did not show a strong support for the principles of traditional urban neighborhoods (Talen, 2001). An internet survey among 1720 persons in the city of Ghent (Belgium) showed that people who have a more positive attitude towards traveling opt for suburban neighborhoods that facilitates long trips (both in distance and time), however, people with a negative stance towards traveling prefer living in urban neighborhoods which enables them to minimize travel (De Vos & Witlox, 2016).

Most of the travel behavior studies cited above have analyzed general populations rather than specific age subgroups. Yet, a small branch of literature on travel behavior and the built environment has focused on older adults. The next section summarizes its key findings.

2.4 Literature Gap

A closer look at the literature on older adults' travel behavior reveals a number of gaps and inadequacies. Previous studies have focused primarily on the influence of characteristics of the built environment (urban and/or suburban) on the travel behavior of older adults. However, there is limited information on how the previous residence of older adults (65 years and older) in urban or suburban areas influences their current travel behavior. More specifically, there is a gap in knowledge about the extent to which older adults' mode choice, trip frequency, and travel attitudes change after moving from an urban/suburban setting to a similar or different type of setting.

In addition, most studies of older adults' transportation behavior focus on people living independently in non-institutional buildings. However, a significant number of older adults move

due to their loneliness and/or financial situation live in institutional settings. The particular travel behavior of this group of older adults is rarely examined in the existing literature.

Moreover, quantitative studies of older adults' travel behavior use statistical models to analyze their travel behavior. Nowadays, however, predictive machine learning models are of great advantage in the analysis. These techniques can significantly complement the results of statistical models.

To address these gaps, this study aims to propose solutions to overcome some of the transportation barriers older adults face to maintain mobility and meet their travel needs. This study has the potential to contribute to a better understanding of older adults' mobility experiences and the transportation attitudes and mobility challenges they face in their daily lives. These findings can help transportation planners, neighborhood planners, and urban planning and housing policy makers overcome some of the mobility barriers these people face and provide them with more reliable and convenient transportation choices. This study can help professionals develop more targeted policies for an age-friendly and sustainable environment.

3 Method

This chapter provides an overview of the method I used in this study to examine the travel behavior of older adults. It includes the description of the study area, the selection of the survey sites, the survey instrument and administrative procedures, the criteria used to define urban and suburban areas, and the approaches used to analyze the data. Further details on the specific methods corresponding to each of the study sub-questions are provided in Chapter 4, Chapter 5, and Chapter 6.

3.1 Study Area

This study took place in three counties in southeastern Wisconsin: Milwaukee County, Waukesha County, and Ozaukee County. Milwaukee County has a population of 939,489, with 14.3% of older adults 65 and older (*U.S. Census Bureau QuickFacts*, 2020). Waukesha County, with 406,978 residents and 19.6% older adults (65 years and older), is west of Milwaukee County, and Ozaukee County, with 91,503 residents and 20.7% older adults (65 years and older), is on Milwaukee County's northern border (*U.S. Census Bureau QuickFacts*, 2020). While Milwaukee County is the most densely populated county in the state WI with predominantly urban areas, Waukesha County and Ozaukee County are mostly suburban. The Milwaukee County Transit System (MCTS) is much more extensive than Waukesha County and Ozaukee County. Milwaukee County also has a streetcar (Hop) that serves the downtown area (Figure 1).

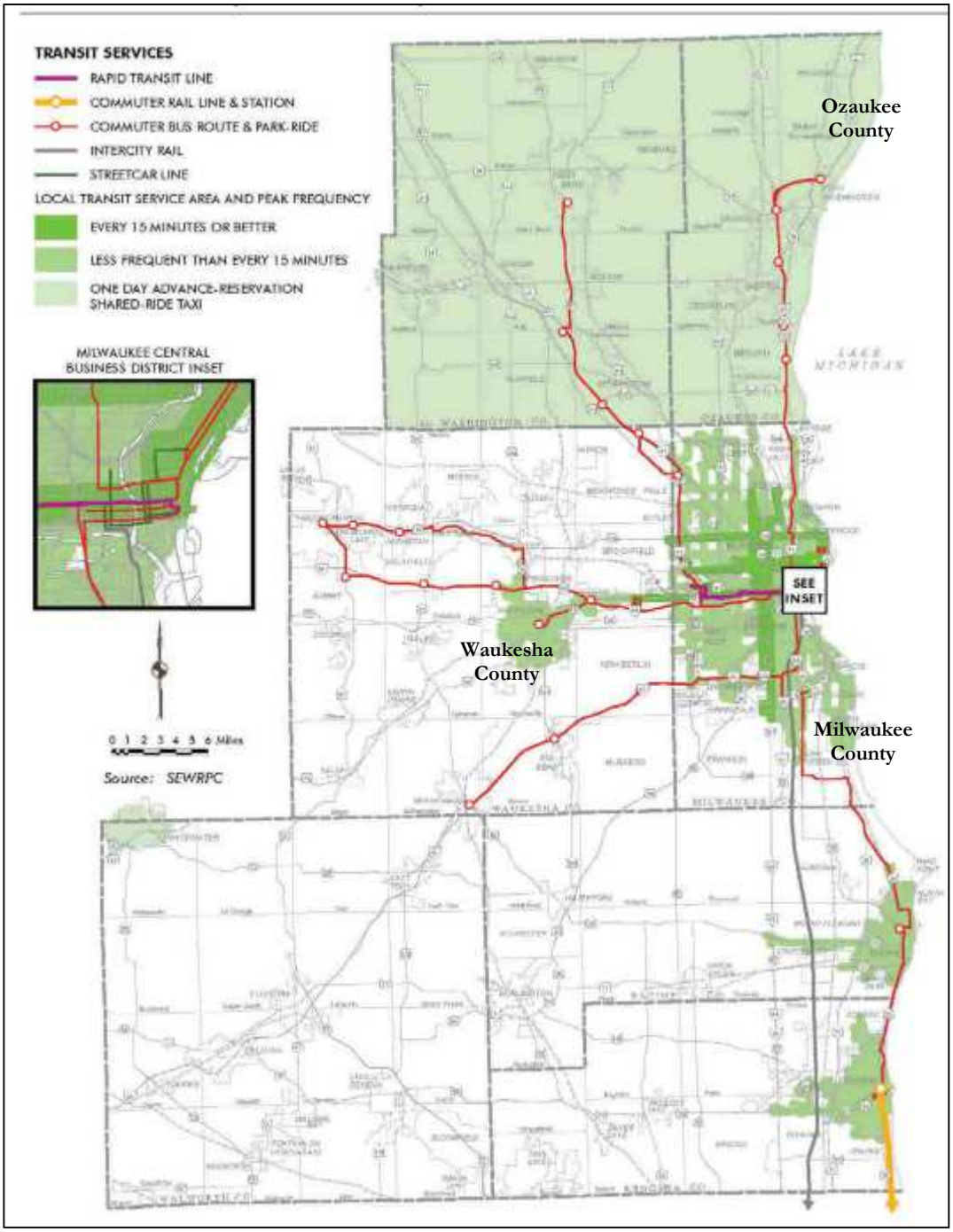

Figure 1 Transit Services (Fiscally constrained transportation Plan)

Source: SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION REPORT

Accessed from: https://www.sewrpc.org/SEWRPCFiles/LUTranSysPlanning/pr-55-vol-3-complete-final-reduced.pdf

3.2 Survey Structure

The primary method of data collection that I used in this study was an in-person survey. The main purpose of this survey was to find out the travel behavior and travel attitudes of older adults in their current and previous residential location. In designing the survey questions, the main considerations were 1) to develop questions based on the research questions and 2) to design questions that would be understandable to the older adults and to try to avoid jargon and technical terminology.

The survey consisted of 31 questions divided into four classes. These classes included basic demographic questions, current travel behavior and attitudes, past travel behavior, and comparison of participants' current travel behavior with their past travel behavior. The survey questions for this study were based on previous travel behavior research summarized in the literature review (Chapter 2). The survey included a combination of fixed-response and open-ended questions (Appendix A).

The first section of the survey included demographic questions such as age group, race/ethnicity, annual household income, education level, and health status. The second and third sections used multiple-choice questions to record respondents' trips to the grocery store before and after their last change of residence. The final part of the survey included attitudinal and behavioral questions about respondents' transportation choices before and after their last change of residence. These included respondents' main reasons for using their current mode of transportation, changes in their mode choice after moving to their current residence, and their level of satisfaction with this change. Since there may have been other events in their lives besides the change in residence, such as acquiring a disability, losing their driver's license, retiring, etc., that affected their transportation behavior, I asked participants in detail about their reasons for changing their mode of transportation and whether they were satisfied with this change.

The survey questions were approved by the UW-Milwaukee Institutional Review Board (Appendix B).

3.3 Survey Site Selection

3.3.1.1 Rationale for Choosing the Survey Sites

In this section, the reasons behind choosing the survey sites and the process to conduct the surveys are described.

The primary objective in selecting the survey sites was to find individuals who were suitable to participate in the study based on the research objectives. Eligibility criteria included 1) individuals who were 65 years of age and older; 2) English-speaking; and 3) non-frail older adults who were able to live independently and did not require skilled nursing care.

This study focuses on subsidized housing and Retirement Communities and the sample of study sites was selected from the Senior Resources Guide("Greater Milwaukee Area Senior Housing Options," 2019). The reason for this decision was to avoid bias against individuals with a particular sociodemographic background.

Subsidized senior living communities are apartment-like facilities that provide affordable rents to qualified low-income older adults. In most communities, people must pay about 30% of their adjusted income for rent and utilities. Other qualifying criteria for applicants include a minimum age of 62 or mobility limitations. Retirement communities (also known as independent senior living communities or independent retirement communities), however, can be strictly market-rate, private-pay housing options, and their prices vary depending on their services. These communities are designed for people 55 (or 62) and older who do not require 24/7 skilled nursing care (2021 Senior Resources Housing Directory, 2021).

Table 2 shows the number of subsidized senior living communities and retirement communities in each of the three counties in 2019. For the purposes of this study and to increase the participation rate, I excluded buildings with fewer than 50 units.

	Number of Subsidized Housing		Number of Retirement Communities	
County	**Total**	**After Excluding < 50 units**	**Total**	**After Excluding <50 units**
Milwaukee	99	63	24	24
Waukesha	17	8	16	16
Ozaukee	5	2	6	4

Table 2 Number of Senior Housing Sites in each County

People living in senior housing are of varying socioeconomic status, including different ages, income levels, and racial backgrounds, and live for rent and alone in institutionalized housing. To expand the sample and conduct surveys of people of different socioeconomic status who were living in regular (non-institutionalized housing), I also selected senior centers and senior dining facilities. Some of these centers are located in senior housing and others are located outside of these buildings. Most of these centers serve meals and some offer a variety of programs and activities including recreational (such as games, crafts, coffee meetings), educational, fitness and social. Mostly people 60 and over and their spouse regardless of income level are eligible to take advantage of the services provided at these centers.

I also participated in two events organized for older adults in Waukesha County. These were a "Community Block Party" hosted by Holy Cross Lutheran Church and an event organized by the Eras Senior Network Organization at the Community Education and Recreation Center to recruit volunteer drivers for the senior transportation program in Menomonee Falls Village.

3.3.1.2 Survey Site Selection Process

One of the main goals of this research was to explore how living in a variety of urban and suburban environments influence the travel behavior of older adults. To achieve this goal, I did background research into the urban/suburban classification method. While many studies have compared the characteristics of urban and suburban development, there is not a consensus among these papers on the definition of urban versus suburban. Studies have used a variety of measures to set thresholds for urban versus suburban, including population density, employment density, and land use mix (Bluthenthal et al., 2008; Krizek, 2003a; S. Lee, 2011). For my study, I chose urban areas having a population density of at least 3000 people per square mile or employment density of at least 5 jobs per acre, considering the spatial characteristics (population and employment density) of census tracts.

After excluding senior living facilities with fewer than 50 units and sites with residents or participants who did not speak English (e.g., Hispanic and Asian senior centers), I created a map of all potential survey sites (i.e., I geocoded the study sites using ARCGIS) (see Appendix C). I then overlaid the map of potential sites with the map of urban/suburban census tracts. Because it was not possible to study all sites, I reviewed all site addresses in each county and selected sites representing different geographic areas with different sociodemographic status.

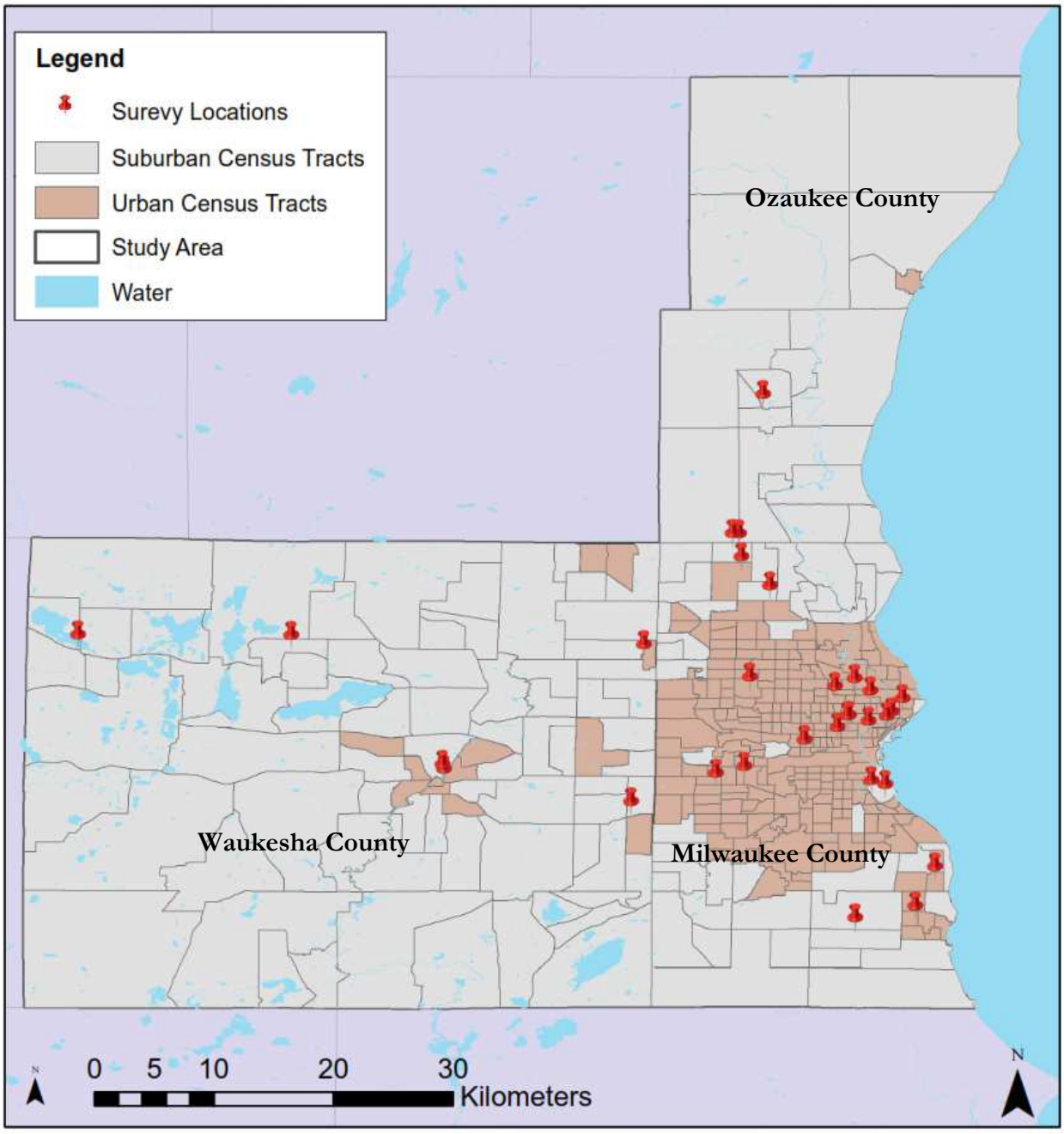

Figure 2 Location of Survey Sites Within the Study Area

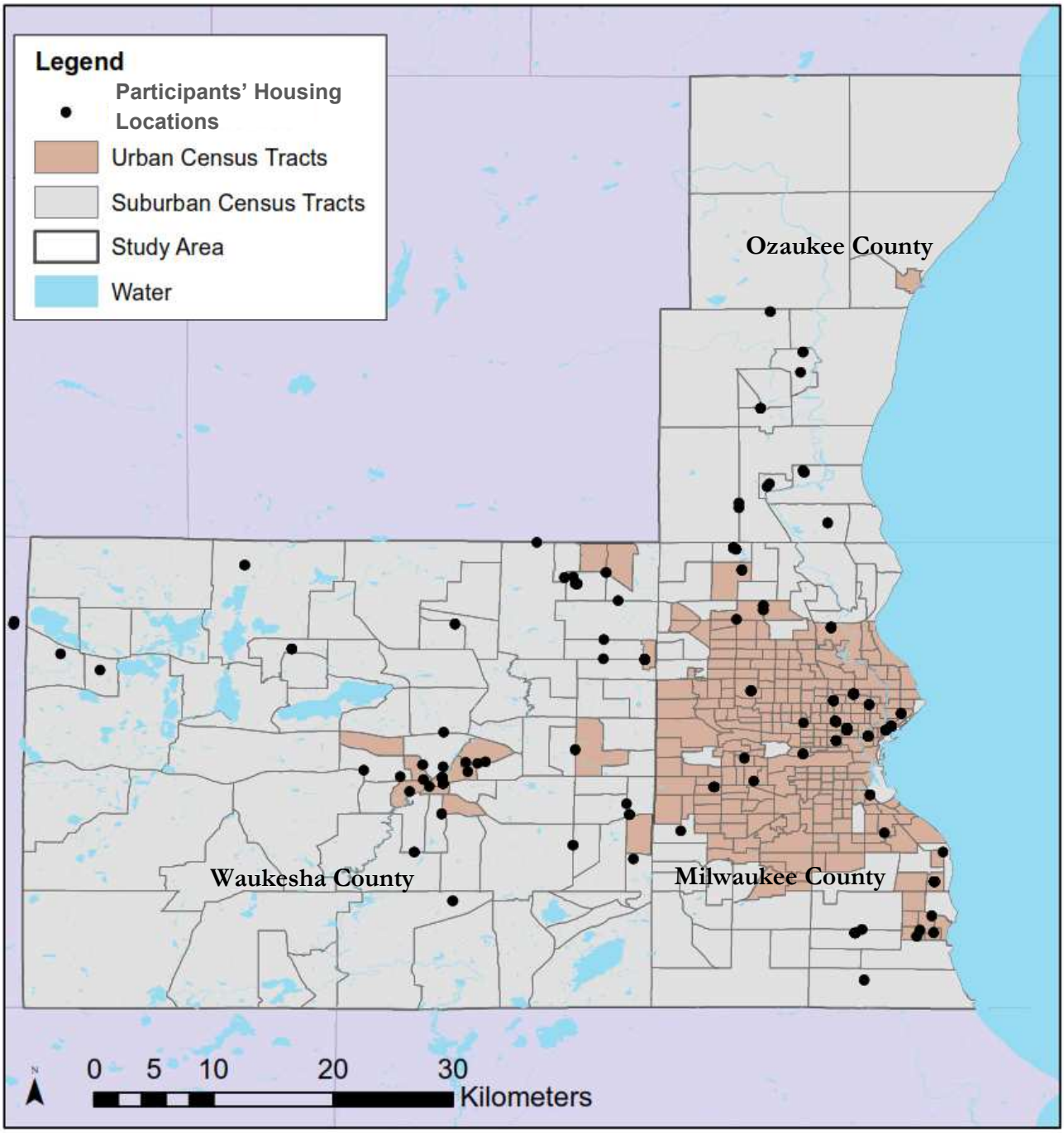

Figure 3 Housing Location of All Study Participants Within the Study Area

3.4 Obtaining Permission

For the Milwaukee County study sites, I approached the directors of each building and asked permission to offer the surveys to older adults in their buildings. If they gave us permission, I scheduled a time to conduct the surveys in the buildings. I preferred a date that coincided with an event or activity such as bingo, art and painting, or coffee hour in the buildings. This was to help increase the participation rate in the survey.

Some buildings had special rules for researchers who wanted to conduct surveys in their buildings. In this regard, some of the building managers asked me to send them a flyer (see Appendix D) about the study at least one week in advance so that they could inform the older adults and encourage them to participate in the study. Also, based on my scheduled appointment, some of the property managers prepared and distributed a sign-up sheet to volunteers who wanted to participate in the survey to indicate their first name and available time.

I followed the same procedure for the study areas in Waukesha County and Ozaukee County. At the same time, with the help of two nonprofit organizations (ERAS Senior Network in Waukesha County and Interfaith Caregivers of Ozaukee County), I was able to obtain permission to conduct surveys without having to make personal appearances to building managers (see Appendix E).

3.5 Conducting the Survey

Older adults aged 65 years and older who resided in Milwaukee County, Waukesha County, and Ozaukee County participated in this study. A requirement for participation in the survey was verbal consent to participate. Criteria for participation were (a) age 65 or older, (b) able to live independently, and (c) English-speaking.

Surveys were conducted in the common areas, private rooms, or dining rooms of the buildings. The way I approached older adults to ask if they wanted to participate in the survey varied across buildings. In some buildings, the building director or service coordinator introduced me to the older adults, briefly explained my research purpose, and asked them to participate in the study if they had time. In other buildings, I approached the older adults individually in the community room, explained the purpose of the survey, and asked them if they would be willing to participate in the study. It is worth noting that I did not offer monetary incentives to participants because I felt that monetary incentives could lead to bias in the participant sample.

Before I began the survey, I asked participants if they would agree to have their responses audiotaped. If they agreed, I recorded their consent verbally and recorded the interview on my cell phone. The survey was conducted in the form of an interview (i.e., it was a face-to-face interview in which I read out all the questions and wrote down and checked the answers on the questionnaire). For the statement question and the question about older people's suggestions for improving their transportation (question 20 and question 21), I gave respondents a copy of the questions in large print and then asked them the questions. Most participants read the statement and the choices themselves and selected their answers. This method helped them focus on the statements and also see the transportation options all at once, which made it easier for them to understand the questions. Each survey took an average of 20 to 30 minutes to complete. At the end of the survey, I handed out the research participation consent form to the participants (see Appendix F).

Because older adults might get tired during the interview due to their age, I tried to have intensive communication with them to encourage and motivate them to answer the questions. Overall, only two older adults refused to continue answering the questions during the survey. Therefore, I removed these surveys and did not include these data in the final spreadsheet.

Most survey data (167 surveys) were collected from February 2019 to March 2020. Although I had permission to conduct studies in additional senior housing, senior centers, and dining sites and had made appointments with them, I had to stop conducting surveys during the second week of March 2020 due to the COVID -19 pandemic. All dining sites in the three counties stopped their meal service, the senior centers were closed, and due to the risk to the older adults, the senior homes canceled the scheduled appointments. With the support of Interfaith Caregivers of Ozaukee County, I was able to conduct telephone interviews with 11 additional older adults living in Ozaukee County in June 2020. The same survey process was used with them. The organization sent them the questions in advance so that when I called, they had the questions in front of them and I recorded their responses with their consent. Ultimately, a total of 178 older adults participated in the study.

3.6 Description of survey participants

Ultimately, 178 older adults participated in the survey, including 59 living in regular (non-institutionalized) housing and 119 living in institutionalized housing (91 subsidized housing and 28 retirement communities). The following table summarizes the socioeconomic characteristics and residential location (urban versus suburban) of survey participants by gender. In addition, Appendix E contains a detailed list of survey locations, housing type, survey date and time, and events held at the time of the survey.

		Gender		
		Male	**Female**	**Total**
County	**Milwaukee**	42	63	105
	Waukesha	19	41	60
	Ozaukee	6	7	13
Age Group	**65-74**	40	67	107

	75+	27	44	71
Race/Ethnicity	**Black/African American**	25	26	51
	White/ Caucasian	42	85	127
Income Group	**24,999 or less**	41	63	104
	25,000 or more	26	48	74
Type of Accommodation	**Own**	16	37	53
	Rent	51	74	125
Highest Education Level	**High School or less**	29	41	70
	More than high school	38	70	108
Physical Disability	**No**	38	56	94
	Yes	29	55	84
Residential Environment	**Urban**	45	73	118
	Suburban	22	38	60

Table 3 Socioeconomic Characteristics and Residential Location of Survey Participants

4 Modelling travel mode choice of older adults: A case study of grocery store trips

Abstract

My study, for which I collected data from 153 older adults from three counties in south-eastern Wisconsin, examines the factors that influence older adults' grocery shopping travel behaviour. Using statistical and machine learning methods, I aimed to predict mode choice for grocery shopping. The results of this study show that owning a car and having a valid driver's license were significant factors that particularly influenced the prediction of transportation mode choice for grocery shopping. I also found that heterogeneity of older adults in terms of age group and physical disability does not play a significant role in modelling and prediction.

4.1 Introduction

Older adults represent a distinctive group of the population with special needs and challenges (Smith, 1988) that require the attention of transportation planners and policy-makers. In particular, the shopping behaviour of older adults requires special attention for many reasons. First, shopping trips account for the highest proportion of trips among this age group (Schmöcker et al., 2005; Su et al., 2009). Comparing the travel patterns of older adults and younger ones indicate that as people age, travel for recreation (such as entertainment, sports, visiting friends) and especially shopping replace working trips (Hjorthol et al., 2010; Schmöcker et al., 2005).

Second, the mobility of older adults is subject to a number of constraints including declining functional ability, driving cessation, and limited financial resources (Smith, 1988). Moreover, studies indicate that dispersion of activities and urban sprawl have exacerbated accessibility to important

destinations among older adults. Study findings indicate that older adults who experienced difficulties in accessing food shops due to the decentralization of stores were at the greatest nutritional risk (Wilson et al., 2004). All of these constraints necessitate understanding older adults' travel behaviour.

The objective of this study is to explore how mode choice relates to older adults' socioeconomic status and mobility characteristics. Particularly, I aim to find out what factors influence older adults to choose certain travel modes for grocery shopping. I explore how traditional discrete choice modelling can be complemented by newer machine learning methods to gain more insights about older adult mode choices.

In this study, I define a grocery shopping trip as a trip to any store that is accessible to the public[1] and mainly sells food products regardless of the size of the store and whether a purchase is made.

4.2 Literature Review

This section begins with a short review of the literature on factors influencing mode choice for shopping trips in the general population and then for older adults.

4.2.1 Shopping travel mode choice in the general population

Several studies have investigated how individual, travel-related, and built environment characteristics are associated with mode choice behaviour (e.g. Schneider, 2013; Ding et al., 2017; Kim & Ulfarsson, 2008). However, the number of studies focusing on travel mode choice for shopping trips particularly grocery shopping is limited. While some of the factors influencing travel mode choice might be common among all trip purposes, two main factors make shopping trips different from other types: first, it is not subject to strict time limits as long as it is within the store's business hours and

[1] This study excludes the on-site retail stores that are located within some of the retirement communities and usually handle the urgent needs of residents.

second, travellers generally carry load after shopping which makes the trip harder for them (Su et al., 2009). Travel for grocery shopping, in particular, differs from travel for other kinds of shopping since it is more likely to be a dedicated and regular trip that is relatively dependent on a car (mainly due to the bulky nature of purchases), and made over a relatively short distance (Cairns, 2005). This distinction necessitates a better understanding of the factors influencing people's mode choice for shopping specifically grocery shopping.

4.2.1.1 Travel Attributes

Some studies suggest that the quantity of items that are purchased from the store influences travel mode choice. Reviews of research point to studies providing evidence that the car was the dominant mode of transport for shopping particularly grocery shopping trips (Hagberg & Holmberg, 2017; Cairns, 2005). Guy (2009) used the term 'basket shopping' for the purchase of small quantities of convenience goods in a visit, and 'trolley shopping' for purchase of large quantities of items in a visit and/or bulky items that are hard to be carried far. He argued that while basket shopping frequently involved walking or biking, trolley shopping made the car the most effective mode of transport especially for food shopping. Regarding this, Nilsson et al. (2015) argued that the car facilitates major shopping travel and enables shoppers to carry more groceries. Also, in a study by Ibrahim (2003) in Singapore, car owners and non-car owners perceived the car as the most practical travel mode for major grocery and clothing shopping.

Research findings indicate that public transit is not the preferred mode for shopping trips. Crowding is one of the major issues making public transit inconvenient (Li & Hensher, 2013), particularly when carrying groceries (Hagberg & Holmberg, 2017). Also, Ibrahim (2003) found that while non-car owners perceived public transit as higher than car owners, they rated it low in terms of reliability and when shopping with aged parents, two or more family members, and a young child. Guy

(2009) indicated that UK policies to make people readily walk or take the public transit instead of private car was supported just in case of 'basket shopping' within urban areas with a good variety of shops and not otherwise. In another study, while shoppers' perceived walking as environmentally-friendly, reliable, and less stressful, they considered it slow, not suitable for less-able shoppers, and making them exposed to weather and pollution when go shopping (Ibrahim, 2003).

4.2.1.2 Built Environment Factors

Studies have pointed to the influences of built environment factors such as place of residence (city centre versus suburb), accessibility and distance to store on shopping mode choice (Dieleman et al., 2002; Hagberg & Holmberg, 2017). Jiao et al. (2011) analysed travel mode for grocery shopping using the 2009 Seattle Obesity Study survey in King County, Washington. They found that as the number of at-ground parking around the grocery store increased, people's tendency to drive to the store increased. However, the increase in street density, quick-service restaurants around homes, and nonchain grocery stores close to the primary grocery store was negatively related to driving to the store. In later studies using the same dataset, Jiao (2016) found that while frequent shoppers lived closer to grocery stores and were more likely to use non-motorized modes to visit these stores, infrequent shoppers lived in low-density neighbourhoods further away from their primary grocery stores and drove longer distances to purchase goods. Likewise, Guy (2009) in a review of UK evidence for routine shopping behaviour indicated that in densely developed urban areas walking and biking were more prevalent. However, a study by Hsu et al. (2010) found a positive correlation between distance to store and customer satisfaction. They further argued that grocery store choice involves a series of trade-offs and customers consider not only the travel distance to the store, but other factors including merchandise attributes (e.g., quality of products), store ambience and service (e.g., favourable environment of the store), and marketing attractiveness (e.g., promotions).

4.2.1.3 Socioeconomic Factors

The influence of socioeconomic factors on shoppers' travel mode has been also explored in previous research. Hagberg & Holmberg (2017) found that living together (as cohabitants or married) with high income were positively correlated with higher frequency of car trips to grocery store, while lower education and young age were predictors of higher frequency of biking to the store. In another study, high income and car ownership were correlated with longer distances travelled by private car for shopping trips. Also, people who owned a car were more likely to use the car rather than to take public transit for the purpose of shopping (Dieleman et al., 2002).

4.2.2 Shopping travel mode choice among older adults

This section reviews the literature related to the shopping travel behaviour of older adults as the travel behaviour of this age group does not often follow the same pattern as that of younger people (Su et al., 2009). According to Nilsson et al. (2015), older adults compared to their younger counterparts generally view shopping as a way to socialize with others and because of that they do not search for the fastest or most convenient location of the store.

4.2.2.1 Travel Attributes

The results of London data analysis showed that walking and taking public transit were the two most frequent modes of older adults for their shopping trips, respectively (Su et al., 2009). Similarly, research from Brooklyn, NY showed that most of the older adults depended on public transit or walking to access food stores. The shoppers' strategy to overcome the burden of carrying more than they could was to buy fewer items with more frequency (Munoz-Plaza et al., 2013a). Ibrahim and McGoldrick (2003), studying how people evaluate transportation options for shopping trips, found that older adults gave higher importance to travel/mode attributes including 'absence of waiting time', 'shortness of walking distance' and 'directness of travel to shopping center'. Regarding

this, findings of a qualitive study among low-income older adults in Ontario, Canada revealed that participants were dissatisfied with taking city buses for shopping due to different reasons including long waiting time (esp. in inclement or cold weather) and difficulty in getting into and out of the vehicle with a walker/cane (Keller et al., 2006). Also, researchers found that older men, people with physical disabilities (Schmocker et al., 2008) and people with high-incomes (Su et al., 2009) are less likely to take public transit when they go shopping (Kim & Ulfarsson, 2004). Additionally, a study by Wilson et al. (2004) demonstrated that while fifty percent of older adults aged 65-91 years walked or took the bus to the store, the remaining used the car (either drove or driven by friend/relative) to the go to the food store.

4.2.2.2 Built Environment Factors

A recent study of 607 older adults in the Helsinki Metropolitan Area revealed that higher exposure of older adults to dense, mixed-use, and green land uses was associated with use of more active and sustainable modes of transportation for shopping (Ramezani et al., 2021). Liu & Engels (2012) pointed to the problem of urban sprawl and over reliance on cars in most Australian cities. In their study in suburban Melbourne, they found that the spatial concentration of essential services and facilities including shopping centres make accessibility to these locations hard for older adults in the area especially for the ones having no access to car and living in underserved areas by public transit. Likewise, Chung and colleagues (2012) found that neighbourhood walkability influence food insecurity among older adults.

However, studies indicate that older adults do not necessarily go to the closest store. Other than location, they consider factors such as quality, affordability, and variety of products at the store. According to Munoz-Plaza et al. (2013b), most of the older adults avoided the local markets due to their dissatisfaction with the price and quality of foods and shopped regularly at stores outside

their immediate neighbourhood. Also, in a study by Wilson et al. (2004), older adults considered social interaction as an important factor in their store choice. Regarding this, many of those who shopped with their relatives/friends enjoyed the supermarkets providing cafes.

4.2.2.3 Shopping Preferences

The results of a focus group study among 32 older adults in the town of Guildford, UK showed that while shopping independently was an important factor for some older adults, some preferred to shop with a relative or friend since it made shopping trips more enjoyable for them, and allowed them to buy heavier goods (Wilson et al., 2004). Also, older adults were more in favour of in-person shopping than online shopping compared to the younger ones (Farag et al., 2003). The findings of a qualitative study among 61 retired individuals in Montreal, Canada revealed that most of the participants never did online grocery shopping. While car users were more likely to adopt online services, the ones using public transit and active travel modes preferred home-delivery after in-person shopping to reduce the barriers linked to these modes (Bezirgani & Lachapelle, 2021). However, Munoz-Plaza et al. (2013b) found that older adults rarely relied on store delivery services since they wanted to remain independent and avoid delivery fees.

4.2.3 Previous Approaches to Travel Mode Choice Modelling

Previous studies have extensively used traditional discrete choice methods and in general statistical models (such as multinomial logit, mixed logit, and nested logit) to estimate travel mode choice for shopping in the general population (e.g. Hagberg & Holmberg, 2017; Jiao et al., 2011; Michel & Scheiner, 2016) and in particular for older adults (Su et al., 2009). In recent years, using machine learning techniques in travel mode choice behaviour have gained popularity due to their superior prediction performance compared to statistical methods. Regarding this, several studies have implemented machine learning methods (e.g., Moons et al., 2007; Rasouli & Timmermans, 2014;

Shafique & Hato, 2015; Yang et al., 2016) or both statistical methods and machine learning techniques (e.g., Cheng et al., 2019; Ermagun et al., 2015; Golshani et al., 2018; Zhang & Xie, 2008; Zhao et al., 2020) for travel mode choice analysis. However, to the best of my knowledge, no prior studies have implemented machine learning methods to study travel mode choice specifically focusing on older adults and/or travel mode choice specifically for shopping purposes.

To bridge this gap, this study aims to predict the travel behavior of older adults and figure out the important factors influencing their travel mode choice using both statistical and machine learning methods. In this approach, I could build a prediction model with a pretty high accuracy that can help planners and policy makers in the decision-making process. As the population of older adults is growing, this model equips planners with an efficient tool to predict which travel mode older adults in an area choose to go to their primary grocery store deriving their sociodemographic, mobility and shopping trip characteristics. To the best of my knowledge, this is the first study using machine learning techniques to predict older adults travel mode choice for shopping.

4.3 Methods and Materials

4.3.1 Study Design and Data Collection

To begin to answer the research question, I developed and implemented a survey among older adults aged 65 and over living in Milwaukee County, Waukesha County and Ozaukee County, WI. In general, Milwaukee County is mostly urban while Waukesha County and Ozaukee County have suburban and exurban communities. In terms of transit system, Milwaukee County has an extensive public bus system countywide along with one public streetcar route located in downtown Milwaukee. However, Waukesha and Ozaukee Counties have much less transit frequent service and route coverage.

Although it was not possible to survey all older adults living in every neighborhood within these three counties, I recruited participants from a number of heterogenous neighborhoods to include participants from different socioeconomic characteristics living in distinct residential areas (Map 1). More details on the selection of survey sites and recruitment of participants are provided in the Methods chapter of Moayyed (2022).

The eligibility criteria for inclusion in the study required that each individual be at least 65 years old, English-speaking and capable to live independently[2]. Once a sample of 178 individuals participated in the study, I had to stop conducting more surveys due to Covid-19 pandemic.

Surveys were conducted one-on-one among older adults living independently whether in institutionalized buildings (including retirement communities and subsidized housings) or non-institutionalized ones from March 2019 to July 2020. The survey included both closed and open-ended questions exploring individuals' socioeconomic, travel behaviour, and travel attitudes before and after moving to their current housing. Each survey lasted about 20 to 30 minutes. The Institutional Review Board of University of Wisconsin Milwaukee reviewed and approved the survey questions (Appendix B).

[2] The focus of this study is on older adults who may have physical and mental limitations, but such that, these limitations do not affect their functional ability to perform daily activities independently. Therefore, a discussion of very frail older adults who cannot live without the help of others is beyond the scope of this study.

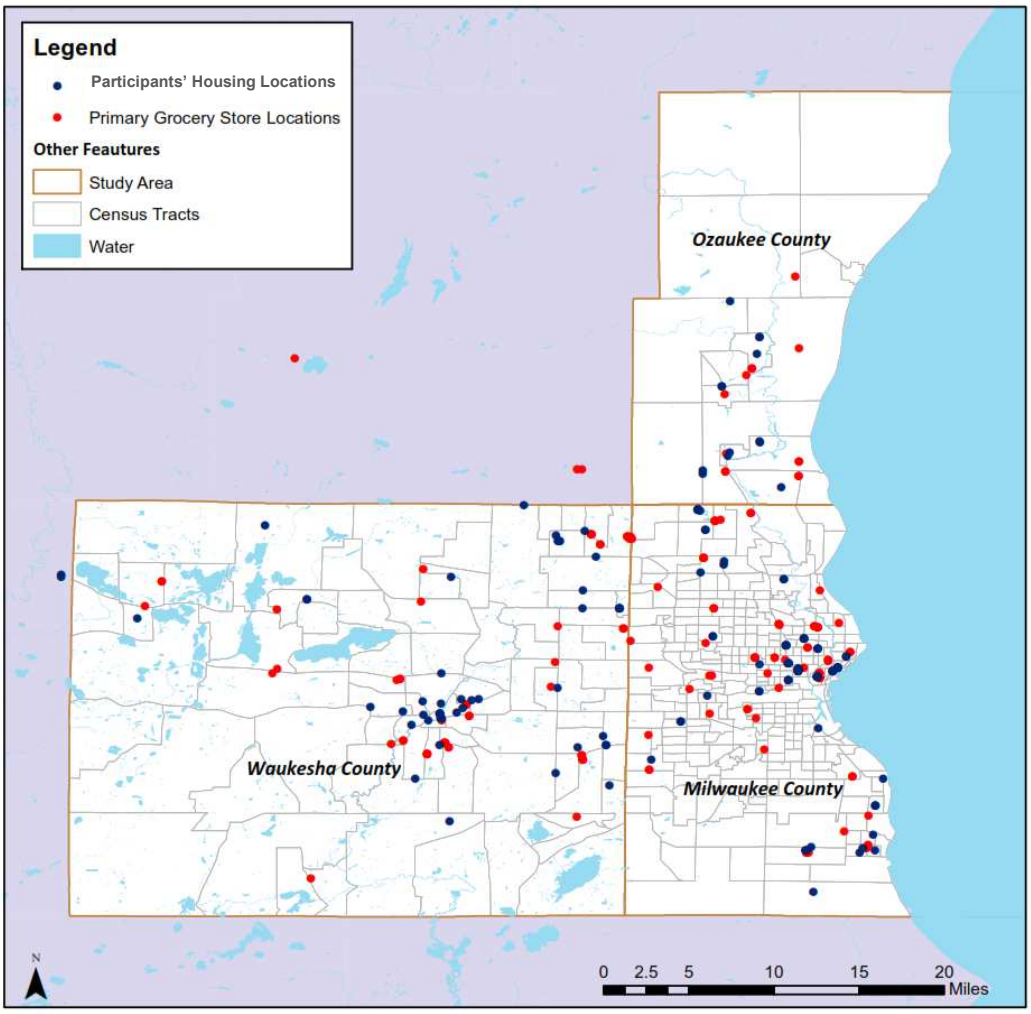

Figure 4 Location of study participants' housings and their primary grocery store

To investigate different factors influencing older adults' travel mode choice for grocery shopping I defined the dependent variable as the mode that the participants most often chose to go to their primary grocery store. Also, the independent variables covered three main areas: socioeconomic characteristics, travel behaviours, and grocery shopping trip characteristics. The socioeconomic characteristics category includes age, gender, type of accommodation (rent/own),

household income group and physical disability. The travel behaviour category includes car ownership in the household, valid driver's license, accessibility (indicating if the participants considered the easy access to destinations as a factor in moving to their current housing). The category of grocery shopping trip characteristics includes frequent mode choice for going to the primary grocery store, the frequency of going to the primary grocery store, drive/ride time, drive cost, walk time, public transit time, public transit cost.

I derived the first two sets of variables from the survey questions. For the grocery shopping trip characteristics, I derived two variables including 'grocery shopping frequency' and 'mode choice' from the survey, however, I measured 'travel cost' and 'travel time' for travel modes.

4.3.2 Data Preparation

I further categorized the modes participants chose to go grocery shopping. I found that a limited number of survey participants bicycled (n=1), took a regular taxi (n=1), took a special senior transportation service (n=4), took the building's private van/bus (n=5) to the grocery store or did not go to the grocery store at all (n=14). So, I removed their records from the dataset, and conducted the analysis on (n=153) responses. The final dependent variable included four modes: drive, ride (family/friends), walk, and bus.

I used the participants' responses regarding the closest intersection to their current housing, and the name and the address of the grocery store that they go most frequently, to geocode the location of their homes and the grocery stores in ArcGIS. Then using the Google Maps, I found the shortest route from their home to the store. This study just focuses on the trip 'from' home 'to' the frequented grocery store, and does not include the return trip or the possibility of trip chaining.

I did not identify any outliers in the dataset; however, I cleaned the survey dataset to remove missing values. In total, I identified 23 records missing values for travel cost and travel time by public

transit because they lived far from existing service. By using the Mice package in RStudio, I imputed these missing values for travel cost and travel time of public transit by fitting a linear regression model for the observed values, predicting the conditional mean for each missing value, and randomly imputing a value from a normal distribution centred on this conditional mean. I also checked to see if a multicollinearity was present between the variables. Just driving cost had high correlation with driving time (VIF>10), however, I kept both of them in the model to achieve a consistent comparison of mode-specific variables.

4.3.3 Final Dataset

The final dataset includes 153 participants (older adult survey respondents). The dependent variable—traveler's mode choice—is categorized as follows: drive (car), drive (ride), walk and public transit. The 14 explanatory variables include socioeconomic characteristics of older adults, the characteristics of their trip to the grocery store, and their personal travel behavior (Table 4). I use this dataset for modelling both multinomial logit and Random Forest methods.

	Features	Description	Mean	SD[a]
Socioeconomic	Gender	Female or male (1=female, 0=male), dummy.	0.614	0.488
	Age group	The participant's age group was 75 years old (1) or 65-74 (0) years old, dummy.	0.366	0.483
	Income group (Household)	More than $25,000 (1), otherwise (0), dummy.	0.399	0.491
	Type of Accommodation	Rent (1), otherwise (0), dummy.	0.673	0.471
	Car Ownership (Household)	Having a car (1), otherwise (0), dummy.	0.641	0.481
	Physical Disability	Having disability (1), otherwise (0), dummy.	0.431	0.497
Transportation Access Characteristics	Valid Driver's License	Having a valid driver's license (1), otherwise (0), dummy.	0.732	0.444
	Accessibility	Valued accessibility to destinations when choosing where to live (1) otherwise (0), dummy.	0.458	0.500
Trip Characteristics	Drive_Ride_Time	The shortest travel time to the most-frequent grocery store by car (min).	9.57	4.80
	Drive_Cost	The cost of travel time to drive to the most-frequent grocery store (dollar).	0.378	0.381
	Walk_Time	The shortest travel time to walk to the most-frequent grocery store (min).	68.9	66.2
	Public_Transit_Time	The shortest travel time to take public transit to the most-frequent grocery store (min). (Note: This feature was imputed for the ones who lived far from existing service).	41.5	68.51
	Public_Transit_Cost	The cost of travel time to take public transit to the most-frequent grocery store (dollar). (Note: This feature was imputed for the ones who lived far from existing service).	1.15	0.39
	Frequency_Store_Once_a_Week	Travel Frequency to the Primary Grocery Store less than once a week (1), otherwise (0).	0.627	0.485

Table 4 Descriptive Statistics for Sample of 153 Older Adults

[a] *SD: standard deviation.*

4.3.4 Statistical Modelling

4.3.4.1 Multinomial Logit Regression

Multinomial logit (MNL) is a discrete choice modelling approach based on random utility maximization (Bhat et al., 2008). I used MNL as a method to understand the factors that are associated with mode choices among older adults.

I formulated a multinomial logit model for all the trips from home to grocery store using the R Apollo software package (S. Hess & Palma, 2019).

In the Multinomial Logit (MNL) the formula to calculate the total utility function U_{nsi} for the alternative i of the individual n is as follows:

$$U_{nsi=}asc_i + \beta_i(x_{nsi}) + \varepsilon_{nsi}$$

Where n indexes individuals, s choice scenarios, and i alternatives. asc_i is the alternative specific constant, β_i is the is the p-dimensional vector of the explanatory variables for the alternative i, and ε_{nsi} is an independent identically distributed standard Gumbel error term. asc_i and β_i are parameters to be estimated.

One of the assumptions in MNL is the independence of irrelevant alternatives (IIA). Based on this assumption, the features of one particular mode choice do not influence the relative probabilities of choosing other alternative modes (Vijverberg, 2011). I tested this assumption using the Hausman-McFadden test. Since I found that I have violated this assumption, I also fit Mixed Logit model that relaxes the IIA assumption. However, since mixed logit considers random variables (additional variables), So, in this paper I only present the results of MNL model (The IIA assumption was tested with the Hausman-McFadden test (see Appendix G).

4.3.5 Machine Learning Modelling

4.3.5.1 Random Forest for Classification

In this study, I used Random Forest (RF) as a decision tree ensemble approach for classifying travel mode choices. Random Forest builds many different decision trees (i.e., a model that has a flowchart-like tree structure and graphically shows the decision-making process) using random sample sets of the training data with replacement (referred to as bootstrap samples). Each decision tree splits on a random selection of variables (mtry), rather than employing all the explanatory variables. Random forest combines the outputs of decision trees through majority voting to get the final predicted class. For more details about the Random Forest model refer to (Hastie, 2009; del Río et al., 2014).

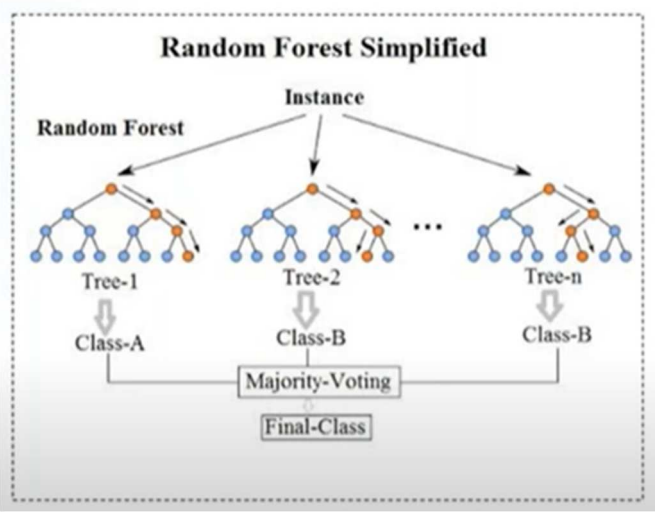

Figure 5 Random Forest Process

Research proves that Random Forest outperforms other machine learning methods for classification tasks (Díaz-Uriarte & Alvarez de Andrés, 2006; Pineda-Jaramillo, 2019). Some of the characteristics that make the Random Forest method ideal for the dataset include: a) being very accurate for predicting outcomes even when the sample size is small; b) being robust to overfitting

and; c) capable of handling a mixture of categorical and continuous predictors (Bhattacharyya et al., 2011; Díaz-Uriarte & Alvarez de Andrés, 2006; Zheng et al., 2021).

4.4 Data Analysis and Results

4.4.1 Descriptive Statistics

4.4.1.1 Characteristics of shopping trip

Overall, 81 (52.9 percent) of the 153 respondents drove, 39 (25.5 percent) got a ride (from a family member/friend), 20 (13.1 percent) used public transit and 13 (8.5 percent) walked to the grocery store (Table 5).

	Respondents' Mode Share			
	Drive	**Ride**	**Walk**	**Public Transit**
Overall Average	52.9%	25.5%	8.5%	13.1%

Table 5 Respondents' mode share

4.4.2 Final Multinomial Logit Model

In order to estimate the accuracy of the MNL model, I split the dataset into 80% (training data) and 20% (test data). I fit the MNL model just on the training dataset. Table 6 presents the estimated MNL model for an older adult's choice of travel mode for a trip to the primary grocery store. I first fitted the model with more detailed age groups (65, 65-74, 75 and above), household income levels, and travel frequency to the primary grocery store. I found using simple dummy variables provided the best model fit. I also did not include additional socioeconomic variables including race/ethnicity, education level, and if the participant lives alone or not to avoid having too many predictors due to the small sample size. The final multinomial logit model estimated 35 parameters (including three constants for the modes). Overall, the model final log-likelihood (-54.65) was relatively high compared

with the log-likelihood value for no model (-169.13) and the log-likelihood value of a model with only constants (-140.36). Its adjusted rho-squared value was 0.4699. All of the parameter estimates were provided for explanatory variables, and the ones that were statistically significant were marked with an asterisk.

4.4.2.1 Multinomial Logit Results

The final multinomial logit model shows that grocery store mode choice has statistically-significant relationships with individual socioeconomic characteristics, transportation access characteristics, and grocery store trip characteristics.

Variable name		Mode to the Grocery Store[1]							
		Car (Drive)		Car (Ride)		Walk		Public Transit	
		Beta[2]	p-value	Beta	p-value	Beta	p-value	Beta	p-value
Constant		-11.703	0.18	10.308	0.19	-3.611	0.38	Base Category	
Socioeconomic Variables	**Gender (Female)**	0.534	0.31	1.824**	0.03	-1.186	0.13	Base Category	
	Age Group (75 and above)	1.074	0.16	0.375	0.33	0.399	0.37	Base Category	
	Higher Household Income >25,000	2.123*	0.05	1.243	0.15	0.794	0.31	Base Category	
	Type of Accommodation (Rent)	-15.181***	0.00	-15.883***	0.00	0.809	0.29	Base Category	
	Car Ownership (Household)	6.344***	0.00	1.747*	0.09	2.703*	0.05	Base Category	

	Physical Disability	0.277	0.41	0.980	0.15	1.900*	0.06	Base Category	
Transportation Access Characteristics	**Valid Driver's License**	21.487***	0.00	0.011	0.50	1.086	0.18	Base Category	
	Accessibility (Walkability importance for the participant)	-2.312**	0.02	-1.416*	0.05	-0.429	0.33	Base Category	
Trip Characteristics	**Travel Time[3,4,5] (min.)**	-0.119	0.23	-0.119	0.23	-0.147**	0.02	-0.053	0.11
	Travel Cost[6,7,8] ($)	-1.494*	0.06	-	-	-	-	-4.541	0.34
	Travel Frequency to the Primary Grocery Store (less than once a week)	-2.317**	0.03	-2.069**	0.01	-2.506**	0.01	Base Category	
Overall Model									
Sample size (N)					122 (80% of the original dataset)				
Log-likelihood (0)					-169.1279				
Log-likelihood (constant)					-140.3621				
Log-likelihood (final)					-54.65021				
Adjusted Rho-square (0)					0.4699				
Adjusted. Rho-square (constant)					0.3613				

Table 6 Multinomial logit regression model

1) The car (drive) mode includes driving and the car (shared-ride) includes riding as a passenger with a family member or friend (taxi is not included in the model). The walk mode includes all pedestrians, including people on foot, in wheelchairs, and using other assistive devices. The public transit mode includes the city/county bus and the streetcar (The Milwaukee Hop).
2) Statistically significant at ***<0.01, **<0.05, *<0.1
3) Travel time by Car (driving and shared-ride) represents the shortest time route selected by Google Maps directions plus 2 minutes (the time needed for older adults to walk to the car).
4) Travel time by walking represents the total time that the customer would need to travel to the grocery store. I used the shortest travel distance selected by Google Maps directions and then considering that the average walking speed of an older adult (65 and above) is about 1.17 m/s (Tarawneh, 2001) I calculated the travel time.
5) Travel time by public transit represents the shortest travel time selected by Google Maps directions. Assuming that older adults are aware of the bus schedule, I considered a 5-minute waiting time for the bus. In case participants had to transfer to one/more buses to get to the grocery store, I multiplied 5 minutes to the number of transfers.
6) Travel cost was estimated for the car (driving) and public transit modes. I considered the travel cost for the car (shared-ride) $0, assuming that the participants got a free ride from their family/friends.
7) Public transit travel cost (Dollars) represented the total fare that the study participant would need to travel to the grocery store by transit. Older adults who are at least 65 pay a reduced fare over the study area. Fares were calculated from fare information provided

by the official websites of counties' transit systems. This fare is $1.10 in Milwaukee County, $1 in Waukesha County, and $1.60 in Ozaukee County. I also considered if the rider needed to pay a transfer fee for going to a different route to complete his/her trip.

8) Car (Driving) travel cost (Dollars) represented the expected gas cost paid by a respondent driving to the grocery store. Since the grocery stores in the area have free parking lots, I considered the cost of parking $0. The gas cost was assumed to be $2.56 per gallon ($0. 676 per lit) the average gas price for Wisconsin in 2019. Automobile fuel economy was assumed to be 22.2 miles per gallon (9.44 km per litre), the average US fuel efficiency based on the Bureau of Transportation Statistics dataset in 2019.

4.4.2.1.1 Socioeconomic Characteristics

As expected, car ownership in the household shows a significant positive relationship with driving, but the effect is smaller for getting a ride and walking, indicating a strong preference to drive to the grocery store when it is available. Higher household income (≥$25,000) has a positive association with driving, but is neutral with getting a ride or walking versus public transit. Compared to taking public transit, older adults with physical disabilities are significantly more likely to select walking. The model is neutral with respect to physical disability and car trips (whether as a driver or passenger) when compared to public transit. Females are more likely to get a ride with a family member or friend than to take public transit. Increasing age is neutral with respect to taking public transit and using other travel modes. Interestingly, the people who rent their current housing are negatively linked to driving or getting a ride for their grocery shopping trips, indicating a relative preference for taking public transit or possibly lack of access to a car.

4.4.2.1.2 Transportation Access Characteristics

Valid driver's license possession is positively associated with driving. However, the model is neutral with respect to valid driver's license possession and ride or walk trips when compared to public transit. Notably, individuals who valued accessibility to destinations when choosing where to live are less likely to use car (as a diver/passenger) when going to grocery shopping.

4.4.2.1.3 Grocery store trip characteristics

Travel time has a strongly negative association with walking trips, but does not have a statistically significant relationship with respect to other modes. Also, as expected, travel cost negatively associates

with driving, however it is neutral for public transit trips. Interestingly, for more frequent grocery shopping trips at the primary store, people tend to prefer driving, being a car passenger, or walking over taking public transit.

4.4.2.2 Multinomial Logit Evaluation Results

I evaluated the MNL model on the unseen test dataset (20% of the original dataset) in order to find out the prediction accuracy of the model for mode choice. The resulting accuracy was 61.29%, which shows the model performs fairly well.

4.4.3 Random Forest Experiment

I used the Tidyverse (Wickham et al., 2019) and DALEXtra (Maksymiuk et al., 2021) packages in RStudio for building and analysing the Random Forest model. The dataset was randomly split

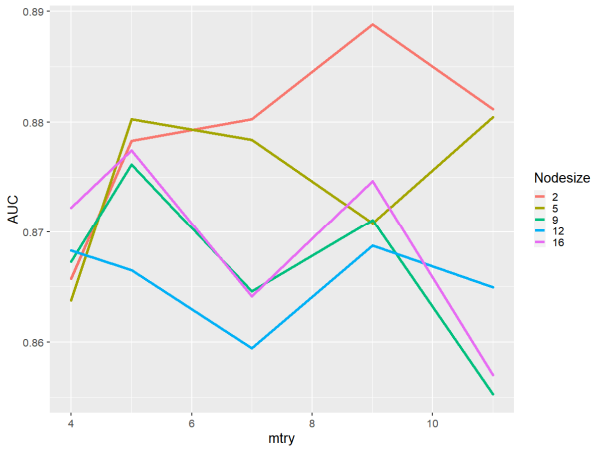

Figure 6 Tuning mtry and nodesize hypermeters for the Random Forest model

into 80% training and 20% testing, ensuring that an overlap does not occur between training and testing subsets. While I set the number of trees (ntree), to 1200 to be large enough, I tuned the values of mtry (the number of predictors to sample at each split) and nodesize (minimum number of observations needed to keep splitting nodes). I optimized these two hypermeters (using area under the Receiver Operating Characteristics curve (AUC) as a performance metric) based on grid search

technique and performing 10-fold cross-validation on the training set. Figure 6 shows the AUC values for different combination sets of mtry and nodesize across resamples of the data. I notice that the maximum AUC is achieved at mtry 9 and nodesize 2. I chose the best model with the specified optimized hyperparameters and ntree=1200 as the final trained model.

4.4.3.1 Random Forest Output Analysis

To provide insights about the research questions, I present two outputs from the Random Forest model: (a) the variable importance plot (VIP), which ranks predictors according to their contribution towards the prediction of travel mode choice and (b) the partial dependence plot (PDP), which represents the effect of individual predictors on mode choice. Figure 7 shows the variable importance plot of the top ten most important variables in the fitted random forest model. This plot clearly indicates that socioeconomic and personal travel behaviour characteristics, including car ownership (household) and possession of a valid driver's license are the most important predictors, respectively. Variables related to the grocery store trip, including public transit time, drive cost, walk time, drive/ride time, and frequency of going to the store do not contribute as much to mode choice prediction in the Random Forest model.

Interestingly, socioeconomic variables such as gender, income group, disability, age group, and type of accommodation (rent/own) are the least important predictors (age group and type of accommodation do not even make the top 10 shown in Figure 7).

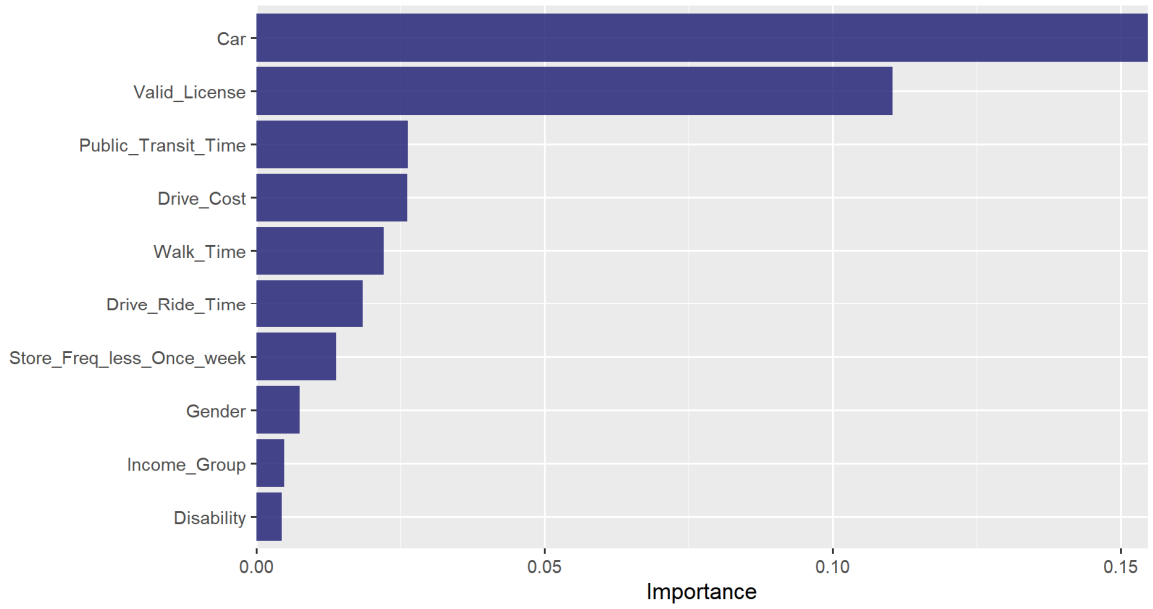

Figure 7 Variable Importance Plot of the RF model for predicting mode choice

After I identified the relative importance of most of the input variables, I used partial dependence plots (PDPs) to understand how the prediction of the output variable (i.e., mode choice) depends on each of the input variables. I focused on the impact of five grocery-trip related variables on mode choice prediction while averaging over the other variables (Hastie, 2009) in the model (Figure 8). On the x-axes of this figure, the little marks (called rugs) indicate the feature distribution (individual cases). This is very important to consider since ignoring it might lead to overinterpretation of parts of the plot with no data (Molnar, 2018). For example, I can see in Figure 8 that in the PDPs for public transit time and public transit cost the trend line almost remained constant over a large part of the plot with almost no data. So, it is not reliable to analyse the partial dependence plots in these regions. The analysis of the PDP for public transit time indicates that when the trip to the grocery store by bus takes more than about 12 minutes, the probability of using bus decreases sharply. However, the probability of getting a ride and walking increases when the travel time by bus takes about 10 to 25 minutes.

The results of PDP for mode choice probability based on drive/ride time show that the probability of driving is high until trip durations of about 16 minutes and decreases after. However, for getting a ride I can see an almost opposite trend. Also, while the probability of walking to the store is higher than taking the bus initially, it significantly goes down close to zero after the drive/ride time takes more than 4 minutes.

For the cost of driving, the PDP depicts that the probability of driving increases until the cost reaches about $0.06, then it stays almost constant and drops at about $0.60 and then flattens. Also, the model predicts that as the cost of driving increases, the probability of getting a ride increases gradually between the range of about $0.35 to $1.20. Moreover, the probability of taking the bus and walking remains lower than the other two modes and mostly does not change as the drive cost increases.

The PDP of walk time shows that when walking goes up to about 9 minutes, the probability of walking to the store decreases sharply down close to zero. As walking time increases the odds of driving or taking the bus remains steady at around 51% and 15%, respectively. However, the probability of getting a ride gradually increases as it takes longer to walk to the store. This may indicate substitution between walking and getting a ride.

Overall, the results indicate that older adults' tendency to drive for grocery shopping trips is higher than the other modes for a wide range of travel time and travel cost values (pink lines within each chart in Figure 8). However, as the cost and time of driving increase, older adults' tendency to drive decreases gradually while the probability of getting a ride from a family/friend increase.

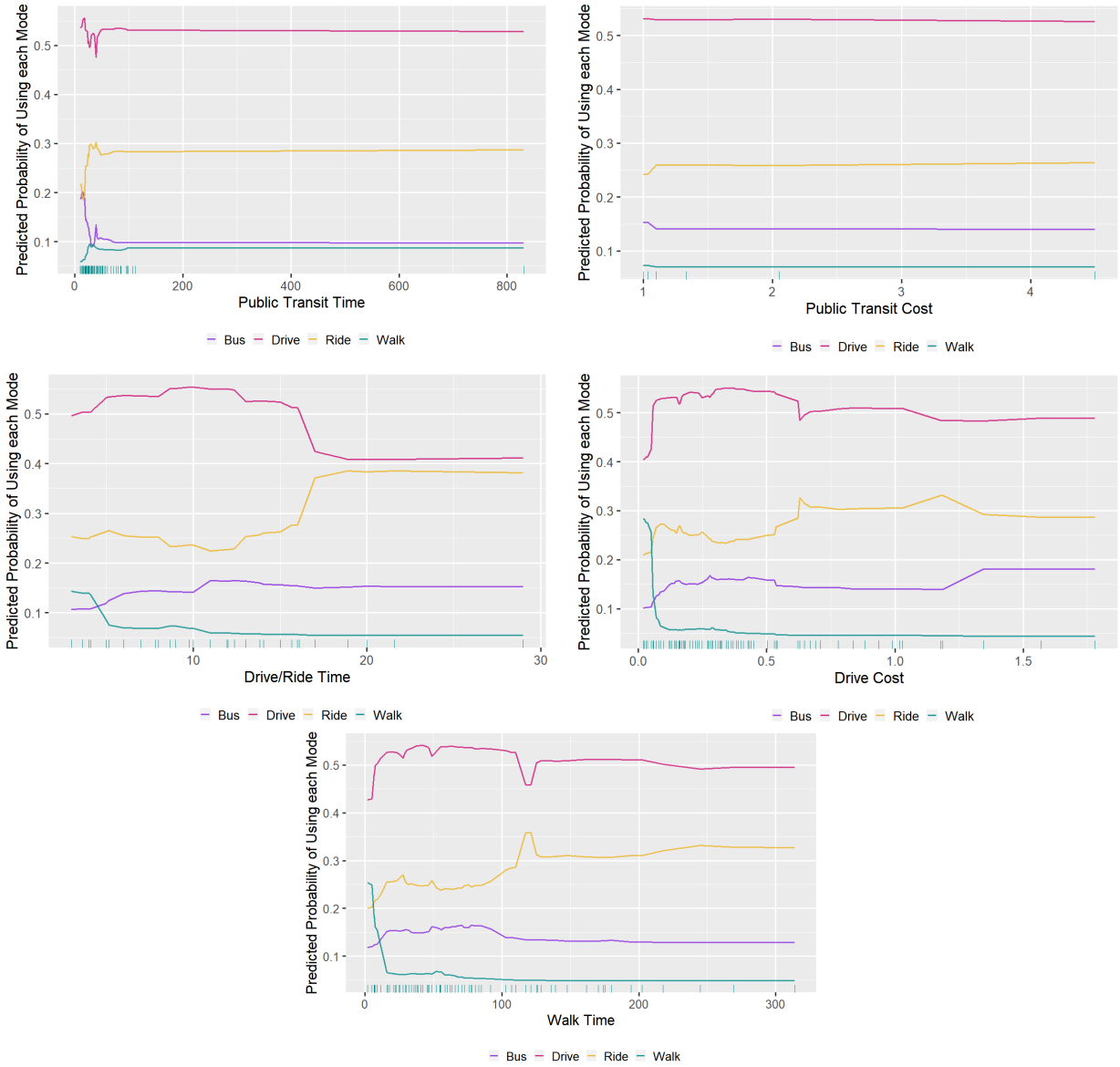

Figure 8 Partial Dependence Plot for the probability of mode choice in response to different trip variables based on the RF model

4.4.3.2 Random Forest Evaluation Metrics

I evaluated the performance of the model using the number of true positives (TP), the number of true negatives (TN), the number of false positives (FP), and the number of false negatives (FN). These four outcome categories define a Confusion Matrix (Table 7).

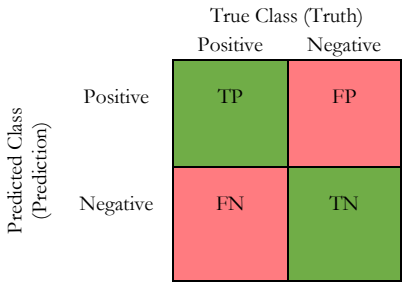

Table 7 Confusion Matrix for binary classification

Since this study focuses on a multi-class classification task, each of the four outcome categories in the confusion matrix should be calculated for each individual class (i.e., bus, drive, ride, and walk). For example, if I take the bus class, bus is regarded as positive class and all the other three modes are regarded as negative classes. Also, True is when the prediction is correct, and False is when the prediction is incorrect. So, in this case TP is the number of people who truly took the bus; TN is the number of people who truly did not take the bus; FP is the number of people who truly did not take the bus but the model misclassifies them as taking the bus; and finally, FN is the number of people who truly took the bus but the model misclassifies them as not taking the bus.

I use the four outcome categories to calculate the following performance indices: accuracy, sensitivity, specificity, balanced accuracy, precision, and F-beta-Measure. The indices' main definitions and formulations for a binary classification are as follows:

Accuracy is the proportion of the data that the model predicts correctly.

$$\text{Accuracy} = \frac{\text{TP}+\text{TN}}{\text{TP}+\text{TN}+\text{FP}+\text{FN}} \qquad (1)$$

Sensitivity (Recall) is the model's ability to predict if an observation belongs to a particular category, while Specificity is the model's ability to predict if an observation does not belong to a particular category.

$$\text{Sensitivity} = \frac{TP}{TP+FN} \quad (2)$$

$$\text{Specificity} = \frac{TN}{TN+FP} \quad (3)$$

Balanced Accuracy is the average of sensitivity and specificity.

Precision is the ratio of positive predictions that are true positives.

$$\text{Precision} = \frac{TP}{TP+FP} \quad (4)$$

And, the F-beta-Measure is a way of combing precision and recall by calculating their weighted harmonic mean as follows:

$$\text{F-beta-measure} = (1+\beta^2) \times \frac{Precision \times Recall}{(\beta^2 \times Precision)+Recall} \quad (5)$$

In the above equation β is a metric that enables F-measure to favour either precision or recall.

$$\beta > 1: Favors\ Recall$$

$$\beta < 1: Favors\ Precision$$

4.4.3.3 Random Forest Evaluation Results

I evaluated the RF model on the unseen test dataset (20% of the original dataset) to see how much the model can predict travel mode choice correctly. Table 8 presents the detailed results of the model evaluation. The resulting accuracy was 80.6%, which shows the model performs very well. Also, the balanced accuracy is just slightly lower than the accuracy since the dataset was not very imbalanced. It appears that the specificity was high (92.5%), however the sensitivity was moderate

(66.1%). The RF precision was high (81.2%) indicating the considerable ability of the model to identify only the relevant instances.

Performance Index	Performance Value
Accuracy	**0.806**
Sensitivity (Recall)	**0.661**
Specificity	**0.925**
Balanced Accuracy	**0.793**
Precision	**0.812**
F-beta-Measure	**0.690**

Table 8 Performance indices for the Random Forest model

One of the other effective performance measurements for the model is through receiver operating characteristic (ROC) curves. The ROC curve which plots sensitivity (true positive rate)

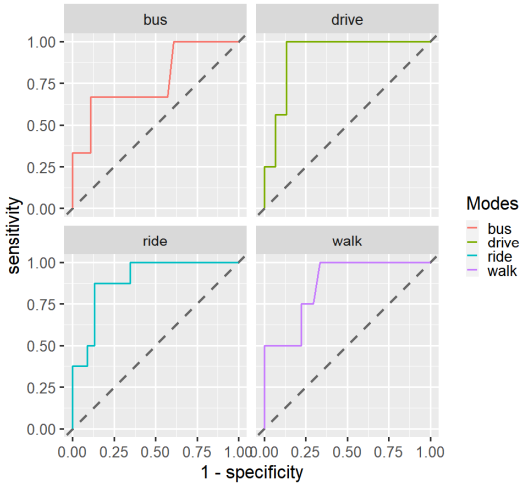

Figure 9 ROC curves of classifier for each class

against 1-specificity (false positive rate) at different cut-off points are presented in Figure 9. The closer the curve is to the upper left corner, the better the discriminating ability of the model is (DeLong et al., 1988). This figure shows that the model identifies drive and ride classes better than the walk and bus classes.

4.4.4 Comparison of the Applied Models

In this section, I compare the prediction accuracy of the estimated models to assess the performance of them. Table 9 summarizes the prediction accuracy of MNL and Random Forest models with respect to the travel mode decision. The results indicate that Random Forest model outperforms MNL model in correctly predicting mode choices. Looking in more detail at the predicted accuracy of each mode, I can see that Random Forest model performs better than MNL in all modes except for the drive mode. Walk and Ride modes have the worst prediction accuracy in the MNL model, while the Random Forest model performed significantly better for these two modes. Overall, MNL and Random Forest models have the best prediction for the drive mode with an accuracy rate of 100% and 93.75%, respectively. However, the worst prediction accuracy belongs to walk and bus modes. The small number of observations in these two cases in the test dataset may be the main reason of this low prediction accuracy.

	Prediction Accuracy (%)		**Mode Share testing dataset (%)**
Predicted Travel Modes	Multinomial Logit	Random Forest	
Car (Drive)	100	93.75	51.61
Car (Ride)	25	87.5	25.81
Walk	0	50	12.90
Public Transit	33.33	33.33	9.68
Overall Prediction Accuracy	61.29	80.64	Not applicable

Table 9 Comparison of the prediction accuracy of the MNL and Random Forest models

4.5 Discussion

Studying older adults' travel behaviour for shopping is an important area of research as these trips account for a large proportion of older adults' trips after retirement. In this study, I aimed to explore older adult travel mode choice for grocery shopping. In particular, the main study objectives

were to find out how much different factors, including the individuals' socioeconomic status, their transportation access characteristics, and grocery shopping trip characteristics influence their travel mode choice.

The multinomial logit and Random Forest model results suggest that out of the 14 socioeconomic, personal travel, and trip characteristics studied, household car ownership is the most important in predicting their travel mode choice for grocery shopping, followed by valid driver's license possession. Interestingly, the age group of older adults (65-74 versus 75 and above) and the presence of a physical disability were relatively unimportant among the respondents in this analysis.

Evaluating the performance of the models showed that overall, the Random Forest model achieved a much higher predictive accuracy (80.64%), than the MNL model (61.29%). Also, Random Forest model mainly outperformed the MNL model in predicting each of the travel mode choices. However, I believe that while high predictive ability of Random Forest model is advantageous in the decision-making process, MNL model also could help policy makers to interpret the impact and strength of different factors on mode choice. Regarding this, the argument is that integrating machine learning models with statistical models is a promising method (Ermagun et al., 2015) that could lead to better decision making in the transportation planning field.

This study supports previous research findings indicating that car is the dominant mode for grocery shopping. However, I could see that an increase in drive time and drive cost would lead to an increase in older adults rideshare. Considering that as older adults age, their ability to drive decreases, there is an important implication for policy makers to improve informal rideshare services and make investments in rideshare programs to counter this trend. They are already some programs in the study area that recruit volunteer drivers in the form of senior rideshare programs. Also, programs exist in Milwaukee County that family members of low-income older adults receive reimbursement for riding

services. However, these programs are very limited and not uniformly available in the study area. Also, I found that when walking time to the store is in the range of about 2 to 9 minutes, the probability of using it is higher than getting a ride and taking public transit. This finding underscores the importance of creating more developments where older adults can afford to live relatively close to grocery stores. One way to do this is through zoning regulations and other incentives that support higher residential densities with mixed land uses. These areas should also include sidewalks and safe street crossing facilities to make pedestrian access to stores comfortable and convenient. Experience from the UK (Guy, 2009) supports that location, scale, density, design and mix of land uses encourage older adults to reduce car travel.

4.6 Research Limitation and Future Research

The study findings have limited generalisability due the following reasons. First, a large number of individuals who participated in this study were residents with low incomes living in subsidized buildings. I also excluded older adults whose physical disability prevented them from independent living. Therefore, this study might not be representative of older adults with distinct travel behaviours. Second, I studied 153 individuals, and the number of observations using walk and public transit modes were small. Future studies could improve the multinomial logit and random forest model accuracy and expand this study findings by increasing the sample size.

Another point to consider is that this study only focused on a single trip to the grocery store, and did not consider the return trip or the possibility of trip chaining. While empirical research shows that for simple tours (home-shop-home), older adults changed their mode choice in only about 3.79% of trips before and after shopping (Su et al., 2009), there is an opportunity for future research to study the possibility of combined mode choice among older adults for grocery shopping.

Future studies should also examine how trip-chains impact a person's initial mode choice when leaving home. Furthermore, I did not explore the impact of built environment characteristics of the home and the destination location (e.g. Jiao et al., 2011), or characteristics of the specific route from home to destination (e.g. Krizek, 2003) on individual's travel behaviour.

Moreover, this study explored the most frequent mode choice and the primary grocery store that older adults go to. However, they might choose different modes for going to different grocery stores, and factors such as weather, time of the day, weekday or weekend, type and quantity of their purchase may influence their mode choice. Future studies should consider the heterogeneity of older adults' travel behaviour with regard to these factors.

Finally, the review of literature indicated that older adults do not often rely on online shopping and/or delivery services. However, during the past few years due to the COVID-19 pandemic, many grocery stores expanded their online shopping and pick up/delivery services, to protect older adults, as a vulnerable group, against Coronavirus disease. Therefore, this age group may be adapting quickly to e-shopping and delivery services. A potential avenue for future research involves studying travel mode choice of older adults after the COVID-19 pandemic for grocery shopping.

5 Exploring Reasons Behind Older Adults' Decision whether to Renew their Driver's License using a Mixed Method

Abstract

The objective of this chapter was to explore the reasons older adults with driver's licenses decide to renew their driver's licenses (Yes) or do not intend/hesitant to renew their driver's licenses after expiration (No/Not sure). The secondary objective was to find out the reasons behind the decisions of older adults who still had a valid driver's license but had decided not to drive at the time of the study. Study data came from one-on-one surveys with 116 older adults who had valid driver's licenses and lived in non-institutional or institutional settings in Milwaukee County, Waukesha County, and Ozaukee County. I limited the analysis to older adults who were at least 65 years old, spoke English, and were healthy enough to live independently. I used a mixed-method approach (binomial logit regression and a qualitative analysis) to examine the factors that lead older adults to renew or not renew their driver's licenses. In the binomial logit regression, this study examined the influence of various socioeconomic factors, travel behavior, and travel attitudes on this decision. In the qualitative part, after coding the responses, participants were divided into four different groups based on their driving status at the time of the study (still driving or not) and their intention to renew their driver's license (Yes) or not to renew/reluctant (No/Not sure). The results of this study indicate that the decision to renew a driver's license is negatively associated with socioeconomic factors such as age group (75 years and older), physical disability, and education level (high school or less). Driving frequency and positive attitudes toward driving to destinations were positively related to this decision. This relationship was not mediated by income group and living alone. The results of the qualitative analysis were largely consistent with the quantitative analysis, which showed that age

(and associated factors such as age-related safety and health problems) negatively affects people's decision to renew their driver's licenses. Eventually, older adults are faced with the fact that they no longer drive and must surrender their driver's license. Policy makers and transportation planners should help drivers with licenses plan ahead, improve transportation infrastructure, and implement long-term land use policies to help older adults better cope with this situation.

5.1 Literature Review

The population of older adults age 65 and older is growing rapidly in the United States and around the world. The number of older Americans increased 35% between 2008 and 2018, and is expected to nearly double, reaching 94.7 million by 2060 (Administration for Community Living, 2020). Contrary to the assumption that people give up driving as they age and rely more on public transportation than younger age groups, the studies' findings suggest that as the population of older adults increases, so does the number of driver's license holders in this age group (Rosenbloom, 2009; Luiu et al., 2018).

The increasing reliance on the automobile and the inability of other modes of transportation to meet the mobility needs of older adults (Siren & Haustein, 2015; Rosenbloom, 2009) not only in low-density suburban and rural areas, but also in urban environments (Schouten, Wachs, et al., 2022) needs special consideration. As older people age, their physical and mental health changes in ways that make driving more dangerous for them (Ammerman, 2021). However, just few of older adults adequately plan to reduce or stop driving (Vivoda et al., 2021) and even strict driver's license renewal policies and procedures are unlikely to affect them (Siren & Haustein, 2015).

Numerous studies have looked at the causes of driving cessation among older adults. These factors include individual and household characteristics (involving also social and perceived environment) and characteristics related to the physical environment.

Individual characteristics including older age (Dellinger et al., 2001; Edwards et al., 2008, 2010; Feng & Meuleners, 2020; Vivoda et al., 2020) and poorer health and medical conditions (Edwards et al., 2008; Ragland et al., 2004; Dellinger et al., 2001; Vivoda et al., 2020; Hakamies-Blomqvist & Wahlström, 1998; Adler & Rottunda, 2006) are among the major factors contributing to driving cessation among older adults. Related to this factor, studies indicate that vision problems (Ragland et al., 2004) specially losses in night vision (Carp, 1988) and slower processing speed (Edwards et al., 2008, 2010) cause older adults to limit or abandon driving. In addition, lack of confidence and anxious driving (Vivoda et al., 2021; Gwyther & Holland, 2012; Feng & Meuleners, 2020), lower household income (Ragland et al., 2004; Shen et al., 2020), less accumulated wealth (Vivoda et al., 2020), the cost of maintaining a car and license renewal problems (Dellinger et al., 2001), are some other individual factors that lead older adults to give up driving. Moreover, Mezuk and Rebok (2008b) found that older adults who stopped driving were more likely to be female and non-White and had lower education. Having lower levels of education as a predictive factor in driving cessation was also found in other studies (Kulikov, 2010; Marottoli et al., 2000). However, Choi et al. (2012) found that this was the case only for women.

In addition, the results of studies suggest that the perceived and social environment as well as the driving characteristics of older adults contribute to the limitation or avoidance of driving. Worries about being involved in an accident, concerns about crime (Ragland et al., 2004), feeling that it is unimportant to continue driving, feeling less confident in one's driving abilities (Feng & Meuleners, 2020), having no reason to drive (Ragland et al., 2004), habit and personal driving history (i.e., duration and amount of driving activity) (Hakamies-Blomqvist & Siren, 2003), having someone else drive for

them, and recommendations from family members/physicians (Adler & Rottunda, 2006; Feng & Meuleners, 2020) are among these factors.

Studying the impact of factors related to physical environment on driving cession among older adults shows that living in dense, urban, transit-oriented neighbourhoods with better access to other transportation options (Schouten et al., 2022; Shen et al., 2020) and increased congestion and roadway density (Vivoda et al., 2017; Hakamies-Blomqvist & Wahlström, 1998) are positively associated with driving cessation among older adults. However, Schouten et al. (2022) found that while very few older adults relocate from suburban to urban neighbourhoods, after relocation they were less likely to limit or give up driving.

In addition, the results of studies show that the decision to give up driving has important implications for older adults. Although giving up driving reduces the risk of crashes and injuries for this age group, it has negative impacts on their psychological and physical well-being (Schouten, Wachs, et al., 2022; Edwards et al., 2009). Some of these negative consequences include: decline in out-of-home and leisure activities (such as playing cards, going to a movie, restaurant, taking trips, and volunteer work) (Marottoli et al., 2000; Siren & Haustein, 2015; Spinney et al., 2020), changes in social interactions and reduced network of friends (Mezuk & Rebok, 2008a), significant increase in depressive symptoms and practical and emotional loss of independence (Marottoli et al., 1997; Stepney et al., 2018) leading to accelerated general health decline (Edwards et al., 2009) and morbidity and possible mortality among those who retire from driving without a plan (Ammerman, 2021).

Review of the literature shows that most researchers have used a quantitative method to examine the factors that influence driving limitation or cessation in older adults. However, it should be noted that driving cessation does not necessarily mean that older adults do not intend to renew

their driver's license after it expires. In addition, studies show that some older adults give up driving altogether before they reach the age for renewal (Siren & Haustein, 2015). Therefore, it is important to examine the factors that influence older adults' decisions about renewing their driver's licenses from their own perspectives. In addition, a gap exists in the literature on older adult driver's license renewal because most of these studies examine the driver's license renewal process, driver's license restriction programs, retesting, and vision screening laws in various states (e.g. Braitman et al., 2010; McGwin et al., 2008; Stamatiadis et al., 2003).

This study attempts to fill this gap in the literature by identifying the reasons behind the decision to whether renew a driver's license from the perspective of older adults using a mixed-method approach. This study examines the reasons for older adults' intentions to renew or not renew their driver's licenses in four different groups: (1) individuals who drive and intend to renew their driver's license when it expires, (2) individuals who drive but do not intend/are unsure whether to renew their driver's license, (3) individuals who have given up driving altogether but still intend to renew their driver's license when it expires, and (4) individuals who have given up driving altogether and do not intend/are unsure whether they will renew their driver's license.

5.2 Data and Method

5.2.1 Study Design and Data Collection

To answer the research question, I developed and conducted a survey of older adults age 65 and older living in south-eastern Wisconsin, including Milwaukee County, Waukesha County, and Ozaukee County from March 2019 to July 2020.

I conducted one-on-one surveys of 178 older adults living in urban and suburban areas. While Studies have used a variety of measures to set thresholds for urban versus suburban, including population density, employment density, and land use mix (Bluthenthal et al., 2008; D. B. Hess & Ong,

2001; S. Lee, 2011), for this study, I defined urban areas having the population density of at least 3000 people per square mile or employment density of at least 5 jobs per acre (Map 1).

The eligibility criteria for inclusion were: (1) be at least 65 years old, (2) speak English; and (3) be able to live independently[3]. I conducted in-person one-on-one surveys in institutionalized buildings (including retirement communities and subsidized housings) and non-institutionalized ones. Each survey took about 20-30 minutes examining socioeconomic, travel behaviour, and travel attitudes of older adults. The University of Wisconsin Milwaukee Institutional Review Board has reviewed and approved the survey questions.

To investigate different factors influencing older adults' intention to renew their driver's license I defined the dependent binary variable for whether the individual plans to renew the license (Yes) or does not plan/is hesitant about doing it (No/Not Sure). Moreover, the independent variables covered two main areas including the participants' socioeconomic characteristics and their travel behaviour and attitude. Socioeconomic characteristics include gender, age group, physical disability, highest education level, income group and whether living alone. The travel behaviour and attitude category include driving frequency and whether or not the participant agreed with the statement: "I would like to be able to drive to destinations easily."

[3] This study excludes older adults whose physical or mental limitations prevent them from performing daily activities independently.

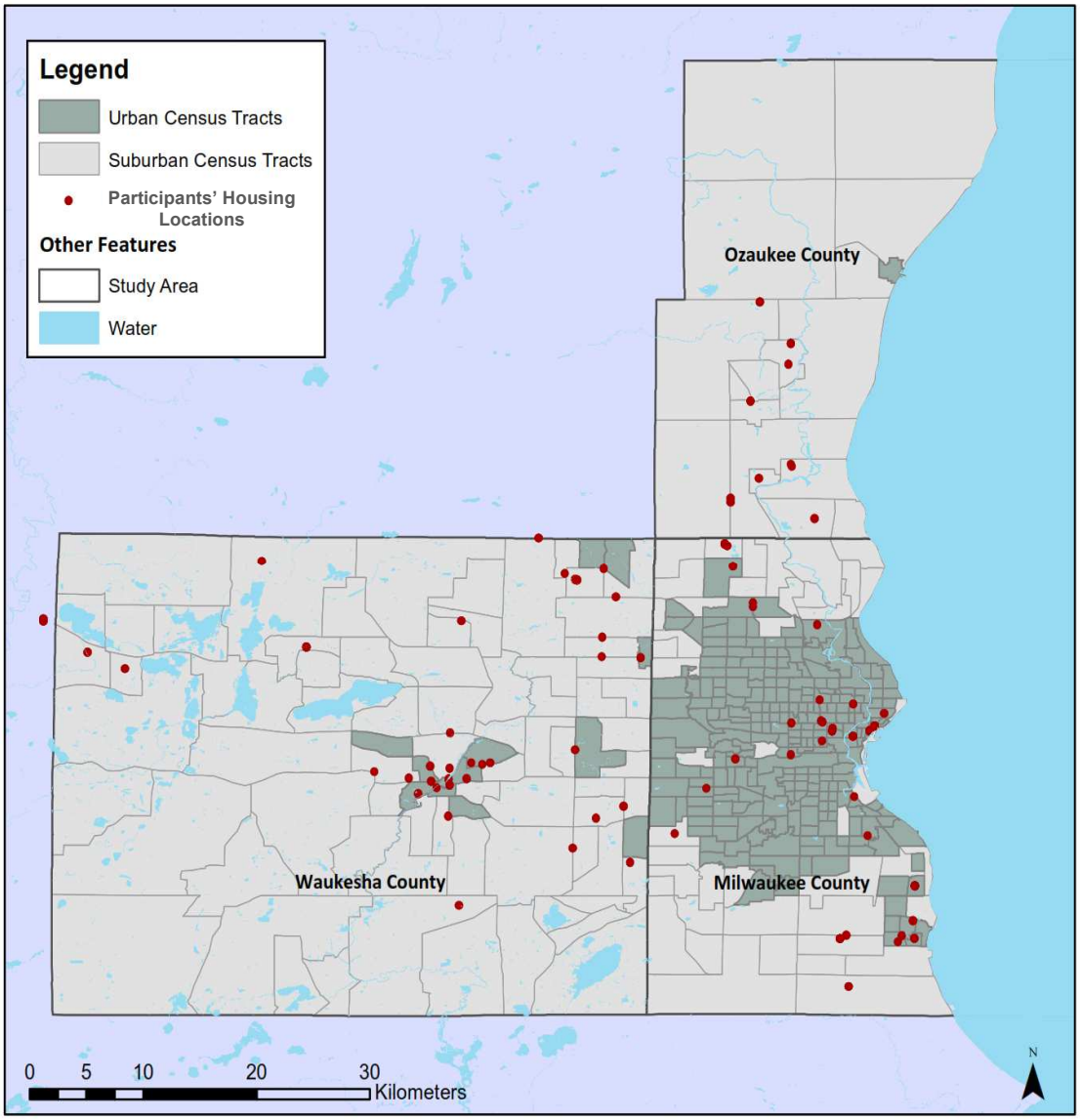

Figure 10 Location of study participants' housings in urban and suburban census tracts

5.2.2 Quantitative Method

5.2.2.1 Binary Logistic Regression Model

Logistic regression is a method to study the impact of a set of predictors on a categorical dependent variable (Pallant, 2010). In binary logistic regression, the dependent variable is dichotomous (i.e., with only two categories or values), while the independent variables could be a combination of

continuous and categorical or binary variables (Pallant, 2010). Given the observed values of the predictor variables, the binary logistic regression predicts the probability of presence and absence of the dependent variable (Ozdemir, 2011).

In this study, I use the binary logistic model to find the best model describing the relationship between the dichotomous coded variable (i.e., whether the licensed older adults want to renew their driver's license or do not want/are not sure about it) and various socioeconomic and travel-related factors.

5.2.2.2 Application of the Binary Logit Model

This study focuses on the intention of older adults to renew their driver's license. To address this goal, I removed 62 records in which the participant did not have a valid driver's license at the study time, which resulted in a final sample of 116 records.

Due to the small sample size, I had some categorical predictors with limited numbers in each category. In order to fit a better model, I converted all predictors to dichotomous variables. I also did not detect multicollinearity and outlier problems in the dataset. I first fitted binary models with all of the socioeconomic variables and travel attitudes of participants toward different travel modes (statements). However, due to the small sample size, I was unable to obtain optimized models with a large number of predictors. Variables such as race/ethnicity, type of accommodation (rent/own) and household car ownership did not improve the model fit. The final model included 1 numeric and 7 categorical variables.

5.2.3 Qualitative Method

5.2.3.1 Synthesis and Finding Common Themes

The purpose of the open-ended questions in the survey was to explore older adults' reasons for deciding whether or not to renew their driver's licenses. In addition, among older adults who

were no longer driving at the time of the survey, I explored the reasons why they stopped driving. Before I began the survey, I asked the participants if they agreed to have the interview recorded. I transcribed the responses to the two open-ended questions and categorized the responses by examining each of them in detail to find a theme/code. After this preliminary stage, I reviewed the themes and combined some of the codes that were related to form more comprehensive categories. On the other hand, I categorized some of the themes that seemed dissimilar into subcategories. After determining the final themes, I made a final check to see if all the core themes that explained all the responses were identified.

5.3 Data Analysis and Results

5.3.1 Descriptive Statistics

5.3.1.1 Characteristics of participants

Among 116 study participants 38% were men and 62% were women. A comparison of socioeconomic characteristics between men and women shows that the share of these features was almost the same in these groups. In total, well over three quarters of participants were white (Caucasian), and almost two times of study participants were well-educated (more than high school), who lived alone and did not have any physical disability. Also, a significant majority of participants indicated household car ownership (Table 10). Participants got their driver's license within the age range of 14-37 years with the mean of 17.85.

	Males (n=44)	Females (n=72)	Entire Sample (n=116)
Age Group			
65-74	52.3	58.3	56
75+	47.7	41.7	44
Race			
White (Caucasian)	72.7	84.7	80.2
Black/African-American	27.3	15.3	19.8
Type of Accommodation			
Own	34.1	47.2	42.2
Rent	65.9	52.8	57.8
Annual Household Income			
≤ 24,999	47.7	48.6	48.3
> 25,000	52.3	51.4	51.7
Highest Education Level			
High School or less	31.8	34.7	33.6
More than High School	68.2	65.3	66.4
Physical Disability			
No	59.1	62.5	61.2
Yes	40.9	37.5	38.8
Living Alone			
No	43.2	30.6	35.3
Yes	56.8	69.4	64.7
Car Ownership (Household)			
No	29.5	16.7	21.6
Yes	70.5	83.3	78.4

Table 10 Socioeconomic Variables: Percentage of respondents with specific characteristics by gender

Notes: OR =odds ratio; CI = confidence interval.

5.3.2 Results of the Binary Logit Model

I developed a binary logistic regression model with a 95% confidence interval to assess the effects of a number of factors on the likelihood that study participants would renew their driver's licenses after expiration.

The results of the model indicates that intention to renew driver's license has statistically significant relationships with socioeconomic and travel-related characteristics and attitudes (Table 11).

Predictor	Adj. OR	95% CI	p-value[1]
Gender (Male)	0.763	0.192-3.027	0.701
Age Group (≥75)	0.196	0.041-0.937	0.041**

Physical Disability (Yes)	0.151	0.028-0.811	0.028**
Highest Education Level (High school or less)	0.219	0.046-1.034	0.055*
Income Group (≤$25,000 a year)	3.887	0.646-23.403	0.138
No. of People Living with the Participant	0.938	0.253-3.471	0.924
Driving Frequency (at least several times a week)	5.406	1.091-26.789	0.039**
Agreement with the statement: "I would like to be able to drive to destinations easily."	5.835	0.974-34.949	0.053*
constant	6.473		0.110

1) Statistically significant at ***<0.01, **<0.05, *<0.1

Table 11 Predictors of responding "Yes", or "No/Not Sure" regrading intent to renew driver's license, according to Binary Regression Model

In terms of socioeconomic characteristics, as expected, being in the older age group (75 years old or above) and having physical disability show a highly significant negative relationship with the intention to renew driver's license. Interestingly, lower education level (high school or less) has a negative association with people's intention for driver's license renewal. The results indicates that high-educated older adults are slightly more likely (0.2 times) to renew their driver's license than lower-educated ones, controlling for all other factors in the model. The model was neutral with respect to socioeconomic characteristics including gender, income group and number of people living with participant.

The model indicates that older adults who drive several times a week or everyday are significantly more likely (about 5.5 times) to renew their driver's license than people who drive less controlling for other factors in the model. As expected, the participants who agreed that they would like to drive to destinations easily have about 6 times the odds of planning to renew their driver's license compared to the people who disagreed/were neutral to this statement.

5.3.3 Result of the Qualitative Analysis

Overall, 87% of participants (n=101) intended to renew their driver's license after expiration. While 85 of these people were still driving (Group 1), 16 participants had stopped driving at the time

of interview (Group 3). Also, 13% of participants (n=15) did not intend to renew their driver's license or were not certain if they would do that. 8 of these people were still driving (Group 2), however, the 7 remaining had stopped driving (Group 4). Figure 11 categorizes these four groups and the reasons they pointed to with regard to their decision. I should note that some respondents gave more than one reason for their intention so the sum of reasons does not necessarily equal the number of participants in each group.

5.3.3.1 Certainty to Renew the Driver's License (Group 1 and Group 3)

Of the 85 older adults in Group 1, the most common reason for wanting to renew their driver's license was to be flexible and retain maximum mobility to go places and events (n=55). This subgroup believed that diving enables them to retain mobile and travel with the purpose of shopping, recreation (e.g., visiting friends, access to park, and lake), and doing volunteer works. Table 12 illustrates some of the quotes older adults gave for this reason. The second most common reason was older adults' positive attitude toward driving (n=30). Twenty-nine of 85 older adults place a high value on driving, believing that driving provides them with independence, freedom, and/or convenience (Table 13).

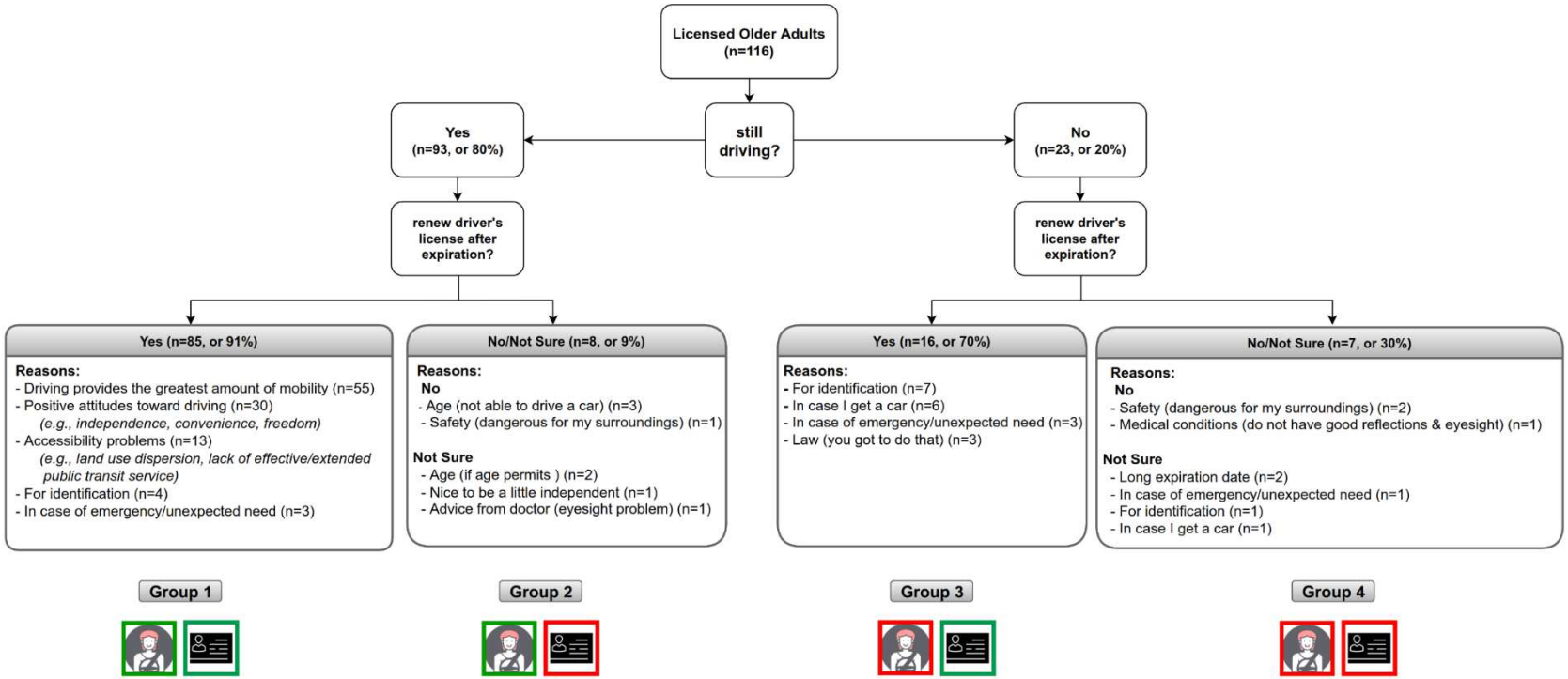

Figure 11 Reasons older adults provided for responding "Yes" or "No/Not sure" regarding intent to renew driver's license after expiration

	Supporting Quotes
Driving provides the greatest amount of mobility	"Oh definitely. So, I can get where I need to go [laughing]. I go a lot of places." (Female, 75 and above)
	"Because I want to keep driving. I have to do my shopping." (Female, 65-74)
	"Yes…I'd like to…even though I don't use it too often but it's handy when I do…for going grocery shopping and stuff." (Female, 75 and above)
	"Yes. Because I need transportation. I need transportation to go to the grocery store, to pharmacy." (Female, 65-74)
	"Yes. It's the…mobility and that...the fact that I can just get out and either go to a grocery store, or go see friends, go do my volunteer work." (Female, 65-74)

Table 12 Quotes illustrating the reason older adults expressed for renewing their driver's license

	Supporting Quotes
Positive attitudes toward driving	"Yes, mam. too late kick me off the streets because I'm a good driver. I am. I got high scores the last…two years ago and went through the driving test and I got high very scores in the 90s so I'm not giving it up. Aha!" (Female, 75 and above)
	"Sure. Because I like to go when I wanna go. I don't want someone to have to take me. I don't want someone to have to wait for me. I don't want someone to...you know, I don't have to pay somebody. I take care of myself. I can still pay for a car. You know cars are expensive, but I can still pay for gas, and pay for insurance...and…I guess when I'm not able to...you know...I'm still able to." (Female, 65-74)
	"Just…so that we can go to other places to get…I don't have to rely on somebody to pick me up and take me anywhere, and I have that independence a little bit to go someplace or do something." (Male, 65-74)
	"Yes. Because don't ever take my driver's license away from me...independence! [laughing]" (Female, 65-74)
	"Yes. to keep driving...the convenience." (Male, 75 and above)

Table 13 Quotes illustrating the reason older adults expressed for renewing their driver's license

Accessibility problems were the third main theme older adults in Group 1 raised regarding their decision to renew their license (n=13). This subgroup pointed to the problem of urban sprawl (i.e., dispersed urban development with low-density and segregated land use) and lack of extended and/or effective public transit system as the main reason behind their decision (Table 14)

	Supporting Quotes
Accessibility problem	"Mm-hmm, if I can.…I'm a 2-time cancer survivor and I just got through the treatment for the last cancer and I spent 42 trips down to Froedtert for radiation. Now, you tell me where the bus here to Froedtert… ."(Male, 65-74)
	"Yes. For mobility...Mequon doesn't have bus service per se and...so you really have to have a car in Mequon I think to get around, to get to the store, to get any place." (Female, 65-74)
	"Yes, I do. well, because I get a lot of places to go, I need to drive. I have to. Because I volunteer…if I don't drive, I can't do any of my volunteering…I also do Meals on Wheels and work at the library…yes I have to drive." (Female, 65-74)
	"Yes. Because where we live, I will still need to drive. I do not have public transportation here or not really able to walk anywhere...so I will need to continue to drive...when I can't drive, we have to leave this house." (Male, 65-74)
	"Oh sure. yes. Because I guess we have to drive around here. There's no public transportation in this area…except well, there's but it's…it's a little inconvenient." (Male, 75 and above)
	"Yes. Well, we do not have stores…churches…libraries and other things...if we [live] without a car, we're in the country." (Male, 75 and above)

Table 14 Quotes illustrating the reason older adults expressed for renewing their driver's license

Using the driver's license as an ID card was the first common reason that both Group 1 (n=4) and Group 3 (n=7) raised for their intention to renew their driver's license. Interestingly, this is the first and foremost reason people in Group 3 stated as their purpose of driver's license renewal. Some of the reasons participants gave for renewing their driver's license as an ID included using it for paperwork, voting, and purchasing specific over-the-counter medications (Table 15).

	Supporting Quotes
For Identification	"I wanna keep driving as long as I can… and it's a good ID to have with you because it's all picture, picture, picture you know… so…. ." (Group 1, Female, 65-74)
	"Yes, I will renew my license...I wanna maintain my driver's license and also...not only that but …they put other things on your driver's license now, like my fishing license is on my driver's license now also…my hunting license is on my driver's license now, too. Okay, so when you have your driver's license…they attach other things to your driver's license to avoid other paperwork." (Group 1, Male, 65-74)
	"Just use it for ID. That's all I change it to it. Yes. Just for the ID." (Group 3, Male, 75 and above)
	"Yea, because it's a very good form of identification. That's the thing about it." (Group 3, Female, 75 and above)

Table 15 Quotes illustrating the reason older adults expressed for renewing their driver's license

In case of emergency/unexpected need was the second common theme that both groups pointed to. While this reason was the least frequent reason people in Group 1 raised (about 3%), about one-fifth of people in Group 3 pointed to it. It is interesting that while people in Group 3 were not driving, they thought having a driver's license enables them to meet their mobility needs when something unpredicted comes up (Table 16).

	Supporting Quotes
In case of emergency/Unexpected need	"Of course, because you never know when you might need it… ." (Group 1, Female, 65-74)
	"Yea…because there's things that I do when I don't... I go by myself...like that my husband's not along and then in emergency...then I would have to drive. I've already had to take my husband once to the emergency room so...and my independence...you know... ." (Group 1, Female, 75 and above)
	"All the time…for the identification purposes and if I ever need it to drive… you know in case that I have to go and be somewhere, where I need it, I have it…they needed me to drive so I could you know…somebody's sick, somebody's drunk somebody is…you know… ." (Group 3, Male, 65-74)
	"Yea, I do… In case, one of my children… I watch my grandkids; they leave me a car then I need license to drive it...that's why I keep it." (Group 3, Female, 65-74)

Table 16 Quotes illustrating the reason older adults expressed for renewing their driver's license

The third most common reason, given only by those in group 3, was to renew their driver's license because they might/hoped to get a car in the future (Table 17). I should note that the reason this subgroup decided to stop driving was medical conditions, car affordability and crash involvement. Later in this chapter I will discuss the reasons ex-drivers (Group 3 and 4) stopped driving in detail.

	Supporting Quotes
In case I get a car	"Yea. just in case I decide to buy a car [laughing]." (Male, 65-74)
	"I do this all the time. I don't let it expire. I keep getting it renewed…I wanna keep it because I'm hoping that I'd be able to get another car. I can drive. I just don't have a car. I need transportation to get around till I get the car." (Female, 65-74)
	"Oh, yes. well...because I hope to be driving at that time." (Male, 75 and above)
	"I renew it. Yea...but that's my ID, too. But then when I get a car, I will need it to drive [laughing]" (Male, 65-74)

Table 17 Quotes illustrating the reason older adults expressed for renewing their driver's license

Only 3 of 16 participants said they had to renew their driver's license because it was required by law (Table 18). It is interesting that some older adults believe that it is required to renew their driver's license when it expires. This could also indicate that they believe they could drive again in the future, as two of them stopped driving for financial reasons and one stopped driving because his doctor told him not to until he changes his stick-shift car to an automatic.

	Supporting Quotes
	"Because it's the law, yea, you got to do that. Every time it expires you gotta go back and renew it." (Female, 65-74)

Law (you got to do that)	"You got to. [It] would be no good." (Male, 65-74)

Table 18 Quotes illustrating the reason older adults expressed for renewing their driver's license

5.3.3.2 Certainty/Hesitation not to Renew the Driver's License (Group 2 and Group 4)

Age, safety, and medical condition were among the reasons respondents in groups 2 and 4 gave for their intention not to renew their driver's licenses. It is important to note that these reasons are interrelated in many ways as advancing age can be the cause of medical conditions and functional limitations and that might lead to unsafe driving. Interestingly, the people who brought up the safety reason were concerned not about themselves but their surroundings (Table 19).

	Supporting Quotes
Age/ Safety/ Medical Conditions	"I don't think so...because I think I would not be able to drive after that." (Group 2, Female, 75 and above)
	"Well, I haven't had to face that because it's 2024 and so by then…no I wouldn't renew and I shouldn't be driving that long anyway. I can tell that it's getting more challenging not for me but for my surroundings…even if I live that long I wouldn't…no." (Group 2, Female, 75 and above)
	"No, when it expires then it's done. I miss it very very much but I don't drive because I'm dangerous. That's how I feel. I'm dangerous. That's true." (Group 4, Female, 75 and above)
	"No, I don't wanna drive anymore. My reflections aren't as good. My eyesight isn't as good." (Group 4, Female, 75 and above)
	"I want to get rid of it…because I'm not a safe driver the way I'm getting around." (Group 4, Female, 65-74)

Table 19 Quotes illustrating the reasons why older adults do not renew or are not sure to renew their driver's licenses

About half of the participants in each of groups 2 and 4 were hesitant about whether they would renew their driver's licenses. Some of them were not sure if they would live that long (age issue) and some indicated that they could not decide at the moment because of the long expiration date (Table 20). Two people in Group 4 (who had already stopped driving) were hesitant about

whether they would be able to get a car or whether an unprecedented situation would arise in the future that would make a driver's license an option. Interestingly, while some hesitant older adults pointed out the benefits a driver's license would offer them (e.g., identification, independence, as an alternative), they were not entirely sure they would do so.

	Supporting Quotes
Age/ Long Expiration Date/ Independence/ In case I get a car	"Well, if I'm alive… it goes for 8 years…you know…I think mine goes until 2025 or something like that." (Group 2, Male, 75 and above (93 yrs. old))
	"I really don't know what I will do…it's good for 7,8 years or something like that…maybe I don't wanna do it …I know people who say… you know one lady here [is] in her 90s. She said I gave myself a present I gave up driving so I would know how to do that…anyway." (Group 2, Male, 75 and above (91 yrs. old))
	"Hmm… probably… I don't need it all that terribly but it's nice to be a little independent." (Group 2, Male, 75 and above (88 yrs. old))
	"I will decide that when I get up to it. Because I renewed it last year. So, it's good for…they give you 8 years, I don't know…You make a decision at that time... I don't see myself going past that much but you never know." (Group 4, Female, 65-74 (72 yrs. old))
	"I'm not sure…I will renew if I afford a car." (Group 4, Male, 75 and above (78 yrs. old))

Table 20 Quotes illustrating the reasons why older adults do not renew or are not sure to renew their driver's licenses

5.3.4 Comparison of Groups in terms of Socioeconomic Status and Urban/Suburban Settings

To get a better idea of the characteristics of the people in each group, I compare these groups based on their socioeconomic characteristics and living environment (Figure 12). Although the majority of participants are in Group 1 and there is an imbalance between Group 1 and the other three groups, it may still be beneficial to understand the differences between these groups in order to develop effective and targeted urban planning strategies for each group.

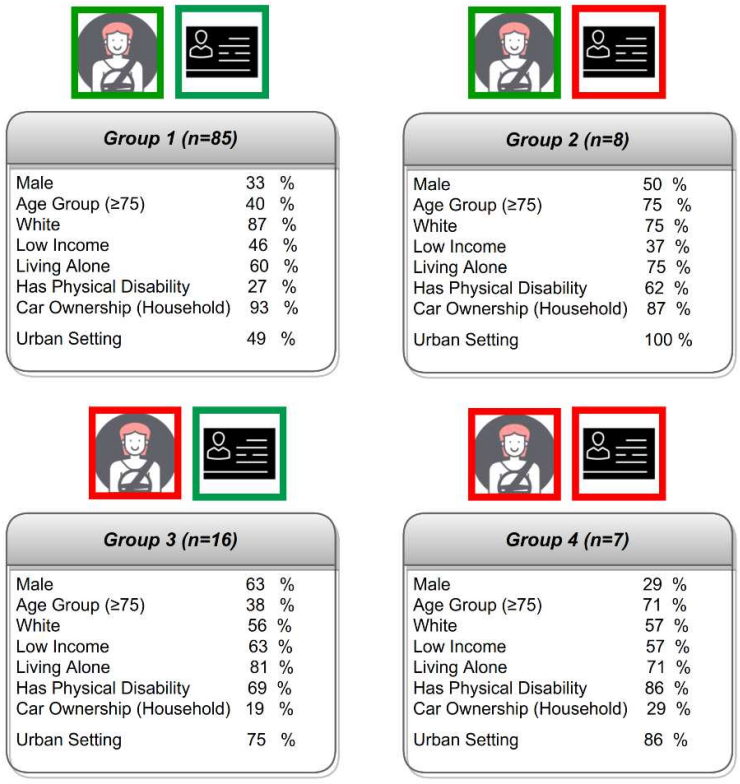

Figure 12 Preliminary comparison of socioeconomic characteristics and urban/ suburban settings of four groups

As expected, those aged 75 and over make up about 40% of the groups who intend to renew their driver's licenses (groups 1 and 3). However, this age group accounts for nearly three-quarters of those in the other two groups who do not intend to renew their driver's licenses or who are hesitant to do so. Interestingly, people who still drive and plan to renew their driver's license have the least physical disability (27%), while those who have stopped driving or do not plan to/are hesitant renewing their driver's license have at least twice as much physical disability.

In addition, more than 85% of those who still drive (groups 1 and 2) own a car in their household. However, in the other two groups who do not drive, this percentage is at least three times lower.

Interestingly, about half of those who still drive and intend to renew their driver's license live in suburban areas. However, only about one in four ex-drivers (Groups 3 and 4) live in suburbs. In addition, all individuals (100%) who still drive but do not intend to renew their driver's license live in urban areas. This suggests that living in suburban areas with low density, dispersed land use, and poor transportation access makes driving and renewing a driver's license a necessity.

5.3.5 Reasons to stop driving

Examining the reasons why older adults stopped driving is important because it could help us better understand the casual factors behind their decision whether to renew their driver's license. Twenty-three participants in this study had stopped driving at the time of the survey, and the average duration was about 5 years. Some of them had given up driving altogether, while others had given up driving primarily because of their financial situation. However, they still hoped that they would have the opportunity to resume driving in the future. In this part of the qualitative analysis, I explore the main issues/reasons that led older adults in Groups 3 and 4 to give up driving (Table 21).

Reason	**n**	**%[1]**
Medical Conditions/Advice from a physician	**11**	**48**
Financial (buying a car and/or pay for maintenance/ insurance/license plate renewal)	**8**	**35**
Not using the car anymore/Not interested to continue driving	**2**	**9**
Traffic/ Change of traffic rules	**2**	**9**
Intervention from a family member	**1**	**4**
Crash involvement	**1**	**4**

1- Note: some participants mentioned more than one reason, so the percentage does not equal 100.

Table 21 Reasons given by older adults for driving cessation (n=23)

The main reason that influenced ex-drivers (Group 3 and 4) to stop driving was health problems. Heart Arrhythmia, Arthritis, and knee replacement were some of the health problems they pointed to (Table 13). A 92-year-old male expressed how his health issue resulted in a crash and made him stop driving:

> "I can't drive, I have chosen not to drive because I have a problem with TIA[4]s, that's many strokes. I don't feel very safe driving at all…a TIA… it's like going to sleep…I mean completely…If I just give you one example it happened to me…I remember being at the exit of Bailey Street [not the real location for confidentiality purposes] and the next thing I knew I had hit the curb on the other side. That was the last time I drove. Well…it happened to me. I had a real stroke."

Financial problems were the second most important reason for not driving among participants. The financial burden of having to afford a car and associated payments such as repairs, insurance, and license plate renewal were the factors some participants mentioned (Table 22). Although the other factors that influenced older adults to stop driving are limited, it is important to explore them further because they provide us with information about whether older adults consciously stop driving or whether uncontrolled situations (e.g., family intervention) lead them to stop driving.

	Supporting Quotes
Medical Conditions	"Well, the reason I stopped driving was that I was already using a walker and I also…I was having some more trouble with the car and because I was having arthritis in the shoulder it's hard to move the steering wheel for me. I know some people drive like this all the time but I wanted to drive properly and not have anything freeze on me. You know when I'm trying to turn a corner or something like that and hit somebody or… so that's why I stopped because of the shoulder problem more than anything else." (Female, 75 and above)
Financial	"Because my car needed too much work and I had to get rid of it…so…too much work that I just couldn't afford." (Female, 75 and above)
	"Because I can't afford a car...you know the plates are like a hundred or something dollars then insurance, all that... I don't…My income wouldn't cover

[4] Transient ischemic attack

	one of those so…It's too much money. I make such a low-income. I can't afford you know like the license plate not every year…so. I didn't get another car." (Female, 65-74)
Not using the car anymore/Not interested to continue driving	"Well…it was…I wasn't using the car much living where I did…living downtown…and…then when I moved here, I wasn't using a car much so I just thought I'd sell it. I sold my car. I always had a car before that…but it's kinda nice not to even think of having a car because you've got have a worthy time and so forth." (Male, 75 and above)
	"It's not because I couldn't drive. I just got no more car. not interested in... I just didn't drive…no interest…no more…no." (Male, 65-74)
Change of traffic rules & Medical Conditions	"Because I was not alert enough and I don't know all the new rules they keep changing on me [laughing]...and I was well aware of that." (Female, 65-74)
Intervention from a family member	*Interviewee*: "My daughter took my car and said I shouldn't be driving." *Interviewer*: "why?" *Interviewee*: "she is...somebody else said that I hit a car but I didn't hit a car. I went off the road cuz they cut a... on the road they cut a hole and they didn't fill it in and then I didn't look at that." *Interviewer*: "and she said you shouldn't drive anymore?" *Interviewee*: "yea, she thought I ran into...and that's what she thought." (Male, 75 and above)

Table 22 Quotes illustrating the reasons for driving cessation among older adults in group 3 and 4

5.4 Discussion

Studies show that older adults are increasingly reliant on cars and that the younger cohort of older adults are less likely to limit or abandon driving compared to their older peers (Siren & Haustein, 2015; Schouten, Wachs, et al., 2022). The ability to drive provides older adults with a sense of freedom and independence, in such a way that their greatest concern regarding cessation of driving was "loss of independence and having to rely on others" (Feng & Meuleners, 2020). The importance of driving for older adults goes beyond being able to get places, as driving gives them an emotional sense of pleasure and enjoyment (Stepney et al., 2018).

While the majority of older adults have to stop driving at some point in their life and it is a "normal life stage" (Ammerman, 2021), this decision incurs significant implications for their quality of life. Although it is not clear to what extent driving cessation affects or is affected by health (Siren & Haustein, 2015), most studies suggest that this decision exacerbates health problems in older adults. This problem is even more critical for those who give up driving without a plan, as they are at higher risk of becoming isolated and developing depression, which leads to morbidity and possibly mortality (Ammerman, 2021). Results from a qualitative secondary study of older adults with neurological conditions such as epilepsy and Parkinson's disease show that driving and being with other drivers gives participants a sense of normalcy behind the wheel (i.e., that they are just like other drivers) and protects them from being judged by others (Stepney et al., 2018).

As the importance of driving cessation is widely recognized in the literature, it is critical to explore the reasons why older adults with driver's licenses decide to renew or not renew their driver's licenses. The present study used a mixed-methods approach to determine the reasons older adults decide whether to renew their driver's licenses after expiration. The quantitative analysis examined the influence of sociodemographic factors, travel behavior, and travel attitudes on the decision. The results of the analysis are largely consistent with the literature showing the negative relationship between age and physical disability and the decision of older adults to renew their driver's licenses. Consistent with previous studies discussed in the literature review, the present study found that older adults with lower levels of education were less likely to renew their driver's licenses (Kulikov, 2010; Marottoli et al., 2000). However, gender, income group, and living alone were not found to be significant predictors of the decision to renew a driver's license in this study.

As expected, the present study found that older adults who drive more frequently and those who have a positive attitude toward driving are more likely to renew their driver's licenses. This finding

suggests that personal driving history and driving habits play a role in people's decision. It is important to note that where people live and their attitudes toward the environment influence their travel behavior. Regarding this, people with an "urban attitude" tend to drive less, whether in urban or suburban areas, than people with a "suburban attitude" (Schouten, Blumenberg, et al., 2022).

The results of the qualitative analysis were largely consistent with the statistical model, which indicated that age and physical disability, as well as the related factor of being dangerous to others, were the main factors that discouraged or made older adults hesitant to renew their driver's licenses. In addition, the most common reasons for deciding to renew their driver's license were the car's ability to provide them with mobility and their positive attitude toward driving, which also confirmed the results of the quantitative analysis.

This study classified older adults with driver's licenses into four groups based on their current driving status (whether they were driving or not at the time of the study) and whether they intend to renew (Yes) or not renew/hesitant to renew (No/Not sure) their driver's licenses. The preliminary comparison of these four groups in terms of urban/suburban residential location and socioeconomic status is of great importance to policy makers and transportation planners. While in the present study, only a small proportion of participants belong to Group 4, i.e., are non-drivers who intend to give up their driver's licenses, they are mostly older age cohorts, with a physical disability, living alone and without a car in the household. This group face unfulfilled mobility needs and considering their transportation problems and barriers and helping them to fulfil their mobility needs calls special attention of policymakers.

We should also note that although the majority of participants belong to group (1), i.e., they are drivers who want to renew their driver's license, they are younger in age (only about 40% are 75 years and older), mostly healthy, and have a car in the household, as they age, they may develop

physical limitations that prevent them from continuing to drive, so they may move to group 3 and eventually to group 4 in the near future.

Policies that prepare older drivers to make this important life decision and provide them with reliable and acceptable alternative modes of transportation are of great importance. In addition, education and training programs that help older adults learn about alternative transportation could help them be better prepared for this normal stage of life. Unfortunately, older adults who have primarily driven cars their entire lives do not feel the need to learn about other modes of transportation, and some do not even know how to use them (e.g., ride-hailing services and public transportation). Policymakers can play an important role by investing in and supporting transportation training programs for older adults. In addition, integrating transportation infrastructure into land use patterns can improve accessibility to destinations for older adults. Developing mixed land use in low-density environments and improving transportation infrastructure can help meet the travel needs of this age group to better address the situation of giving up driving.

This study focused only on older adults who met a specific set of criteria. Future studies could further explore this important topic with older adults in other areas. The small sample size of this study, particularly individuals in groups 3 and 4, may limit the generalizability of the results. While this study was primarily exploratory, future research is needed to examine the reasons older adults make decisions about renewing their driver's licenses in these two groups. Interviews and conducting focus groups could provide valuable insight into their decision. In addition, future studies are needed to conduct a longitudinal analysis to examine how the decision of these groups might change over time.

6 Understanding and Overcoming Barriers to Walking, Bicycling, and Transit Among Older Adults

Abstract

This study examines the barriers older adults face in using modes of transportation besides personal automobiles, such as walking, bicycling, public transportation, and ride-hailing. This study focused specifically on healthy older adults who are able to live independently, are 65 years of age and older, and live either in their own home (non-institutionalized) or institutionalized buildings. I conducted in-depth interviews with 103 adults and used content analysis to code the responses, fitting the codes into an ecological model. Finally, I proposed policy recommendations for short- and long-term actions for policymakers and city officials to overcome these barriers to walking, bicycling, and transit for older adults. The results of this study highlight the importance of four key policy recommendations: (1) implementing transportation education and outreach programs, (2) improving accessibility to services and facilities through land use interventions, (3) improving transportation infrastructure and services, and (4) helping for-profit and nonprofit organizations organize informal groups to walk, bike, or carpool together.

6.1 Background

The population of older adults is increasing substantially in the United States. By 2030, the number of people aged 65 and older will be 72.1 million, more than double the number of older adults in 2000. While older adults accounted for 13.1% of the population in 2010, they are projected to increase to 19.3% of the population) ("A Profile of Older Americans: 2011," 2011). Several studies indicate that driving is the preferred mode of transportation among older adults as it is correlated with freedom, independence, mobility and life satisfaction (Chihuri et al., 2016; Zahoor et

al., 2019; Adler & Rottunda, 2006). However, as older adults age they often decide to limit their driving by changing their driving patterns and habits and many eventually stop driving altogether (Adler & Rottunda, 2006). Research indicates many factors including health decline (e.g., vision changes and slowed reaction time), role of family members and physicians, financial limitations to maintain a private automobile, being concerned to cause injury to others while driving contribute to driving cessation among older adults (Adler & Rottunda, 2006; Choi & DiNitto, 2016; Hansen et al., 2020).

A large number of studies have focused on the negative impacts of driving cessation and how a bidirectional relationship exists between older adults' driving cessation and physical and cognitive impairments. Studies indicate that an association exists between driving cessation and poorer physical and social functioning, social isolation, and an increase risk of mortality (Chihuri et al., 2016; Choi et al., 2014; Hansen et al., 2020). Research found that former drivers were more at risk of accelerated cognitive decline than people who had never driven (Choi et al., 2014). Further, older adults are more likely to experience physical and psychological problems (such as increase in depressive symptoms) (Chihuri et al., 2016; Marottoli et al., 1997) after driving cessation. Yet, the problem that older adults face is not simply losing the ability to drive (i.e., missing the activity of driving, in and of itself). Instead, a core issue is that many older adults experience reduced access to activities. Therefore, some suggest that this problem can be solved, at least in part, by having other good transportation options besides driving and living closer to where activities are located (Rosenbloom, 2009; Peel et al., 2002).

For people who are unable to drive a car, other transportation options include getting a ride from a family member or friend, walking, bicycling, and transit (transit includes public transportation, and community transportation services such as ride-hailing and shared shuttle vans).

However, within many existing transport and land use systems, these alternatives are unlikely to meet the needs of a large group of older adults and serve as a solution/replacement for the lost mobility of older drivers who no longer drive (Rosenbloom, 2009). Studies suggest that driving as a driver/passenger is the preferred mode of transportation among older adults. Older adults often find it a burden to ask a friend/family/neighbor for a ride. In addition, lack of social networks, concerns about the reliability of a ride, communication between the older adult and the driver, and privacy (Payyanadan & Lee, 2018) are among the important challenges that make ride hailing services an unattractive solution. In addition, functional limitations and psychological problems discourage some older adults from walking especially long distances, in bad weather, in dark and unfamiliar places and on unsuitable walking surfaces (e.g., uneven and cracked sidewalks). Moreover, traditional public transit cannot meet the mobility needs of the aging population in the United States. Even when public transportation is accessible, it may not be a suitable transportation mode for older adults for reasons of safety, personal security, flexibility, reliability, and convenience (Rosenbloom, 2009). In addition, other transportation options such as ADA paratransit services have a strict eligibility requirement related to disabilities, so older adults who do not have severe mental or physical limitations cannot use these services. Using community transportation services provided by government agencies, nonprofit organizations, religious groups, and advocates for older adults also have their obstacles. These obstacles include only providing services to selected clients, limiting rides to only specific destinations (such as medical appointments) and offering limited guidance and information on coordination (Van Cauwenberg, de Geus, et al., 2018, 2018).

Therefore, older adults would benefit from having other attractive transportation options besides driving. Given the need to provide alternatives to driving for transportation, I explore the following research question: what barriers do older adults perceive to existing walking, bicycling, and

transit options? Based on the findings, I propose several policy recommendations to overcome these barriers.

6.2 Literature Review

I reviewed the literature on older adults' transportation barriers including barriers to transit (including both public transit and private transit, such as ride hailing) and active travel modes. I conclude the section with several gaps in the literature.

6.2.1 Barriers to Transit

Previous studies have shown that public transit is not a preferred mode of transportation for older adults. Aside from the individual impairments of older adults that may prevent them from using public transportation (Adler & Rottunda, 2006), the characteristics of the system itself also influence whether older adults use it as an acceptable transportation option. The attractiveness of public transportation for older adults depends on accessibility, affordability, availability, and acceptability. If there is an issue within one of these elements, older adults might not be able to use the system regardless of how excellent the other elements are (Shrestha et al., 2017). In terms of accessibility, the design, and attributes of the bus (for example stepless entrances and wheelchair space), the location and characteristics of bus stops, and route to the bus stop (e.g., its safety and maintenance) are among the important factors that might deter older adults from using the bus. A study by Sun and Lau (2021) investigated older adults' perspectives on walking paths approaching public transport in Hong Kong. The results indicated that sidewalk barriers (e.g., pavement unevenness, railings between road and pavement), pedestrian crowdedness, prolonged walking and insufficient seat and rest areas along the way to the transit station were among the barriers older adults brought up for public transport use. Affordability is another important barrier as many older adults have limited financial resources to pay for the travel cost (Shrestha et al., 2017; Hyun et al.,

2022). Availability of the transit service is also necessary for this age group in terms of connecting their residences and desired destinations with acceptable timetables and frequencies (Shrestha et al., 2017). Finally, acceptability is an important factor that includes a broad range of barriers including safety, security, attitudes of the bus driver, information (e.g., route information, timetable), and transitioning from driving to using public transit (especially for the people who mostly relied on driving as their main mode of transport) (Shrestha et al., 2017). Some studies even indicate that there is a social stigma associated with public transit among some older adults (Cirella et al., 2019).

Older adults also experience barriers to private transit modes, such as ride hailing. Ride-hailing services can be offered informally (through individuals such as family member/friends) and formally (through organizations and programs). Studies indicate that concerns with offering/requesting a ride, planning/scheduling, uncomfortable situations, safety concerns and privacy are among the important ride hailing challenges older adults face (Bayne et al., 2021; Payyanadan & Lee, 2018). Also, trust is a major barrier discouraging older adults from offering or taking rides with people they did not know (Payyanadan & Lee, 2018). A study of low-income older adults in Dallas, Texas showed that lack of knowledge about ride-hailing options was a predominant concern among older drivers Hyun et al. (2022). Also, lack of familiarity with technology is one of the barriers keeping older adults from using ride-hailing options: one recent study indicated that older adults preferred to schedule ride-hailing services using telephones because they were able to speak with a person who could help answer their questions (Bayne et al., 2021).

6.2.2 Barriers to Active travel modes (Walking and Biking)

Several studies suggest that dispersion of activities within the environment discourage older adults from walking (Alidoust et al., 2018). The results of a study by Gallagher et al (2014) found

that total neighborhood walking was associated with the presence of destinations withing walking distance among women, and higher population density among men (Gallagher et al., 2014).

A study by Alidoust et al. (2018) indicated that older adults walked less in suburban neighborhoods due to safety issues concerning traffic hazards and avoided busy, heavily trafficked roads. Older adults also avoid walking in their neighborhoods due to concerns about traffic safety issues related to unsafe street crossings (e.g. controlled road crossings without audible or tactile signals), high speeds by passing cars, and cyclist-pedestrian-conflicts (Alidoust et al., 2018; Lavery et al., 1996; Strohmeier, 2016). Sidewalk design and providing adequate walking infrastructure is particularly important for older adults, as studies show that sensory and mobility impairments, fatigue, and pain are common among older adults (Cooper et al., 2001), and physical impairments are a barrier to walking within this age group (Dawson et al., 2007). Related to this, inadequate pedestrian infrastructure (such as missing or low-quality pedestrian paths, uneven or hilly sidewalks) could increase risk of falls and injuries. Missing curb ramps, sidewalk obstructions (e.g., poles, signs, poorly-located street furniture), lack of adapted toilets, and steps or stairs with badly designed handrails or no handrails also discouraged older adults from walking (Alidoust et al., 2018; Lavery et al., 1996).

Personal security, including concerns about crime also negatively impacted older adults' perception of neighborhood walkability (Alidoust et al., 2018). A study of 680 older adults in the UK found that being worried to be attacked and having no one to go walking with were among the most commonly reported barriers to walking (Dawson et al., 2007). In addition, older adults were afraid to walk in remote or unfamiliar environments with low pedestrian flow (Sun & Lau, 2021).

Older adults also perceive many barriers to bicycling. Traffic safety concerns (Van Cauwenberg, Clarys, et al., 2018; Van Cauwenberg, de Geus, et al., 2018), inadequate bicycle

infrastructure, road design & maintenance, connectivity, aesthetics, and hilliness were identified as major barriers to bicycling among older adults (Van Cauwenberg, Clarys, et al., 2018). Also, obstacles ranging from lack of strength or balance to fear of exacerbating their health problems or being physically unable to sit, pedal, or steer a regular bicycle discourage older adults from riding standard bicycles (Macarthur et al., 2020). Despite these barriers, some countries have made bicycling more attractive for older adults. For example, some European countries have made bicycling to a safe, convenient and practical way to get around. Studies have found that the share of bicycle trips made by older adults is 30 times higher in Germany and Denmark than in the United States (Pucher & Buehler, 2008).

6.2.3 Literature Gaps

Despite some studies showing mobility barriers faced by older adults when using different modes of transportation, there is still a gap in understanding transportation barriers when older adults limit and eventually stop driving. Notably, existing studies mostly examined mobility barriers in relation to only one or a few modes, such as walking, ride-hailing and paratransit options, or public transportation. Many of the studies were based on a small number of surveys or just focused on a subgroup of older adults (e.g., lower-income). Importantly, few studies attempted to understand the role of various transportation agencies and institutions in facilitating and overcoming these transportation barriers. However, in the qualitative study, I examined the narratives of 103 older adults about their transportation barriers, fitted the study findings into an ecological model, and proposed possible solutions to these barriers.

6.3 Method

6.3.1 Study Area and Participants

To answer the research question, I initially conducted one-on-one surveys with 178 older adults living in Milwaukee County, Waukesha County, and Ozaukee County in Southeastern Wisconsin. This study area includes urban and suburban communities. While Milwaukee County tends to be urban with high population and job densities, Waukesha and Ozaukee counties have suburban areas with low densities and scattered land use growth[5]. People in Milwaukee County can take advantage of extensive bus service, while the other two counties either do not have a transit network (i.e., only shuttle services) or have limited coverage and service.

Between March 2019 and July 2020, I recruited participants from independent living communities (including retirement communities and subsidized housing) and from facilities where older adults gather for activities or events (e.g., dining facilities and senior centers). Individuals who (a) spoke English, (b) were 65 years of age and older, and (c) were physically able to live independently were eligible for the survey. Surveys lasted an average of 20 to 30 minutes, and I recorded interviews if the respondent gave consent. The Institutional Review Board (IRB) at the University of Wisconsin Milwaukee approved the survey questions. For more details on study participant recruitment, see the Method Chapter.

6.3.2 Survey Data

The survey included 31 questions covering topics such as sociodemographic information, current and past travel behavior (in their current and previous residential location), their driving status (i.e., status of driver's license, the frequency of driving, intention to renew the driver's license), and

[5] For more information about how this study defines urban versus suburban environments refer to the Method Chapter.

travel to grocery stores. The key question used for this study was open-ended and presented near the end of the survey. It asked respondents if they had any transportation issues or suggestions they would like to share. Approximately 58% of the study participants (n=103) responded to this question. All of these participants gave us permission to be audio recorded when stating their response.

6.3.3 Theoretical framework

Ecological models consist of different layers that represent the multi-level interventions that target individuals, the social environment, the physical environment, and policy (Sallis et al., 2006). While ecological models have evolved and different representations of the conceptual levels have been proposed, I build the model based on the model presented by Rigolon et al. (2019) because this model fits the data well. The inner and outer layers of the proposed ecological model are bi-directionally connected with each other. So, the policy environment in the outer layer can affect individual perceptions and preferences, but also the individual perception and preferences could influence and shape policies at a broader scale.

6.3.4 Content Analysis

In this study, I first hand-transcribed respondents' quotes and then conducted a content analysis to identify themes that emerged in study participants' responses (Harwood & Garry, 2003), and finally counted the number of participants who mentioned each theme (Cope, 2010). This content analysis is summarized in Figure 13. The phases of the analysis included identifying initial themes from participants' responses and then searching for overarching themes by aggregating the themes. To find the initial themes, I was guided by the ecological model presented by Rigolon et al. (2019). This model fit the qualitative data very well; however, there were cases where a theme could fit two layers of the ecological model. In these cases, I assigned the theme to the layer that fit better.

6.4 Results

This section summarizes barriers to walking, bicycling, and public transit expressed by survey participants. It is organized according to the layers of the conceptual model.

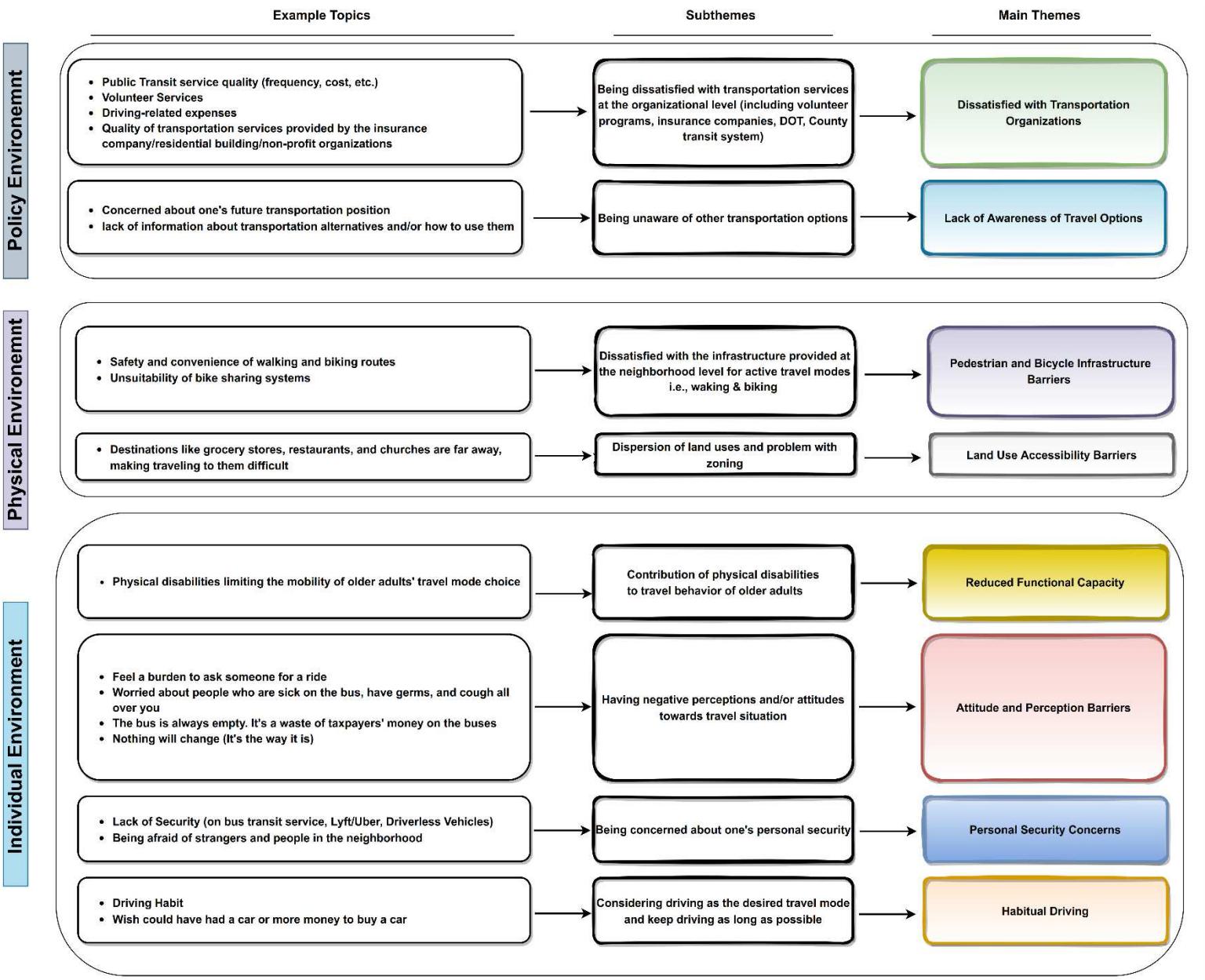

Figure 13 Coding structure to aggregate and group themes/codes together based on their conceptual links and similarities

The ecological model consists of three main layers: (a) Individual (Perceived-Social environments), (b) Physical Environment, and (c) Policy Environment. The individual layer (e.g., income level, age group, gender, physical disability) includes both older adults' perceptions of the environment (i.e., perceived environment) and their interactions with others in these settings (i.e., social environment) (Rigolon et al., 2019).

Table 23 presents the sociodemographic characteristics of study participants who brought up each theme. Note that some individuals mentioned multiple topics, so the total frequency of topics does not reflect the total number of participants. Analyzing this table indicates that the policy environment was mentioned most often, followed by the individual environment and physical environment.

	Theme	n	Male	Urban	Age group (65-74)
Policy Environment	Dissatisfied with Transportation Organizations	45	41%	78%	66%
	Travel Options Unawareness	13	31%	62%	69%
Physical Environment	Pedestrian/Cyclist Dissatisfaction	7	43%	100%	57%
	Land use/Proximity Barrier	4	0%	50%	50%
Individual Environment	Reduced Functional Capacity	3	23%	67%	67%
	Attitude/Perception Barrier	15	33%	53%	47%
	Personal Security Concerns	7	0%	100%	86%
	Tendency to Drive	14	46%	46%	71%

Table 23 Sociodemographic characteristics of participants who mentioned each theme

6.4.1 Policy Environment

6.4.1.1 Theme1: Dissatisfied with Transportation Organizations

People in this group expressed dissatisfaction with transportation services provided by (a) public, (b) private, (c) non-profit organizations or (d) in general.

Various studies promoted the idea of A's regarding public transport need of older adults. In this study, I will build upon 4 A's, as issues an ideal public transport system might have, including Accessibility, Affordability, Availability, and Acceptability (Shrestha et al., 2017) and I expand it to issues of services provided by all types of organizations. Table 24 presents the issues that the study participants brought up related to each organization.

Theme	Organization Type	Organization	Issue	Subthemes
Theme 1	Public Organizations	Public transit providers (Bus service)	Availability	• Cuts to bus service in the city (n=1) • Lack of bus transit (route coverage) between counties (n=1) • Route coverage within the county (n=2) • Frequency of bus service (n=4) • Number of bus stops (n=1)
			Affordability	• Cost of transport for older adults (n=4)
			Accessibility	• Bringing the shopping cart on the bus (n=1) • Distance from the bus stop to the destination (n=1)
			Acceptability	• Concerns about the behavior of the bus driver (n=2)

		Department of Motor Vehicles (DMV)	Affordability	• Fees associated with driving an automobile including license plates, insurance, etc. (n=2)
		Department of Transportation (DOT)	Availability	• Lack of consideration of the mobility needs of older adults who do not drive in the county (n=1)
		Department of Public Works (DPW)	Acceptability	• Designs of streets need reconsideration (n=1)
	Private Organizations	**Shuttle Service provided by Insurance Companies**	Availability	• Scheduling problems (n=2) • Long waiting times/ do not show up (n=2) • Lack of trust in older adults if they cannot use the bus to visit the doctor (n=1) • Inadequate (n=1)
			Acceptability	• Unreliable (n=1)
		Uber/Lyft	Affordability	• Cost of Uber/Lyft for older adults (n=2)
		Bus/Van of the building	Accessibility	• Does not have a chair lift (n=2)
	Non-profit Organizations	**Non-profit organizations (Volunteer shared-ride services)**	Accessibility	• Scheduling problems/ time slots (n=2)
			Availability	• Shortage of volunteer drivers (n=1) • Schedule problem (not working on specific days) (n=1)
			Affordability	• The fee associated with shared ride services in Ozaukee County (n=1)
			Acceptability	• Less convenience (n=1)

	General	**General**	Availability	• Not enough people to volunteer/no rides for older adults to provide them transportation to their doctors' appointments, lunch, and grocery shopping (n=3) • Lack of transportation options to take older adults to activities (n=2)

Table 24 Categorizing older adults' points of view on transportation services provided by different organizations

6.4.1.2 Theme 2: Lack of Awareness of Travel Options

This theme included participants who did not know what transportation options were available to them and/or did not know how to use a particular mode of transportation. For example, various companies (e.g., non-profit and private companies) have provided different ride-hailing services in recent years. However, the lack of information about these options led the older adult participants to not use these services.

This concern was reflected by two participants who stated that:

"More information about the Transit Plus…I need to get more information about …do I qualify or what?"
(Male, 65-74)

"No, I just need more information about what's available and the procedures."
(Male, 75 and above)

Noticeably, most respondents in this group indicated that they did not know much about the public bus, either about how to use it, the coverage of bus routes, or the location of bus stops.

"…I have no idea what to do on the buses. I don't know how to ride a bus; I don't know how to get on a bus...it takes me a while to figure out how it works. Very few people in this building take the bus."
(Male, 65-74)

In addition, some respondents expressed more general concerns about their future transportation if they were no longer able to drive. One 75+ year old man mentioned that while he does not have transportation issues right now, if the situation changes and he is no longer able to drive, he is not sure what transportation options are available to him other than Uber or Lyft.

"Not at the present time. But if ever became sick, you know unable to drive, it wouldn't be easy finding transportation around here. it really wouldn't. I have to call for a cab or Uber or Lyft or something which [I] haven't done [laughing]." (Male, 75 and above)

6.4.2 Physical Environment

6.4.2.1 Theme 3: Pedestrian and Bicycle Infrastructure Barriers

This group consists of individuals who addressed barriers to walking (n=3) and biking (n=4). Interestingly, all individuals in this group lived in urban environments. This finding is in line with the literature showing that living in urban environments contributes to more walking and biking than suburban environments (Næss, 2005; Næss & Jensen, 2002; Chen & McKnight, 2007). Some participants discussed sidewalk maintenance issues and the problem of icy and snowy sidewalks interfering with their walking as a means of transportation. One old man in a wheelchair asked that someone come and clear the snow on the walkway from his home to the private bus service he used. "*I would like to pay a young boy or a young girl that come to our house anytime we get quite a bit of snow…because I need to go to places, I need to go from the house to the bus.*" The problem of walking in inclement weather may be considered a non-modifiable environmental factor (Van Cauwenberg, Clarys, et al., 2018), as suggested by one participant.

Cycling infrastructure and road design and maintenance were two important factors that emerged from the interviews. These two factors which influence traffic safety are found to be critical issues for older adults' mobility in other studies (Van Cauwenberg, Clarys, et al., 2018; Yen et al., 2014). An older male stated how essential it is to have designated cycling space for older adults in one-way roads, and lack of these spaces made him to use sidewalks which are discouraged for cycling. In addition to citing uneven sidewalk surfaces, this respondent stated, *"They got too many one-way streets you wanna go there, oh the hell!"*

6.4.2.2 Theme 4: Land Use Accessibility Barriers

Only 4 respondents, all women, two of whom live in urban areas, expressed concerns about accessibility to destinations. All of these individuals still drove and emphasized the need to drive due to the spatial dispersion of land use activities. However, one woman over the age of 74 indicated that she was reluctant to drive to these destinations because of the spatial dispersion of activities, unless someone offered her a ride.

"Yea, there is probably places I'd like to go but it's further than what I like to drive so I don't go unless that somebody wants to take me… you know if they're going, they take me."

Some older adults desire a car because it fulfils their unmet travel needs. In this regard, two participants mentioned that the lack of accessibility to their destinations, makes driving a necessity rather than a choice:

"I could get a better car. I wanna a new one...It does make a difference when you're living out here. Because you have so far to go to anything and...you have to drive. You can't go anywhere without driving here." (Female, 65-74)

"I'd rather not have to drive so much but you know I'm kinda used to it...Because we are further out so it takes longer to get to everything. whereas in Fox Point you know it's closer to downtown, closer to Bayshore shopping or just to say...and now we have to drive a lot further to get to things." (Female, 65-74)

6.4.3 Individual Environment

The individual factors in the ecological model include demographic status (e.g., age group, gender, race, income group), family situation, and abilities.

6.4.3.1 Theme 5: Reduced Functional Capacity

The main theme based on the data that is most consistent with the individual level is Reduced Functional Capacity. Only three individuals indicated that their physical disabilities prevented them from taking trips in the community. The reason for the small number of individuals

in this group may be that I recruited only healthy older adults in this study whose physical disabilities do not prevent them from living independently. Participants in this group cited their functional disability as the main reason for limiting their mobility in the community:

"No, … I just want to grab my bike...be able to grab my bike." (Male, 65-74)

This finding is consistent with studies showing that although participants somewhat accepted that decline in functional capacity is common with age, this fact was a barrier to their occupational performance (Hovbrandt et al., 2007). However, studies show that it is the interaction between physical disabilities and the physical environment that leads to mobility disability. Sometimes the challenges of the environment reduce the willingness of older people to engage with the physical environment and can affect the mobility of this group in the community (Shumway-Cook et al., 2003; Hovbrandt et al., 2007).

"I guess mostly I'm unhappy that I can't physically do more because of my medical problem. I would like to be able to deal more but it stops me. I do as much as I can though." (Female, 65-74)

Some participants expressed concern about using regular bicycles. One elderly woman said she was afraid of riding a bike because she had fallen off once and never tried again. She suggested that scooters and rollerblades be made available to her. This concern was also reflected by another woman who said that because of balance and standing issues, it would be beneficial to provide tricycles in the local bikeshare system. She also mentioned that she wanted to purchase an electric bike but declined because of the cost.

"These bikes racks that they have around the city and scooter things…You're gonna be able to stand up and you gotta be able to balance and people need like a tricycle kind of a bike, so that there's a back-end for the senior. Cause your balance is imperfect. You need some 3-wheel bikes in some of those racks."

6.4.3.2 Theme 6: Attitude and Perception Barriers

Some people's attitudes toward particular types of transportation prevent them from taking advantage of certain options. One of the subthemes in this category is people who find it a burden or even hate asking someone for a ride. One respondent mentioned that this is part of the American culture and people find it difficult to ask someone for a ride, but if someone offers her a ride, she could easily accept it. Another respondent said that since it is hard for people to stop by on Sundays and give her a ride to the church, the pastor does come to her house, though she misses going to the church. On the other hand, a female guessed that it is other people who are hesitant to give them a ride due to their insurance coverage.

"Sometimes these people are driving…people are hesitant to take you with their car...a different thought about it because I took…I always drove people, but I guess people some people if their insurance doesn't cover somebody, that could be a factor, I guess. So, they are some people who I do mention driving but I guess for insurance purposes they're not always willing to take you.... So that's how it is."

Another noteworthy sub-theme in this category was people who have a stigma toward bus transportation, and did not consider it as an acceptable alternative travel mode (Shrestha et al., 2017). Older adults' fear of other people on the bus, the presence of kids on the bus, the attitude that low-income people take the bus, being anxious that they might be contacted by sick, infectious people who might have viruses or bed bugs were among the examples mentioned by participants. Moreover, some people in this category said that the investment in bus service is a waste of money. One person said that, in her husband's opinion, the authorities could buy everyone a car instead of putting so much money into improving the bus system.

"I don't like to be close to anybody. Then I also have to worry about people who are sick on the bus, and they cough all over you. They have germs. You never know… When you get on the bus you gotta be able to deal with all the people on the bus. Sometimes they're people that where you have to be worried about cause I'm scared. I think they're gonna hit me over the hair or throw me down or whatever…."

The final sub-theme was one participant's attitude toward the travel behavior of other older adults. This participant, who worked at a senior center, said that some older adults have become accustomed to using the free rides provided by the centers rather than trying to travel by foot or public transportation.

"…I have a physical fitness center, but nobody goes.… I don't know why they don't go. I'm just saying if they did, they probably could walk. They probably could use the bus. They probably could...but again they don't want to…They want...I mean I know because they tell me at the window what they want...get me this ride, get me that ride, get me here, get me there…."

6.4.3.3 Theme 7: Personal Security Concerns

This group included seven women, all of whom lived in urban areas. Most of the participants raised the problem of personal security with regard to using the public bus. Those who were afraid to use the bus spoke of crimes such as robbery and physical assault, as well as fear of crime while waiting at the bus stop.

Only one respondent addressed the problem of feeling insecure while using other modes of transportation such as ride-hailing and driverless cars. She raised the issue of gun crime that she had heard about in the news, and also stated that she was afraid of using driverless cars in the future because she might be attacked in a car that she felt could not controlled by a human.

"I'm scared of Lyft and Uber. After I was hearing in the news that Uber drivers shooting people ... I'm like nooo…and now they're gonna bring out cars that don't have a driver, I'm like Stop Insanity! That's insane! cause that car [has] nowhere to go and when to stop and when if a malfunction, then you're going to really have a mess."

This supports a previous research finding that older adults feel more insecure and vulnerable compared with younger age groups in public areas (Mollenkopf et al., 2004; Chaudhury et al., 2012). A female stated that since she is afraid of strangers she does not go out of her residential building.

6.4.3.4 Theme 8: Habitual Driving

People in this group expressed their preference to drive rather than use other modes of transportation. 54% of this group lived in suburbs, while 46% lived in urban settings. Some older adults prefer a mode of transportation over other modes because of the convenience it offers them, but habit also plays an important role in choosing a mode of transportation (Schneider, 2013). Some of the respondents who still drove were happy to do so, and some of those who did not have a car at the time of the survey still expressed a desire to own a car.

It is important to note that while other transportation options might be available in some areas, still some older adults stick to their habit of driving. Two of the male study participants reflected this view in their response:

"No. I wanna keep driving as long as I can."

"I'm a good driver. I've probably driven...I'm not exaggerating I've driven 4 million miles."

While habit is something that is shaped by long-term, prior behaviors, driving habits might also reflect people's unawareness of other transportation options, the built environment surrounding where they live, and their lack of familiarity with technological devices and transportation apps that make them stick to their driving habit.

6.5 Discussion

To the best of the knowledge, this study is the first study to address different barriers to multiple modes of transportation from the perspective of older adults. In this section, I propose short-term and long-term policy recommendations to mitigate concerns with walking, bicycling, and public transportation.

To analyze the in-depth survey data, I conducted content analysis with the aid of ecological model. As this study results indicate, there exist many challenges and barriers in the current

transportation system that prevent older adults from taking advantage of non-driving options. Policymakers and urban practitioners should refer to Table 25 for a summary of strategies to address policy environment, physical environment, and individual environment barriers to walking, bicycling, and using public transportation among older adults. I have organized Table 25 according to the ecological framework. I discuss several of these potential solutions in more detail below.

Layer	Barriers		Potential Solutions
Policy Environment	**Theme 1 Dissatisfied with Transportation Organizations**	**1.Accessibility**	1.1.1. Provision of spaces on the bus for shopping carts * 1.1.2. Wheelchair lift on buses and shuttles (especially the ones giving services to older adults) * 1.1.3. Identifying hotspots with more potential older adults' ride requests * 1.1.4. Advocacy for volunteer ride-hailing options funding and policy * 1.1.5. Designating special signage, roadway signs, intersection markings and signals for older adults that are more comprehensive and help them in navigation* 1.1.6. Improving maintenance of sidewalks and crosswalks to avoid the risk of falling among older age groups
		2.Affordability	1.2.1. Provision of free bus fares for older adults aged 65 and over* 1.2.2. "Transferable and flexible tickets" * (Shrestha et al., 2017) 1.2.3. Providing encouraging plans for older adults to use their discount cards (e.g., if they use their card regularly in one month, they can get a card at a concessionary fares the next months) * 1.2.4. Providing bikes at the bike racks at a discounted rate/free for older adults by the bike sharing programs such as Bublr Bike* 1.2.5. Providing discount and special offers for license renewal and insurance for older

				adults who have modified and reduced their driving frequency *
		3.Availability	1.3.1.	Services connecting residence and senior centers/dining locations to place of interest (e.g., grocery store, & pharmacy (most frequent origin-destination of older adults) and health clinics and hospitals**
			1.3.2.	Better scheduling and more frequent public transit and ride-share services based on demand of older adults*
			1.3.3.	Provide safe, well-lit bus stops with suitable seating and shelters near places of interest to older adults*
			1.3.4.	Increasing/providing services for older adults on specific days including weekends **
			1.3.5.	Providing private shuttle services for seniors (esp. the ones in suburban areas with poor transit services) to seasonal activities such as Summerfest in Milwaukee County **
			1.3.6.	Proving bike racks with tricycles close to the residential location and places of interest for older adults*
			1.3.7.	Organizing encouraging programs with incentives to make more people interested in joining volunteer drivers for older adults*
		4.Acceptability	1.4.1.	Proving educational plans for older adults and informing them of the advantages of active travel modes*
			1.4.2.	Educating students at school about respecting older adults and giving the rights to them on buses*
			1.4.3.	Organizing groups to ride as a companion with older adults on different ride-hailing options and public transit to help them get familiar with other modes and mitigate their stigma using these modes *
			1.4.4.	Educating drivers of the vulnerability of older adults who are bicycling and walking to provide a safer walking and biking environment *
			1.4.5.	Organizing sessions and meetings of city officials with older adults within senior centers and dining facilities so they could

			talk directly to officials about their transportation challenges* 1.4.6. Reevaluate the criteria for eligibility for shuttle services provided by nonprofit organizations and insurance companies to allow, for example, people with less severe physical illnesses to use these services * 1.4.7. Educating drivers of shuttle/van, Uber/Lyft, and public transit services of the way they should treat older adults (e.g., the ones with physical/mental conditions) so they feel comfortable and secure to use these services*
	Theme 2: Lack of Awareness of Travel Options		2.1. Training older adults how to use different transportation services (e.g., bus training classes for people especially never-drivers and ex-drivers who have never used the public transit services) * 2.2. Making older adults aware of different transportation options and their eligibility criteria through media, and leaflets in senior centers, and senior housing* 2.3. Training older adults to use internet and smartphone apps so they can take advantage of ride-hailing services and public transit much easier * 2.4. Organizing training groups by volunteers to visit older adults in their homes and help them use the Internet and become familiar with smartphone apps *
Physical Environment	**Theme 3: Pedestrian and Bicycle Infrastructure Barriers**		3.1. Providing designated low-stress bike routes especially in streets and the routes from older adults' residence and senior centers/dining locations to place of interest (e.g., grocery store, & pharmacy (most frequent origin-destination of older adults) ** 3.2. Improving design and maintenance of sidewalks** 3.3. Snow plowing from routes especially at the locations where older adults live by the Department of public works *
	Theme 4: Land Use Accessibility Barriers		4.1. Urban planners allocate incentives and subsidies for building grocery stores, pharmacies, and recreation spaces (such

		as parks, sports centers) close to the senior centers, and in low density areas* 4.2. Improving street connectivity and Land use mix** 4.3. Allocating subsidies to build more senior housing in mixed-use and high-density areas* 4.4. Allowing older adults to pick up their medications and food at senior facilities and dining facilities (e.g., by organizing groups in these buildings to pick up their medications and provide them at the facilities). * 4.5. Plans and incentives for older adults to encourage them to move from suburban areas to urban environments**
Individual Environment	**Theme 5: Reduced Functional Capacity**	5.1. Prevention and rehabilitation of mobility impairments through therapeutic strategies (Shumway-Cook et al., 2003) ** and individualized physical activity counseling (Rasinaho et al., 2007) 5.2. Public and non-profit investments in providing therapeutic services at senior housings and senior centers ** 5.3. Providing electric bikes and tricycles for older adults at senior housing and bike racks * 5.4. Discounts for older adults to use sport facilities and gyms*
	Theme 6: Attitude and Perception Barriers	6.1. Making older adults aware of different transportation options and the advantages of taking them * 6.2. Allocating Security officers on buses to provide a more secure environment for vulnerable riders including older adults* 6.3. Providing the family/friend of older adults, subsidies for gas and incentives for giving a ride to them* 6.4. Training for family members, friends, and neighbors of older adults to better understand how older people feel when they need to ask for a ride, so they can offer them a ride service 6.5. Provide services through social workers and counselors in senior housing and senior facilities to help older adults with mental health issues (e.g., PTSD and trauma while using transportation and being outdoors). * 6.6. Organizing group walking, cycling and ride-share services

	Theme 7: Personal Security Concerns	7.1. Allocating Security officers on buses to provide a more secure environment for vulnerable riders including older adults* 7.2. Educating older adults about new technological advances such as driverless vehicles through classes, presentations, and seminars*
	Theme 8: Habitual Driving	8.1. Making older adults aware of different transportation options and the advantages of taking them* 8.2. Providing door to door services for older adults through volunteer groups to places of interest (e.g., grocery store, & pharmacy) * 8.3. Making older adults more familiar with technological devices, smartphones, etc. so they can take advantage of apps for ride-hailing options and public transit * 8.4. Developing applications dedicated with specifications for older users that are more older person-compliant such as the ones with visual impairments (e.g., with bigger fonts and less complexity) (Cirella et al., 2019) ** 8.5. Encouraging plans for older adults to move from suburban to urban locations** 8.6. Providng more subsidized housing in dense locations so older adults do not have to live in areas with poor transportation services due to the long waiting lists **

*Lt= Short-term solutions (1-3 years)

**St= Long -term . solutions (More than 3 years)

Table 25 Providing potential solutions to the barriers older adults brought up in using different travel modes

6.5.1 Policy Recommendations

Here, I discuss four important policy recommendations that could potentially make walking, bicycling, and transit options more viable, accessible and attractive choices for older adults.

6.5.1.1 Implement education and training programs to inform older adults of non-driving travel options

The results of this study suggest a need to educate older adults about alternatives to driving. Various organizations and institutions could offer educational courses for older adults at different

locations such as senior homes, senior centers, senior dining sites, hospitals, and clinics. Informative and educational classes led by trained instructors would educate older adults on how to use various transportation options (including public transit, walking, ride-hailing services and bicycling), what resources are available, and where to get information on transportation options. Studies have found that information technology and smartphone use is a major barrier to mobility for older adults (Bayne et al., 2021). Nonprofit and for-profit organizations could train older people to use internet and smartphone apps to help them use ride-hailing and public transportation. Individual rides with friends, family, and other "transportation mentors" (older adults who are paid as helpers) could not only show older adults how to use other transportation options, but also overcome the stigma of using transportation options like public transit and ride hailing services as reflected in the response of one of the study participants:

> *"…the stigma about the bus will change when more people start using it and if, if I'm using it and I have a friend and then we go somewhere together that's how you change it but right now that's the stigma because that's the way it was that poor people used it… in my role as part of the Green Committee I have done bus tours for people here and showed them how they could get out to the zoo because you know the Gold bus goes out to the zoo the Gold bus goes to the...medical complex that people have to go to. People will join my husband and I on a bus down to the PAC but they won't go alone but if we're going, they all go with us and so it's just a matter of...just changing...changing perceptions..."*

These approaches could also reduce older adults' fears and concerns about walking and bicycling and encourage them to use them enthusiastically and even encourage their peers to do so.

6.5.1.2 Adjust land use planning practices to increase accessibility for older adults

Several studies on older adults' travel behavior suggest that living in traditional neighborhoods (Cao et al., 2010), and particularly living in destination-rich neighborhoods (Cerin et al., 2013), closer to the central business district (Fatmi & Habib, 2016), in high population density areas (Kim & Ulfarsson, 2004; Hess, 2012), with high building density (Böcker et al., 2017;

Moniruzzaman et al., 2013; Yang et al., 2018), high street density (D. B. Hess, 2012; Moniruzzaman et al., 2013; Y. Yang et al., 2018), mix of land uses (Böcker et al., 2017; Y. Yang et al., 2018), and shorter distance to services (Böcker et al., 2017) make older adults less likely to drive and more likely to walk and take public transit. In this context, policy makers and municipal authorities should focus on developing neighborhoods with high population densities, mixed land uses, and well-connected facilities. In addition, new multi-story senior centers and senior housing could be developed in compact urban developments as multi-use buildings with residential and commercial uses such as grocery stores, pharmacies, and recreational and sports facilities.

6.5.1.3 Enhance transportation infrastructure and services

Another policy that could be implemented is improving pedestrian, bicycle, and transit infrastructure and services. Walking conditions for older adults can be improved through neighborhood design, such as slower-speed streets, wide sidewalks, and enhanced pedestrian crossing facilities. Study findings point to the important role of the built environment in terms of street connectivity, more bike lanes (physically-separated from vehicle traffic) on major roads and more paved (off-street) bike lanes or routes to facilitate bicycling (Boufous et al., 2021).

Regarding public transit and shuttle services, the results indicate that policy makers should consider improving all A's, including accessibility, affordability, acceptability, and availability. Accessibility of these services should be improved by providing wheelchair lifts and spaces on the bus for shopping carts. In addition, maintaining routes leading to bus/shuttle services and optimizing bus/shuttle schedules could be other potential solutions to make bus/shuttle services more accessible to this age group. Other important policy recommendations resulting from the findings of this study include establishing connecting routes between senior housing and facilities of interest to older adults, and establishing connecting routes between suburban areas with poor transit

service and urban areas. These types of routes may be provided by smaller transit vehicles or on-demand transit rather than fixed-route buses.

While improving infrastructure and services for active travel modes and transit are not limited to these factors, policymakers could implement these important strategies to facilitate and increase non-driving transportation rate among older adults.

6.5.1.4 Support private-sector, non-profit, voluntary vanpool, informal shared ride and group walking and cycling programs

Policymakers can take a useful step toward overcoming some of the transportation barriers older adults face by organizing and coordinating informal groups composed of interested older adults in senior housing. These informal groups could help promote ride-hailing, as shown in the following quotes from a study participant:

> *"I think I can share one of the things we started here is because some people who live here do not have cars. we have...we formed here a men's club and 5 or 6 of the men here who have automobiles have offered that if some people here need a ride to a doctor or need a ride to go pick up a prescription at some place and they have no way up getting there, if they call one of us and if we are available we will take them and pick them up but we started that here by ourselves only we have made a much nicer community to live in and to help people out who don't have a way of getting somewhere. So, the people here know that if they need a ride someplace in case of emergency or doing something or whatever...if they have some place that they need to get to and don't have a ride they can call one of us, and hopefully one of us can help them. So, I think that's a little unusual for a place, a senior place probably not many of them even do that. what we have here is called a resident book which does not include management here and we have that in that book...different people at different things to offer to other residents so we put that in this little book so then people can look at that ...and one of the things that came up was this ride program...but we have a 5-mile radius that we will take them and pick them up and bring them back and that's what they need."*

This concept could also apply to promoting non-driving options, such as walking and bicycling. Previous studies suggest that safety concerns and lack of a companion are the most commonly cited barriers to walking for older adults (Dawson et al., 2007). Therefore,

supporting and organizing informal groups for group walking and cycling could encourage older adults to take advantage of these active modes.

6.6 Study limitations and future work

There are a number of limitations to this study. This paper focuses on the last question of the survey. Although a large percentage of respondents answered this question and addressed the barriers they face with respect to different modes of transportation, I did not ask further questions to clarify and find out more details about these barriers. Future research could explore these transportation barriers using unstructured or semi-structured interview questions. Second, I did not examine the relationship between different variables in this study. For example, among respondents who reported that it was difficult for them to reach places because of their health problems, I did not further investigate whether the lack of accessibility to places exacerbated their health problems.

In addition, the generalizability of the results of this study is limited because many of the individuals who participated in this study were low-income and lived in subsidized buildings. In addition, I excluded older adults who are unable to live independently due to a physical disability. Therefore, this study may not be representative of older adults with unique travel behaviors. Future studies could improve the results of this study by increasing the sample size and examining other metropolitan areas.

Moreover, this study did not attempt to rank the barriers that discourage older adults from using different modes of transportation. Future studies could expand this study by examining the magnitude of negative impact each barrier has on older adults' travel behavior. It is also worth exploring in detail whether barriers to not-driving modes differ between

young and older adults so that policymakers and city governments can provide more age-friendly intervention options.

Still, the results of this study have practical implications for policymakers, urban planners, and transportation officials, as they are based on the voices of older adults. There are many transportation barriers that decisionmakers may be unaware of but that older adults experience in real life. Therefore, I hope that this study can help support implementing policies to overcome barriers and establish modes of transportation other than the automobile as viable and acceptable modes of transportation for older adults.

7 Discussion

The population of older adults is rapidly increasing worldwide and in the United States. A review of the literature indicates that older adults, especially the younger age groups, are highly dependent on automobiles. The findings suggest that for most older adults, driving means more than just a mode of transportation that helps them get from point A to point B. The emotional attachment and sense of freedom and independence that driving gives them make it difficult for older adults to give up or limit driving. On the other hand, as older adults age, their physical and/or mental health conditions worsen, making them unable to drive. Previous studies have shown that older non-drivers and former drivers have made adjustments in their lives to deal with their transportation and mobility needs, while those who still drive and do not plan to limit or give up driving face greater mobility problems at this stage of life.

The other major problem is the financial insecurity of older adults after retirement. Statistics show that nearly one-third of older adults aged 65 and older are financially insecure, with incomes below 200% of the official poverty line (Cubanski et al., 2018). The lack of access to reliable and affordable transportation and the fact that the majority of this group are women, black and Hispanic adults, and people in relatively poor health (Cubanski et al., 2018) demonstrates the importance of addressing their transportation needs. The lower frequency of travel among the less affluent older adults could lead to increased mobility problems, as this group is likely to have fewer resources to meet their mobility needs in other ways (Vivoda et al., 2020). Related to this issue, the results of this study showed that the affordability of non-automobile transportation options (such as public transit and ride-hailing services) is a major transportation barrier for older adults.

While studies suggest that older adults living in high-density urban environments with good transportation access are more likely to limit or give up driving, only a small percentage of older

adults live in such environments (Schouten, Blumenberg, et al., 2022). The proportion of older adults living in lower density metropolitan areas increased significantly between 2000 and 2016, from 24 percent to 32 percent (Housing America's Older Adults, 2018). In addition, the possibility of moving from suburban areas to walkable, transit-rich urban neighborhoods is rare among older adults, and they usually prefer to remain in their current living environment as they age. Habit and attitude toward transportation also play a role, as those who move to urban areas are less likely to change their car-oriented travel behavior (Schouten, Blumenberg, et al., 2022).

This scenario highlights the importance of researching the travel needs of older adults, improving the transportation system and infrastructure, and providing supportive programs to help this age group meet their transportation needs. Given the growing population of older adults and the challenges they face in accessing transportation modes other than the automobile, opportunities for healthy aging will diminish if current transportation infrastructure and long-term land use policies remain unchanged.

The findings of this study support previous literature that older adults rely on car to meet their transportation needs. However, the predictive model this study conducted, showed that older adults are more likely to shift from driving to getting a ride when driving cost and driving time increase. Also, this study found that when destinations (in this study case grocery stores) are located in a short walking distance, older adults are more likely to walk to stores than to drive or get a ride. In addition, findings of the present study suggest that land use patterns and dispersion of activities is among one of the important factors making older drivers to still intend to renew their driver's licenses. These are important implications for policymakers and urban practitioners to support non-automobile transportation options.

Exploring the travel barriers that older adults face in using sustainable travel modes from their own perspective provided many great insights on the reasons behind their travel mode decision. While using automobile is the main mode of transportation among older adults and it gives them a feel of independence and freedom, it is important to consider that the deficiencies in alternative travel modes play an important role in their travel mode choice. A great number of this group will eventually face the situation to stop driving entirely. Also, a significant proportion of older adults have not driven in their whole life (non-drivers) or have already stopped driving (ex-drivers).

The current transportation infrastructure, the land use pattern, and lack of knowledge of older adults about the alternative transportation services that are available to them all make mobility needs of this group unfulfilled. In order to meet the mobility needs of older adults and help them overcome the transportation barriers it is important to:

- Improve alternative transportation modes other than personal automobile

It is best to provide quality and reliable transportation alternatives to older adults. We should keep in mind that improving the four A's (Accessibility, Affordability, Acceptability, and Availability) are the most important factors that policymakers should consider when planning transportation for older adults.

- Integrate land-use models with high quality transportation services

Neighborhood design and land use patterns play an important role in facilitating or limiting travel choices for older adults. Studies suggest that car dependency among older adults is primarily due to the "auto-oriented development" in the U.S., which makes travel by car a "necessity" rather than a "choice" (Cao et al., 2010). However, traditional neighborhood design that emphasizes accessibility and facilitates walking and public transit to daily activities has the potential not only to reduce car dependence, but also to ensure access for those who do not (or cannot) drive.

While literature shows that older adults are mostly living in low-density environments, providing mix-land use buildings and facilities that older adults frequently go to (including pharmacy, health clinics, grocery store, recreational services) can significantly help older adults have better accessibility to the services they need most.

- Support informal and local groups in providing transportation for older adults

People who are accustomed to an active social life will be at risk for isolation and depression (Ammerman, 2021). Encouraging older adults to engage in social activities and providing rides to the local senior center, friend's homes and arranging rides will help them to maintain socialization.

- Support formal and informal volunteer networks and encouraging ride-hailing

In many communities, there is an abundance of unused or underutilized transportation options and alternatives, many of which could become an important part of older adults' transportation lives if supported by state laws and federal funding. This study found that informal groups have been shaped within senior housing that if supported by public agency or the transit agency through federal legislation could potentially play an important role in meeting transportation needs of older adults. In this context, a transit agency or other public entity could develop ways to encourage volunteers and interested older adults, for example, through incentives such as providing maintenance services for their vehicles at discounted rates.

In conclusion, addressing the transportation problems of older adults requires multi-faceted and multi-layered intervention. Strengthening and improving only one facet cannot improve the current situation of older adults. Various organizations (for-profit and not-for-profit), urban planners, volunteers, older adults' families and friends, and social networks can play an important role in meeting the mobility needs of older adults.

8 Limitations and Future Directions

This dissertation addressed several questions related to travel behavior and mobility needs of older adults. However, the study has several limitations that future researchers should address. First, this study established specific eligibility criteria for study participants focusing only on older adults aged 65 years and older who speak English and are healthy enough to live independently. In addition, this study primarily conducted surveys in residential facilities, and the proportion of older adults living in nonresidential facilities was limited. In addition, the study area was limited to three counties in southeastern Wisconsin and may not be representative of other areas. These are important concerns because older adults are a heterogeneous group with varying travel behaviors and attitudes, and the results of this study may not be generalizable to other groups in the aging population living in other locations. In this regard, future studies should expand the sample size and conduct surveys in other locations in the United States and other countries around the world where older adults have more diverse socioeconomic status, travel behavior and travel attitudes.

In addition, the surveys were conducted from March 2019 to July 2020. During the period after the survey collection, the COVID -19 pandemic occurred, which most likely affected older adults' travel behavior and how they reach destinations. Older adults are likely more adapted to use the Internet and technological devices to meet their transportation needs during this period. Future research is needed to examine the travel behavior of older adults after the COVID -19 pandemic and determine if significant changes in their travel behavior occurred.

Another important limitation to consider relates to the data collection of this study. While I personally completed the older adult surveys and the survey took a form of semi-structured interview, in-depth interviews are needed to further explore the travel behaviors of older adults and the challenges they face in meeting their transportation needs. In addition, focus group studies, a

mix of surveys and follow-up interviews, longitudinal studies, and travel diaries could also be influential in capturing older adults' travel behaviors.

The present study also did not comprehensively analyze the role of built environment factors (such as bus stop proximity, parking availability, street and building density, green space) on older adults' travel behavior and mode choice. Future studies are needed to fill this important gap.

Lastly, although I used a machine learning technique (Random Forest) to predict the future travel behavior of older adults, with the improvement of artificial intelligence techniques, further studies are needed to use other ML techniques to compare between the different methods and make better predictions.

9 Conclusion

This study supports previous research showing that driving is the dominant mode of transportation for older adults. However, I found that an increase in driving time and cost would lead to an increase in carpooling among the elderly. Considering that as older people age, their ability to drive decreases, policymakers should improve informal ridesharing services and invest in ridesharing programs to counteract this trend. In addition, I found that the likelihood of reaching a store on foot is higher for a walk time of about 2 to 9 minutes than for a public transit trip. This finding underscores the importance of creating more housing developments where older adults can live in relative proximity to grocery stores through long-term zoning ordinances and other incentives that encourage higher density mixed-use housing.

The results of the analysis also support the literature showing the negative influence of age and physical disability on older adults' decision to renew their driver's licenses. Consistent with previous studies, the present study found that older adults with lower levels of education were less likely to renew their driver's licenses after expiration. As expected, the present study found that older adults who drive more frequently and have positive attitudes toward driving are more likely to renew their driver's licenses. This finding suggests that personal driving history and habits play a role in people's decision. In this context, it is important to note that where people live and their attitudes toward the environment influence their driving behavior. As the majority of older licensed drivers face the situation of limiting and eventually abandoning their driving behavior, policy makers and urban practitioners should improve alternative transportation modes and better integrate transportation infrastructure into land use patterns.

Finally, this study suggests that there are many challenges and barriers in the current transportation system that prevent older adults from taking advantage of non-driving options. Policy

makers and urban practitioners should implement strategies to remove barriers in the policy environment, physical environment, and individual environment that discourage older adults from walking, bicycling, and using public transportation. Some of the key policy recommendations to overcome these barriers include informing older adults about ways to get around without a car through education and training programs, improving accessibility to destinations by improving current land use policies, improving transportation infrastructure and services, and supporting various for-profit and non-profit organizations and social networks such as local groups and informal associations to help older adults use sustainable transportation modes through programs including group walking and cycling.

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APPENDICES

Appendix A. Survey Instrument

The following pages contain the survey instrument I used to collect the data. When printed, the form consisted of two double-sided sheets. As mentioned in Chapter 3, I read all of the questions to them, but for questions 20 (statements) and 21 (possible solutions), I used another sheet of paper with these two questions printed in a larger font and gave it to them so they could read through the statements and multiple choices and make the choice(s) they wanted.

The survey instrument was reviewed and approved by the Institutional Review Board (IRB) of the University of Wisconsin-Milwaukee for the Protection of Human Subjects.

Introduction

- Gender: a) Male b) Female
- Survey Location: a) Milwaukee County b) Waukesha County c) Ozaukee County
- **Participant's Type of Housing: a) Subsidized Housing b) Other**
- Interview Location: a) Subsidized Housing b) Senior Center/Dining center c)other
- Address of housing:.....
- Location of senior center/subsidized housing: a) urban setting b) suburban setting

---

Basic Demographic Questions

1. Which age group describes you?
   a) 65 b) 65-74 c) 75+

2. How would you describe your race/ethnicity?
   a) Caucasian/White b) Black/African American c) Asian d) Native Hawaiian/ Other Pacific Islander e) American Indian or Alaska Native

3. Which group describes your annual household income? (this includes SS payments and all other forms of assistance)

a) $25,000 or less	b) $25k-$49,999	c) $50k-$99,999	d) $100k-$149,999
e) $150k or more	f) prefer not to answer	g) not sure	

4. Do you own or rent your current residence, or do you have other type of living arrangement?

a) own	b) rent	c) other type of living arrangement, what type? .....

5. **What was the highest education level you obtained?**

6. How many people are living with you (in your house/apartment)? .....
7. Do you have any physical disability that keeps you from walking, driving or using public transportation? a) yes b) no
   7.1. If **Yes**, from which mode does this disability keep you? (**select all choices that apply**)

a) walking	b) driving	c) using public transportation	d) bicycling	d) Other .....

   7.2. If **Yes**, Approximately, when did this disability/health difficulty begin? (at what age)? .....

8. **What is the closest intersection to your home?.....**

9. How long have you been living in your current housing?.....
10. **What factors impacted your decision to live in your current housing?** .....
....

11. Did you also consider transportation as a factor?

a) yes	b) no	c) Not sure

11.1.**Why?** ....
....

12. How many automobiles does your household have?.....
13. Do you have a valid driver's license? a) yes b) no
    13.1. ● If **NO**, have you ever had one? a) yes b) no
    13.1.1 If you had one before:
        13.1.1.1 **When** did you get the license?.....
        13.1.1.2 **when and why** did you quit driving? .....
        ....
        ....
    13.2. ● If **YES**, when did you get your driver's license?.....
        13.2.1. How often do you drive?
            a) Everyday b) several times a week c) at least once a week d) at least once a month
            e) less than once a month f) never h) not sure
        13.2.2. Do you want to renew it after expiration or not? Why?
.....

14. How often, on average, do you go to **grocery store**?
    a) Everyday b) several times a week c) at least once a week d) at least once a month
    e) less than once a month f) never h) not sure

15. How do you mostly go to **grocery store**?
    a) Drive yourself b) get a ride with family or friends c) Walk d) Ride a bike e) Use public transportation (e.g. the county bus, MCTS, Waukesha Metro Transit, The Hop (Milwaukee Streetcar)) f) take a taxi/cab/Lyft/Uber g) Use special transportation service (para-transit services and/or the ones provided by an insurance company) h) Use subsidized Housing or senior center's bus or shuttle service i) never go j) don't know

16. Why do you mostly use that mode of transportation? ....
....

17. Can you tell me the name and the approximate location of the grocery store you often go to?
    Name: .....
    Location: .....

18. How long do you go to that particular grocery store? .....
19. During this time, have you changed your travel mode to get to that grocery store? a) yes b) no
    19.1. If **YES**, would you please explain more? Did anything specific happened that you changed your travel mode?.....
20. From 1 to 5 how much do you agree with each statement? (1=strongly disagree to 5=strongly agree)

Statements	1=strongly disagree	2=somewhat disagree	3= Neither agree nor disagree	4= somewhat agree	5= strongly agree
I prefer living in a location where it is easy to walk to destinations.					
Driving gives me freedom and independence.					
I get frustrated if I cannot participate in an activity due to lack of transportation.					
I don't want to burden my family or friends by asking for rides.					
I would like to be able to drive to destinations easily.					
Public transit is a good alternative to driving or being driven.					

21. If you want to suggest anything that could improve your transportation options, what would it be? (**select 2-3 top choices**)

a) Bus stops close to my home and my destinations b) the county bus service being faster and more frequent
c) free/ subsidized bus fares d) Improved road and sidewalk conditions for pedestrians e) more delivery services for groceries, prescriptions and other daily necessities f) More driving alternatives e.g. community vans, volunteer drivers, carpooling. g) free/ subsidized ride-hailing options (e.g. Lyft, Uber) h) Other, please specify.....

Past Travel Behavior Questions

22. Before your current residential address, where did you live? (The zip code?) .....
23. What was the closest intersection to your previous housing?.....
24. How long did you live in that housing?.....
25. For the majority of time, how many people lived with you? .....
26. For the majority of time, what was your annual household income (approximately)?

a) $25,000 or less b) $25k-$49,999 c) $50k-$99,999 d) $100k-$149,999 e) $150k or more f) prefer not to answer g) not sure

27. In your previous housing, how did you mostly go to a **Grocery Store**?
    a) Drive yourself b) get a ride with family or friends c) Walk d) Ride a bike e) Use public transportation (e.g. the county bus, MCTS, Waukesha Metro Transit, The Hop (Milwaukee Streetcar)) f) take a taxi/cab/Lyft/Uber g) Use special transportation service (para-transit services and/or the ones provided by an insurance company) h) Use subsidized Housing or senior center's bus or shuttle service i) never go j) don't know

28. Did you use that mode of transportation to get to the grocery store during the whole time you were living in that housing? If **NO**, why? Did any event or something specific happened that you changed your mode of transportation?
    ....

29. For how many years living in that housing, did NOT your household have any automobiles?.....
    ....

30. How frequently do you **now** use different travel modes for your daily travel **compared to before the relocation**?

	-2 (a lot less now)	-1 (a little less now)	0 (about the same)	+1 (a little more now)	+2 (a lot more now)	Reason(s) / Did any event or something specific happened that you changed your travel behavior?	➢ If the participant has changed mode frequency, this question will be asked. (satisfaction) Do you like this change or not? How much?
Drive yourself							
Get a ride with family/friend							
walk							
Use THE CITY BUS							

31. Do you want to provide any other information about your current or your past transportation experience?
    ....

Appendix B: IRB Approval

UNIVERSITY of WISCONSIN
UWMILWAUKEE
Department of University Safety & Assurances

Leah Stoiber
IRB Administrator
Institutional Review Board
Engelmann 270
P. O. Box 413
Milwaukee, WI 53201-0413
(414) 229-7455 *phone*
(414) 229-6729 *fax*

http://www.irb.uwm.edu
lstoiber@uwm.edu

Modification/Amendment Notice of IRB Exempt Status

Date: March 25, 2019

To: Robert Schneider, PhD
Dept: Urban Studies Programs

CC: Hamideh Moayyed

IRB#: 19.117
Title: Assessing the Impact of Urban and Suburban Settings on Seniors' Travel Behavior in Milwaukee County, Waukesha County and Ozaukee County

After review of your proposed changes to the research protocol by the University of Wisconsin – Milwaukee Institutional Review Board, your protocol still meets the criteria for Exempt Status under Category 2 as governed by 45 CFR 46.101 subpart b, and your protocol has received modification/amendment approval for:

- Revising survey questions
- Adding (optional) audio recording of survey

This protocol has been approved as exempt for three years and IRB approval will expire on November 13, 2021. If you plan to continue any research related activities (e.g., enrollment of subjects, study interventions, data analysis, etc.) past the date of IRB expiration, please respond to the IRB's status request that will be sent by email approximately two weeks before the expiration date. If the study is closed or completed before the IRB expiration date, you may notify the IRB by sending an email to irbinfo@uwm.edu with the study number and the status, so we can keep our study records accurate.

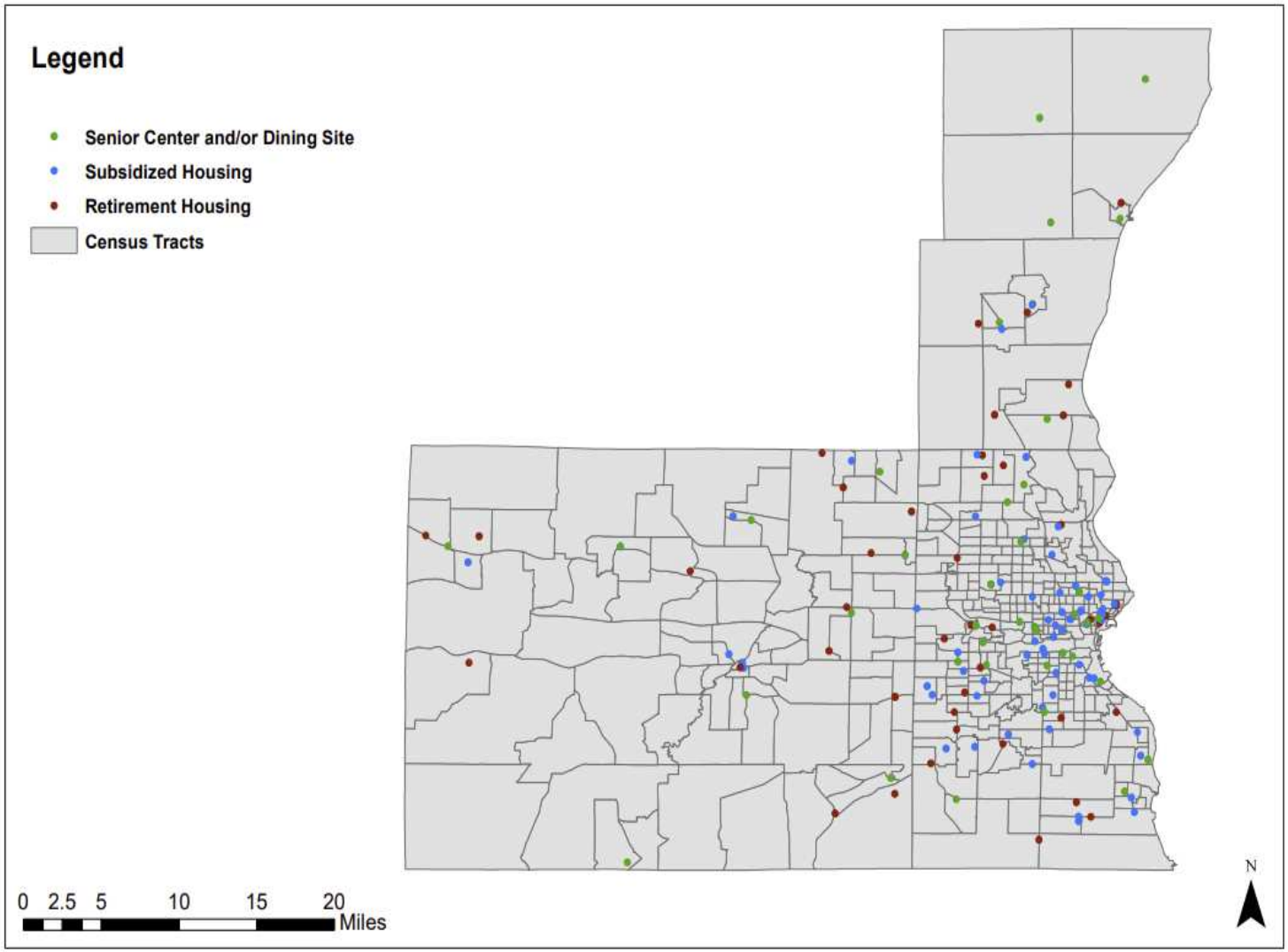
Any proposed changes to the protocol must be reviewed by the IRB before implementation, unless the change is specifically necessary to eliminate apparent immediate hazards to the subjects. The principal investigator is responsible for adhering to the policies and guidelines set forth by the UWM IRB, maintaining proper documentation of study records and promptly reporting to the IRB any adverse events which require reporting. The principal investigator is also responsible for ensuring that all study staff receive appropriate training in the ethical guidelines of conducting human subjects research.

As Principal Investigator, it is also your responsibility to adhere to UWM and UW System Policies, and any applicable state and federal laws governing activities which are independent of IRB review/approval (e.g., FERPA, Radiation Safety, UWM Data Security, UW System policy on Prizes, Awards and Gifts, state gambling laws, etc.). When conducting research at institutions outside of UWM, be sure to obtain permission and/or approval as required by their policies.

Contact the IRB office if you have any further questions. Thank you for your cooperation and best wishes for a successful project.

Respectfully,
Leah Stoiber
Leah Stoiber
IRB Administrator

Appendix C: All the Potential Survey Site Locations



Appendix D. Research Flyer

Would you like to help improve the transportation experiences of seniors dealing with mobility needs?

- Are you willing to participate in a **10-minute survey** with a researcher?
- Would you be willing to share your experiences about **getting around and reaching destinations?**

My name is Hamideh Moayyed. I am an Urban Studies doctoral student at the University of Wisconsin Milwaukee. I am working on my dissertation that is about seniors' transportation.

I want to do surveys with volunteer participants (adults aged 65 and over) who are living in this building to explore how they get from place to place.

UWM
UNIVERSITY of WISCONSIN
MILWAUKEE

Who can participate?

Adults who are 65 years old and older

I will meet you

in-person at the Becher Terrace Apts

and ask you some questions about how you get around.

When?

Wed, March 11th

6:00 pm

Appendix E: Detailed List of Survey Site Locations

ID	County	City/Village (Interview_Location)	Type_of_interview_location	Type_of_Housing_Center	Event	Getting_permission_from_the_manager	Interview_Date_and_Time	Interview_specific_location	Address_code	Name_of_housing_or_center	Type_of_Current_Housing_Other
1	Waukesha	Waukesha	Private room	Recreation Center	Golden Age	Eras	3-Jul-19 (10:30)	private room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
2	Waukesha	Waukesha	Private room	Recreation Center	Golden Age	Eras	3-Jul-19 (10:30)	private room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
3	Waukesha	Waukesha	Private room	Recreation Center	Golden Age	Eras	3-Jul-19 (10:30)	private room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
4	Waukesha	Waukesha	Private room	Recreation Center	Golden Age	Eras	3-Jul-19 (10:30)	private room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
5	Waukesha	Waukesha	Private room	Recreation Center	Golden Age	Eras	3-Jul-19 (10:30)	private room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
6	Waukesha	Waukesha	Private room	Recreation Center	Golden Age	Eras	3-Jul-19 (10:30)	private room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
7	Waukesha	Waukesha	Private room	Recreation Center	Golden Age	Eras	3-Jul-19 (10:30)	private room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
8	Waukesha	Waukesha	Private room	Recreation Center	Golden Age	Eras	3-Jul-19 (10:30)	private room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing

9	Waukesha	Waukesha	Private room	Recreation Center	Golden Age	Eras	3-Jul-19 (10:30)	private room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
10	Waukesha	Waukesha	Private room	Recreation Center	Golden Age	Eras	3-Jul-19 (10:30)	private room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
11	Waukesha	Waukesha	Private room	Recreation Center	Golden Age	Eras	3-Jul-19 (10:30)	private room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
12	Milwaukee	Milwaukee	Private room	Retirement Community	none-by appointment	Myself	04-Sep-19 (morning)	private room	Saint John's On The Lake-1840 N Prospect Ave, Milwaukee, WI 53202	Saint John's On The Lake	retirement community
13	Milwaukee	Milwaukee	Private room	Retirement Community	none-by appointment	Myself	04-Sep-19 (morning)	private room	Saint John's On The Lake-1840 N Prospect Ave, Milwaukee, WI 53202	Saint John's On The Lake	retirement community
14	Milwaukee	Milwaukee	Private room	Retirement Community	none-by appointment	Myself	04-Sep-19 (morning)	private room	Saint John's On The Lake-1840 N Prospect Ave, Milwaukee, WI 53202	Saint John's On The Lake	retirement community
15	Milwaukee	Milwaukee	Private room	Retirement Community	none-by appointment	Myself	04-Sep-19 (morning)	private room	Saint John's On The Lake-1840 N Prospect Ave, Milwaukee, WI 53202	Saint John's On The Lake	retirement community
16	Milwaukee	Milwaukee	Private room	Retirement Community	none-by appointment	Myself	04-Sep-19 (morning)	private room	Saint John's On The Lake-1840 N Prospect Ave, Milwaukee, WI 53202	Saint John's On The Lake	retirement community
17	Milwaukee	Milwaukee	Private room	Retirement Community	none-by appointment	Myself	04-Sep-19 (morning)	private room	Saint John's On The Lake-1840 N Prospect Ave, Milwaukee, WI 53202	Saint John's On The Lake	retirement community

18	Milwaukee	Milwaukee	Private room	Retirement Community	none-by appointment	Myself	04-Sep-19 (morning)	private room	Saint John's On The Lake-1840 N Prospect Ave, Milwaukee, WI 53202	Saint John's On The Lake	retirement community
19	Milwaukee	Milwaukee	Private room	Retirement Community	none-by appointment	Myself	05-Sep-19 (morning)	private room	Saint John's On The Lake-1840 N Prospect Ave, Milwaukee, WI 53202	Saint John's On The Lake	retirement community
20	Milwaukee	Milwaukee	Private room	Retirement Community	none-by appointment	Myself	05-Sep-19 (morning)	private room	Saint John's On The Lake-1840 N Prospect Ave, Milwaukee, WI 53202	Saint John's On The Lake	retirement community
21	Milwaukee	Milwaukee	Private room	Retirement Community	none-by appointment	Myself	05-Sep-19 (morning)	private room	Saint John's On The Lake-1840 N Prospect Ave, Milwaukee, WI 53202	Saint John's On The Lake	retirement community
22	Milwaukee	Milwaukee	Private room	Retirement Community	none-by appointment	Myself	05-Sep-19 (morning)	private room	Saint John's On The Lake-1840 N Prospect Ave, Milwaukee, WI 53202	Saint John's On The Lake	retirement community
23	Milwaukee	Milwaukee	Private room	Retirement Community	none-by appointment	Myself	30-Oct-19	private room	Saint John's On The Lake-1840 N Prospect Ave, Milwaukee, WI 53202	Saint John's On The Lake	retirement community
24	Waukesha	Menomonee Falls	Church Hallway	NA	Community Block Party	Eras	07-Sep-19 time: 12:00 pm to 4:00 pm	church	church (Holy Cross Lutheran Church) address: W156N8131 Pilgrim Rd, Menomonee Falls, WI 53051		regular housing
25	Waukesha	Menomonee Falls	Church Hallway	NA	Community Block Party	Eras	07-Sep-19 time: 12:00 pm to 4:00 pm	church	church (Holy Cross Lutheran Church) address: W156N8131 Pilgrim Rd,		regular housing

									Menomonee Falls, WI 53051	
26	Waukesha	Menomonee Falls	Church Hallway	NA	Community Block Party	Eras	07-Sep-19 time: 12:00 pm to 4:00 pm	church	church (Holy Cross Lutheran Church) address: W156N8131 Pilgrim Rd, Menomonee Falls, WI 53051	regular housing
27	Waukesha	Menomonee Falls	Church Hallway	NA	Community Block Party	Eras	07-Sep-19 time: 12:00 pm to 4:00 pm	church	church (Holy Cross Lutheran Church) address: W156N8131 Pilgrim Rd, Menomonee Falls, WI 53051	regular housing
28	Waukesha	Menomonee Falls	Church Hallway	NA	Community Block Party	Eras	07-Sep-19 time: 12:00 pm to 4:00 pm	church	church (Holy Cross Lutheran Church) address: W156N8131 Pilgrim Rd, Menomonee Falls, WI 53051	retirement community
29	Waukesha	Menomonee Falls	Church Hallway	NA	Community Block Party	Eras	07-Sep-19 time: 12:00 pm to 4:00 pm	church	church (Holy Cross Lutheran Church) address: W156N8131 Pilgrim Rd, Menomonee Falls, WI 53051	regular housing
30	Waukesha	Menomonee Falls	Church Hallway	NA	Community Block Party	Eras	07-Sep-19 time: 12:00 pm to 4:00 pm	church	church (Holy Cross Lutheran Church) address: W156N8131 Pilgrim Rd, Menomonee Falls, WI 53051	regular housing
31	Waukesha	Menomonee Falls	Church Hallway	NA	Community Block Party	Eras	07-Sep-19 time: 12:00 pm to 4:00 pm	church	church (Holy Cross Lutheran Church)	regular housing

									address: W156N8131 Pilgrim Rd, Menomonee Falls, WI 53051		
32	Waukesha	New Berlin	At the Dining Site	Dining site and Retirement Community	Dining (Lunch)	Eras_ADRC	02-Oct-19 time: 11:00 am to 1:00 pm	dining room	13750 W National Ave, New Berlin *the dining center was in the downstairs. In the upstairs there is a retirement center. (ProHealth Care Regency Senior Communities New Berlin) New Berlin-Dining Site- National Regency Retirement Commmunity: 13750 West National Avenue	Dining Site at the National Regency Retirement Commmunity	regular housing
33	Waukesha	New Berlin	At the Dining Site	Dining site and Retirement Community	Dining (Lunch)	Eras_ADRC	02-Oct-19 time: 11:00 am to 1:00 pm	dining room	13750 W National Ave, New Berlin *the dining center was in the downstairs. In the upstairs there is a retirement center. (ProHealth Care Regency Senior Communities New Berlin) New Berlin-Dining Site- National Regency Retirement Commmunity: 13750 West National Avenue	Dining Site at the National Regency Retirement Commmunity	retirement community

34	Waukesha	New Berlin	At the Dining Site	Dining site and Retirement Community	Dining (Lunch)	Eras_ADRC	02-Oct-19 time: 11:00 am to 1:00 pm	dining room	13750 W National Ave, New Berlin *the dining center was in the downstairs. In the upstairs there is a retirement center. (ProHealth Care Regency Senior Communities New Berlin) New Berlin-Dining Site- National Regency Retirement Commmunity: 13750 West National Avenue	Dining Site at the National Regency Retirement Commmunity	retirement community
35	Waukesha	New Berlin	At the Dining Site	Dining site and Retirement Community	Dining (Lunch)	Eras_ADRC	02-Oct-19 time: 11:00 am to 1:00 pm	dining room	13750 W National Ave, New Berlin *the dining center was in the downstairs. In the upstairs there is a retirement center. (ProHealth Care Regency Senior Communities New Berlin) New Berlin-Dining Site- National Regency Retirement Commmunity: 13750 West National Avenue	Dining Site at the National Regency Retirement Commmunity	regular housing
36	Waukesha	New Berlin	At the Dining Site	Dining site and Retirement Community	Dining (Lunch)	Eras_ADRC	02-Oct-19 and 03-Oct-19	dining room	13750 W National Ave, New Berlin *the dining center was in the downstairs. In the	Dining Site at the National Regency Retirement Commmunity	regular housing

									upstairs there is a retirement center. (ProHealth Care Regency Senior Communities New Berlin) New Berlin- Dining Site- National Regency Retirement Commmunity: 13750 West National Avenue		
37	Waukesha	Butler	At the Dining Site	sub_housing_and_dining_location	Dining (Lunch)	Eras_ADRC	18-Oct-19 lunch time	dining room	12999 West Hampton Avenue, Butler	Dining Location at the Hampton Regency Apartments	subsidized
38	Waukesha	New Berlin	At the Dining Site	Dining site and Retirement Community	Dining (Lunch)	Eras_ADRC	3-Oct-19 (Lunch time-around 11:30)	dining room	13750 W National Ave, New Berlin *the dining center was in the downstairs. In the upstairs there is a retirement center. (ProHealth Care Regency Senior Communities New Berlin) New Berlin- Dining Site- National Regency Retirement Commmunity: 13750 West National Avenue	Dining Site at the National Regency Retirement Commmunity	regular housing
39	Waukesha	New Berlin	At the Dining Site	Dining site and Retirement Community	Dining (Lunch)	Eras_ADRC	3-Oct-19 (Lunch time-around 11:30)	dining room	13750 W National Ave, New Berlin *the dining center was in the downstairs. In the	Dining Site at the National Regency Retirement Commmunity	regular housing

									upstairs there is a retirement center. (ProHealth Care Regency Senior Communities New Berlin) New Berlin- Dining Site- National Regency Retirement Commmunity: 13750 West National Avenue		
40	Waukesha	New Berlin	At the Dining Site	Dining site and Retirement Community	Dining (Lunch)	Eras_ADRC	3-Oct-19 (Lunch time-around 11:30)	dining room	13750 W National Ave, New Berlin *the dining center was in the downstairs. In the upstairs there is a retirement center. (ProHealth Care Regency Senior Communities New Berlin) New Berlin- Dining Site- National Regency Retirement Commmunity: 13750 West National Avenue	Dining Site at the National Regency Retirement Commmunity	retirement community
41	Waukesha	Butler	At the Dining Site	sub_housing_and_dining_location	Dining (Lunch)	Eras_ADRC	18-Oct-19 lunch time	Community Room	12999 West Hampton Avenue, Butler	Hampton Regency Apartments	subsidized
42	Waukesha	Butler	At the Dining Site	sub_housing_and_dining_location	Dining (Lunch)	Eras_ADRC	18-Oct-19 lunch time	dining room	12999 West Hampton Avenue, Butler	Dining Location at the Hampton Regency Apartments	subsidized
43	Waukesha	Butler	At the Dining Site	sub_housing_and_dining_location	Dining (Lunch)	Eras_ADRC	18-Oct-19 lunch time	dining room	12999 West Hampton Avenue, Butler	Dining Location at the Hampton	subsidized

										Regency Apartments	
44	Waukesha	Butler	At the Dining Site	sub_housing_and_dining_location	Dining (Lunch)	Eras_ADRC	18-Oct-19 lunch time	dining room	12999 West Hampton Avenue, Butler	Dining Location at the Hampton Regency Apartments	subsidized
45	Waukesha	Oconomowoc	At the Dining Site	Dining Site at a Community Center	Dining (Lunch)	Eras_ADRC	21-Nov-19 (Lunch time-around 11:30)	dining room	Oconomowoc - Dining Site- Oconomowoc Community Center- 220 West Wisconsin Avenue	Dining Site at the Oconomowoc Community Center	regular housing
46	Waukesha	Oconomowoc	At the Dining Site	Dining Site at a Community Center	Dining (Lunch)	Eras_ADRC	21-Nov-19 (Lunch time-around 11:30)	dining room	Oconomowoc - Dining Site- Oconomowoc Community Center- 220 West Wisconsin Avenue	Dining Site at the Oconomowoc Community Center	regular housing
47	Waukesha	Oconomowoc	At the Dining Site	Dining Site at a Community Center	Dining (Lunch)	Eras_ADRC	21-Nov-19 (Lunch time-around 11:30)	dining room	Oconomowoc - Dining Site- Oconomowoc Community Center- 220 West Wisconsin Avenue	Dining Site at the Oconomowoc Community Center	regular housing
48	Waukesha	Oconomowoc	At the Dining Site	Dining Site at a Community Center	Dining (Lunch)	Eras_ADRC	21-Nov-19 (Lunch time-around 11:30)	dining room	Oconomowoc - Dining Site- Oconomowoc Community Center- 220 West Wisconsin Avenue	Dining Site at the Oconomowoc Community Center	regular housing
49	Waukesha	Hartland	At the Dining Site	sub_housing_and_dining_location	Dining (Lunch)	Eras_ADRC	27-Nov-19 (Lunch time-around 11:30)	dining room	Hartland- Dining Site at Breezewood Village Apartments- 400 Sunnyslope Drive	Dining Site at the Breezewood Village Apartments	subsidized

50	Waukesha	Hartland	At the Dining Site	sub_housing_and_dining_location	Dining (Lunch)	Eras_ADRC	27-Nov-19 (Lunch time-around 11:30)	dining room	Hartland- Dining Site at Breezewood Village Apartments- 400 Sunnyslope Drive	Dining Site at the Breezewood Village Apartments	regular housing
51	Waukesha	Hartland	At the Dining Site	sub_housing_and_dining_location	Dining (Lunch)	Eras_ADRC	27-Nov-19 (Lunch time-around 11:30)	dining room	Hartland- Dining Site at Breezewood Village Apartments- 400 Sunnyslope Drive	Dining Site at the Breezewood Village Apartments	subsidized
52	Milwaukee	Bay View	At the Dining Site	Dining Site at a Community Center	Dining (Lunch)	Myself	10-Dec-19 (Lunch time-around 11:15)	dining room	Beulah Brinton, 2555 S. Bay Street, Bay View, WI 53207	Dining Site at Beulah Brinton Community Center	regular housing
53	Milwaukee	Bay View	At the Dining Site	Dining Site at a Community Center	Dining (Lunch)	Myself	10-Dec-19 (Lunch time-around 11:15)	dining room	Beulah Brinton, 2555 S. Bay Street, Bay View, WI 53207	Dining Site at Beulah Brinton Community Center	regular housing
54	Milwaukee	Bay View	At the Dining Site	Dining Site at a Community Center	Dining (Lunch)	Myself	10-Dec-19 (Lunch time-around 11:15)	dining room	Beulah Brinton, 2555 S. Bay Street, Bay View, WI 53207	Dining Site at Beulah Brinton Community Center	subsidized
55	Milwaukee	Cudahy	Community Room	Subsidized_Housing	Cookie Social Event	Myself	18-Dec-19 (10:30 am)	Community Room	Evergreen Square of Cudahy	Evergreen Square Apts (Cudahy)	subsidized
56	Milwaukee	Cudahy	Community Room	Subsidized_Housing	Cookie Social Event	Myself	18-Dec-19 (10:30 am)	Community Room	Evergreen Square of Cudahy	Evergreen Square Apts (Cudahy)	subsidized
57	Milwaukee	Cudahy	Community Room	Subsidized_Housing	Cookie Social Event	Myself	18-Dec-19 (10:30 am)	Community Room	Evergreen Square of Cudahy	Evergreen Square Apts (Cudahy)	subsidized
58	Milwaukee	Cudahy	Community Room	Subsidized_Housing	Cookie Social Event	Myself	18-Dec-19 (10:30 am)	Community Room	Evergreen Square of Cudahy	Evergreen Square Apts (Cudahy)	subsidized
59	Milwaukee	Milwaukee	At the Dining Site	Dining_Location	Music and Lunch	Myself	09-Jan-2020 (10:30 am)	dining room	Elks Lodge,5555 W. Good Hope Road, Milwaukee, WI 53223	Elks Lodge	regular housing
60	Milwaukee	Milwaukee	At the Dining Site	Dining_Location	Music and Lunch	Myself	09-Jan-2020 (10:30 am)	dining room	Elks Lodge,5555 W. Good Hope Road, Milwaukee, WI 53223	Elks Lodge	regular housing

61	Milwaukee	Milwaukee	At the Dining Site	Dining_Location	Music and Lunch	Myself	09-Jan-2020 (10:30 am)	dining room	Elks Lodge,5555 W. Good Hope Road, Milwaukee, WI 53223	Elks Lodge	regular housing
62	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	none-by appointment	Myself	10-Jan-2020 (3:00 pm)	community room	Lincoln Court Apts, 2325 S Howell Ave, Milwaukee, WI 53207	Lincoln Court Apts	subsidized
63	Milwaukee	Milwaukee	entrance lobby of the building	Subsidized_Housing	none-by appointment	Myself	10-Jan-2020 (3:00 pm)	entrance lobby	Lincoln Court Apts, 2325 S Howell Ave, Milwaukee, WI 53207	Lincoln Court Apts	subsidized
64	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Stock Box	Myself	13-Jan-2020 (10:00 am)	community room	Ridgewood & Westridge Apartments, 7901 W Glenbrook Rd, Milwaukee, WI 53223	Ridgewood & Westridge Apartments	subsidized
65	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Stock Box	Myself	13-Jan-2020 (10:00 am)	community room	Ridgewood & Westridge Apartments, 7901 W Glenbrook Rd, Milwaukee, WI 53223	Ridgewood & Westridge Apartments	subsidized
66	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Stock Box	Myself	13-Jan-2020 (10:00 am)	community room	Ridgewood & Westridge Apartments, 7901 W Glenbrook Rd, Milwaukee, WI 53223	Ridgewood & Westridge Apartments	subsidized
67	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Stock Box	Myself	13-Jan-2020 (10:00 am)	community room	Ridgewood & Westridge Apartments, 7901 W Glenbrook Rd, Milwaukee, WI 53223	Ridgewood & Westridge Apartments	subsidized
68	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Stock Box	Myself	13-Jan-2020 (10:00 am)	his unit	Ridgewood & Westridge Apartments, 7901 W Glenbrook Rd, Milwaukee, WI 53223	Ridgewood & Westridge Apartments	subsidized

69	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Stock Box	Myself	13-Jan-2020 (10:00 am)	his friend's unit	Ridgewood & Westridge Apartments, 7901 W Glenbrook Rd, Milwaukee, WI 53223	Ridgewood & Westridge Apartments	subsidized
70	Milwaukee	Milwaukee	Community Room	Retirement Community	Coffee Hour	Myself	28-Jan-2020 (9:00 am)	community room	BRIA of Trinity Village, 7300 W Dean Rd, Milwaukee, WI 53223	BRIA of Trinity Village	retirement community
71	Milwaukee	Milwaukee	Community Room	Retirement Community	Coffee Hour	Myself	28-Jan-2020 (9:00 am)	community room	BRIA of Trinity Village, 7300 W Dean Rd, Milwaukee, WI 53223	BRIA of Trinity Village	retirement community
72	Milwaukee	Milwaukee	Community Room	Retirement Community	Coffee Hour	Myself	28-Jan-2020 (9:00 am)	community room	BRIA of Trinity Village, 7300 W Dean Rd, Milwaukee, WI 53223	BRIA of Trinity Village	retirement community
73	Milwaukee	Milwaukee	Community Room	Retirement Community	Coffee Hour	Myself	28-Jan-2020 (9:00 am)	community room	BRIA of Trinity Village, 7300 W Dean Rd, Milwaukee, WI 53223	BRIA of Trinity Village	retirement community
74	Milwaukee	West Allis	Community Room	Subsidized_Housing	Baked Potato	Myself	29-Jan-2020 (1:00 pm)	community room	Sunrise Apartments, 8750 W National Ave, Milwaukee, WI 53227	Sunrise Apartments	subsidized
75	Milwaukee	West Allis	Community Room	Subsidized_Housing	Baked Potato	Myself	29-Jan-2020 (1:00 pm)	community room	Sunrise Apartments, 8750 W National Ave, Milwaukee, WI 53227	Sunrise Apartments	subsidized
76	Milwaukee	West Allis	Community Room	Subsidized_Housing	Baked Potato	Myself	29-Jan-2020 (1:00 pm)	community room	Sunrise Apartments, 8750 W National Ave, Milwaukee, WI 53227	Sunrise Apartments	subsidized
77	Milwaukee	City of South Milwaukee	Community Room	Senior_Center	Line Dance	Myself	21-Feb-2020 10:15 am	community room	2424,15th Ave, South Milwaukee, WI 53172, Grobschmidt Senior Center	Grobschmidt Senior Center	regular housing

78	Milwaukee	City of South Milwaukee	Community Room	Senior_Center	Line Dance	Myself	21-Feb-2020 10:15 am	community room	2424,15th Ave, South Milwaukee, WI 53172, Grobschmidt Senior Center	Grobschmidt Senior Center	regular housing
79	Milwaukee	City of South Milwaukee	Community Room	Senior_Center	Line Dance	Myself	21-Feb-2020 10:15 am	community room	2424,15th Ave, South Milwaukee, WI 53172, Grobschmidt Senior Center	Grobschmidt Senior Center	regular housing
80	Milwaukee	City of South Milwaukee	Community Room	Senior_Center	Line Dance	Myself	21-Feb-2020 10:15 am	community room	2424,15th Ave, South Milwaukee, WI 53172, Grobschmidt Senior Center	Grobschmidt Senior Center	regular housing
81	Milwaukee	City of South Milwaukee	Community Room	Senior_Center	Line Dance	Myself	21-Feb-2020 10:15 am	community room	2424,15th Ave, South Milwaukee, WI 53172, Grobschmidt Senior Center	Grobschmidt Senior Center	regular housing
82	Milwaukee	City of South Milwaukee	Community Room	Senior_Center	Line Dance	Myself	21-Feb-2020 10:15 am	community room	2424,15th Ave, South Milwaukee, WI 53172, Grobschmidt Senior Center	Grobschmidt Senior Center	regular housing
83	Ozaukee	Na-Phone Call	Phone Call	NA	none-by appointment	Interfaith_Ozaukee	6/1/2020 10:00	phone call	NA	na	regular housing
84	Ozaukee	Na-Phone Call	Phone Call	NA	none-by appointment	Interfaith_Ozaukee	6/1/2020 10:00	phone call	NA	na	regular housing
85	Ozaukee	Na-Phone Call	Phone Call	NA	none-by appointment	Interfaith_Ozaukee	06-02-2020 11:00 am	phone call	NA	na	regular housing
86	Ozaukee	Na-Phone Call	Phone Call	NA	none-by appointment	Interfaith_Ozaukee	06-03-2020 6:00 pm	phone call	NA	na	regular housing
87	Ozaukee	Na-Phone Call	Phone Call	NA	none-by appointment	Interfaith_Ozaukee	06-04-2020 11:30 am	phone call	NA	na	regular housing
88	Ozaukee	Na-Phone Call	Phone Call	NA	none-by appointment	Interfaith_Ozaukee	06-04-2020 10:00 am	phone call	NA	na	regular housing
89	Ozaukee	Na-Phone Call	Phone Call	NA	none-by appointment	Interfaith_Ozaukee	06-04-2020 10:15 am	phone call	NA	na	regular housing

90	Ozaukee	Na-Phone Call	Phone Call	NA	none-by appointment	Interfaith_Ozaukee	06-04-2020 3:00 pm	phone call	NA	na	regular housing
91	Ozaukee	Na-Phone Call	Phone Call	NA	none-by appointment	Interfaith_Ozaukee	06-05-2020 3:00 pm	phone call	NA	na	regular housing
92	Ozaukee	Na-Phone Call	Phone Call	NA	none-by appointment	Interfaith_Ozaukee	06-07-2020 12:00 pm	phone call	NA	na	regular housing
93	Milwaukee	West Allis	Community Room	Senior_Center	Stock Box	Myself	02-11-2020 1:00 pm-3:00 pm	community room	West Allis Senior Center, 7001 W National Ave, West Allis, WI 53214	West Allis Senior Center	regular housing
94	Milwaukee	West Allis	Community Room	Senior_Center	Stock Box	Myself	02-11-2020 1:00 pm-3:00 pm	community room	West Allis Senior Center, 7001 W National Ave, West Allis, WI 53214	West Allis Senior Center	retirement community
95	Milwaukee	West Allis	Community Room	Senior_Center	Stock Box	Myself	02-11-2020 1:00 pm-3:00 pm	community room	West Allis Senior Center, 7001 W National Ave, West Allis, WI 53214	West Allis Senior Center	regular housing
96	Milwaukee	Oak Creek	Cafe at the Housing	Retirement Community	none-by appointment	Myself	02-25-2020 10:00 am-12:30 pm	Cafe	The Waters of Oak Creek, 8000 South Market Street, Oak Creek, WI 53154	The Waters of Oak Creek	retirement community
97	Milwaukee	Oak Creek	Cafe at the Housing	Retirement Community	none-by appointment	Myself	02-25-2020 10:00 am-12:30 pm	Cafe	The Waters of Oak Creek, 8000 South Market Street, Oak Creek, WI 53154	The Waters of Oak Creek	retirement community
98	Milwaukee	Oak Creek	Cafe at the Housing	Retirement Community	none-by appointment	Myself	02-25-2020 10:00 am-12:30 pm	Cafe	The Waters of Oak Creek, 8000 South Market Street, Oak Creek, WI 53154	The Waters of Oak Creek	retirement community
99	Milwaukee	Oak Creek	Cafe at the Housing	Retirement Community	none-by appointment	Myself	02-25-2020 10:00 am-12:30 pm	Cafe	The Waters of Oak Creek, 8000 South Market Street, Oak Creek, WI 53154	The Waters of Oak Creek	retirement community

100	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	wellness clinic and library	Myself	02-13-2020 1:00 pm	community room	Merrill Park Apts, 222 N. 33rd Street Milwaukee, WI 53208	Merrill Park Apts	subsidized
101	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	wellness clinic and library	Myself	02-13-2020 1:00 pm	community room	Merrill Park Apts, 222 N. 33rd Street Milwaukee, WI 53208	Merrill Park Apts	subsidized
102	Milwaukee	Milwaukee	Private room	Retirement Community	none-by appointment	Myself	3-March-20 (9:30 am-1:00 pm)	private room	Alexian Village, 9301 N. 76 Street, Milwaukee, WI 53223	Alexian Village	retirement community
103	Milwaukee	Milwaukee	Gift shop-private	Retirement Community	none-by appointment	Myself	3-March-20 (9:30 am-1:00 pm)	Gift shop at the Retirement Community	Alexian Village, 9301 N. 76 Street, Milwaukee, WI 53223	Alexian Village	retirement community
104	Milwaukee	Milwaukee	entrance lobby of the building	Subsidized_Housing	none-by appointment	Myself	10-March-20 9:30 am	lobby	Holton Terrace, 2825 N Holton St, Milwaukee, WI 53212	Holton Terrace	subsidized
105	Milwaukee	Milwaukee	entrance lobby of the building	Subsidized_Housing	none-by appointment	Myself	10-March-20 9:30 am	lobby	Holton Terrace, 2825 N Holton St, Milwaukee, WI 53212	Holton Terrace	subsidized
106	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	none-by appointment	Myself	10-March-20 9:30 am	community room	Holton Terrace, 2825 N Holton St, Milwaukee, WI 53212	Holton Terrace	subsidized
107	Ozaukee	Cedarburg	Community Room	Subsidized_Housing	none-by appointment	Myself	16-March-20 2:00 pm	community room	Fischer Terrace Apartments, N47W6277 Western Rd, Cedarburg, WI 53012	Fischer Terrace Apartments	subsidized
108	Ozaukee	Cedarburg	Community Room	Subsidized_Housing	none-by appointment	Myself	16-March-20 2:00 pm	community room	Fischer Terrace Apartments, N47W6277 Western Rd, Cedarburg, WI 53012	Fischer Terrace Apartments	subsidized
109	Ozaukee	Thiensville	Phone Call	Retirement Community	none-by appointment	Interfaith_Ozaukee	06-07-2020 10::00 am	phone call	Willowbrook Place, 205 Green Bay Rd Thiensville, WI 53092	Willowbrook Place	retirement community

110	Waukesha	Waukesha	Community Room	Subsidized_Housing	Stock Box	Myself	16-May-19 10:30 am	community room	Saratoga Heights, 120 Corrina Blvd, Waukesha, WI 53186	Saratoga Heights	subsidized
111	Waukesha	Waukesha	Community Room	Subsidized_Housing	Stock Box	Myself	16-May-19 10:30 am	community room	Saratoga Heights, 120 Corrina Blvd, Waukesha, WI 53186	Saratoga Heights	subsidized
112	Waukesha	Waukesha	entrance lobby of the building	Subsidized_Housing	Stock Box	Myself	16-May-19 10:30 am	lobby	Saratoga Heights, 120 Corrina Blvd, Waukesha, WI 53186	Saratoga Heights	subsidized
113	Waukesha	Waukesha	Community Room	Subsidized_Housing	Stock Box	Myself	16-May-19 10:30 am	community room	Saratoga Heights, 120 Corrina Blvd, Waukesha, WI 53186	Saratoga Heights	subsidized
114	Waukesha	Waukesha	entrance lobby of the building	Subsidized_Housing	Stock Box	Myself	16-May-19 10:30 am	lobby	Saratoga Heights, 120 Corrina Blvd, Waukesha, WI 53186	Saratoga Heights	subsidized
115	Waukesha	Waukesha	Community Room	Subsidized_Housing	Stock Box	Myself	16-May-19 10:30 am	community room	Saratoga Heights, 120 Corrina Blvd, Waukesha, WI 53186	Saratoga Heights	subsidized
116	Waukesha	Menomonee Falls	Community Room	Recreation Center	Recruiting Drivers for Eras	Eras	27-June-19 2:00 pm	community room	Menomonee Falls Community Education and Recreation Center, W152 N8645 Margaret Road, Menomonee Falls	Menomonee Falls Community Education and Recreation Center	regular housing
117	Waukesha	Menomonee Falls	Private room	Recreation Center	none-by appointment	Eras	27-June-19 2:00 pm	private room	Menomonee Falls Community Education and Recreation Center, W152 N8645 Margaret Road, Menomonee Falls	Menomonee Falls Community Education and Recreation Center	regular housing
118	Waukesha	Menomonee Falls	Community Room	Recreation Center	Recruiting Drivers for Eras	Eras	27-June-19 2:00 pm	community room	Menomonee Falls Community	Menomonee Falls Community	regular housing

									Education and Recreation Center, W152 N8645 Margaret Road, Menomonee Falls	Education and Recreation Center	
119	Waukesha	Waukesha	Community Room	Recreation Center	none-by appointment	Eras	28-Jun-19 11:30 am to 2:00 pm	community room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
120	Waukesha	Waukesha	Community Room	Recreation Center	none-by appointment	Eras	28-Jun-19 11:30 am to 2:00 pm	community room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
121	Waukesha	Waukesha	Community Room	Recreation Center	none-by appointment	Eras	28-Jun-19 11:30 am to 2:00 pm	community room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
122	Waukesha	Waukesha	Community Room	Recreation Center	none-by appointment	Eras	28-Jun-19 11:30 am to 2:00 pm	community room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	subsidized
123	Waukesha	Waukesha	Community Room	Recreation Center	none-by appointment	Eras	28-Jun-19 11:30 am to 2:00 pm	community room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
124	Waukesha	Waukesha	Community Room	Recreation Center	none-by appointment	Eras	28-Jun-19 (11:30)	community room	1120 Baxter St, Waukesha, WI 53186	Waukesha Schuetze Recreation Center	regular housing
125	Milwaukee	Milwaukee	Private room	Subsidized_Housing	none-by appointment	Myself	12-June-2019 1:00 pm	private room	Calvary Gardens, 1555 W Chambers Ave	Calvary Gardens	subsidized
126	Milwaukee	Milwaukee	Private room	Subsidized_Housing	none-by appointment	Myself	12-June-2019 1:00 pm	private room	Calvary Gardens, 1555 W Chambers Ave	Calvary Gardens	subsidized
127	Milwaukee	Milwaukee	Private room	Subsidized_Housing	none-by appointment	Myself	12-June-2019 1:00 pm	private room	Calvary Gardens, 1555 W Chambers Ave	Calvary Gardens	subsidized

128	Milwaukee	Milwaukee	Private room	Subsidized_Housing	none-by appointment	Myself	12-June-2019 1:00 pm	private room	Calvary Gardens, 1555 W Chambers Ave	Calvary Gardens	subsidized
129	Milwaukee	Milwaukee	Private room	Subsidized_Housing	none-by appointment	Myself	12-June-2019 1:00 pm	private room	Calvary Gardens, 1555 W Chambers Ave	Calvary Gardens	subsidized
130	Milwaukee	Milwaukee	Private room	Subsidized_Housing	none-by appointment	Myself	12-June-2019 1:00 pm	private room	Calvary Gardens, 1555 W Chambers Ave	Calvary Gardens	subsidized
131	Waukesha	Waukesha	Community Room	Subsidized_Housing	Stock Box	Myself	26-April-2019 time: 10:00 am 2:30 pm	community room	801 N. East Ave. Waukesha, 53186	East Terrace Apts	subsidized
132	Waukesha	Waukesha	Community Room	Subsidized_Housing	Stock Box	Myself	26-April-2019 time: 10:00 am 2:30 pm	community room	801 N. East Ave. Waukesha, 53186	East Terrace Apts	subsidized
133	Waukesha	Waukesha	Community Room	Subsidized_Housing	Stock Box	Myself	26-April-2019 time: 10:00 am 2:30 pm	community room	801 N. East Ave. Waukesha, 53186	East Terrace Apts	subsidized
134	Waukesha	Waukesha	Community Room	Subsidized_Housing	Stock Box	Myself	26-April-2019 time: 10:00 am 2:30 pm	community room	801 N. East Ave. Waukesha, 53186	East Terrace Apts	subsidized
135	Waukesha	Waukesha	Community Room	Subsidized_Housing	Stock Box	Myself	26-April-2019 time: 10:00 am 2:30 pm	community room	801 N. East Ave. Waukesha, 53186	East Terrace Apts	subsidized
136	Waukesha	Waukesha	Community Room	Subsidized_Housing	Stock Box	Myself	26-April-2019 time: 10:00 am 2:30 pm	community room	801 N. East Ave. Waukesha, 53186	East Terrace Apts	subsidized
137	Milwaukee	Milwaukee	Private room	Subsidized_Housing	none-by appointment	Myself	05_May_2019 9:00 am	her unit	535 W Concordia Ave Milwaukee, WI 53212	Park Hill	subsidized
138	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	none-by appointment	Myself	05_May_2019 9:00 am	community room	535 W Concordia Ave Milwaukee, WI 53212	Park Hill	subsidized
139	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	none-by appointment	Myself	05_May_2019 9:00 am	community room	535 W Concordia Ave Milwaukee, WI 53212	Park Hill	subsidized
140	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	none-by appointment	Myself	05_May_2019 9:00 am	community room	535 W Concordia Ave Milwaukee, WI 53212	Park Hill	subsidized
141	Milwaukee	Milwaukee	entrance lobby of the building	Subsidized_Housing	Art Event (painting and coloring)	Myself	18-March-2019 time: 1:00 pm- 3:pm	lobby	1567 N Prospect Ave, Milwaukee, WI	Golda Meir House	subsidized
142	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Art Event (painting and coloring)	Myself	18-March-2019 time: 1:00 pm- 3:pm	community room	1567 N Prospect Ave, Milwaukee, WI	Golda Meir House	subsidized

143	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Art Event (painting and coloring)	Myself	18-March-2019 time: 1:00 pm- 3:pm	community room	1567 N Prospect Ave, Milwaukee, WI	Golda Meir House	subsidized
144	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Art Event (painting and coloring)	Myself	18-March-2019 time: 1:00 pm- 3:pm	community room	1567 N Prospect Ave, Milwaukee, WI	Golda Meir House	subsidized
145	Milwaukee	Milwaukee	entrance lobby of the building	Subsidized_Housing	Art Event (painting and coloring)	Myself	18-March-2019 time: 1:00 pm- 3:pm	lobby	1567 N Prospect Ave, Milwaukee, WI	Golda Meir House	subsidized
146	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Art Event (painting and coloring)	Myself	18-March-2019 time: 1:00 pm- 3:pm	community room	1567 N Prospect Ave, Milwaukee, WI	Golda Meir House	subsidized
147	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Library and then Vegetable Box	Myself	20-March-2019 time: 10:00 am- 2:00 pm	community room	415 E. Knapp St. Milwaukee	Jefferson Court	subsidized
148	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Library and then Vegetable Box	Myself	20-March-2019 time: 10:00 am- 2:00 pm	community room	415 E. Knapp St. Milwaukee	Jefferson Court	subsidized
149	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Library and then Vegetable Box	Myself	20-March-2019 time: 10:00 am- 2:00 pm	community room	415 E. Knapp St. Milwaukee	Jefferson Court	subsidized
150	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Library and then Vegetable Box	Myself	20-March-2019 time: 10:00 am- 2:00 pm	community room	415 E. Knapp St. Milwaukee	Jefferson Court	subsidized
151	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Library and then Vegetable Box	Myself	20-March-2019 time: 10:00 am- 2:00 pm	community room	415 E. Knapp St. Milwaukee	Jefferson Court	subsidized
152	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Library and then Vegetable Box	Myself	20-March-2019 time: 10:00 am- 2:00 pm	community room	415 E. Knapp St. Milwaukee	Jefferson Court	subsidized
153	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Stock Box	Myself	26-March-2019 morning till noon	community room	824 W. Galena St. Milwaukee	Plymouth Apts.	subsidized
154	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Stock Box	Myself	26-March-2019 morning till noon	community room	824 W. Galena St. Milwaukee	Plymouth Apts.	subsidized
155	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Stock Box	Myself	26-March-2019 morning till noon	community room	824 W. Galena St. Milwaukee	Plymouth Apts.	subsidized
156	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Stock Box	Myself	26-March-2019 morning till noon	community room	824 W. Galena St. Milwaukee	Plymouth Apts.	subsidized
157	Milwaukee	Milwaukee	Community Room	sub_housing_and_dining_location	Dining (Lunch)	Myself	25-April-19 lunch time (11:00 am- 1:00 pm)	community room	6700 W Appleton Ave	Fernwood Court Apartments	subsidized

158	Milwaukee	Milwaukee	Community Room	sub_housing_and_dining_location	Dining (Lunch)	Myself	25-April-19 lunch time (11:00 am- 1:00 pm)	community room	6700 W Appleton Ave	Fernwood Court Apartments	subsidized
159	Milwaukee	Milwaukee	Community Room	sub_housing_and_dining_location	Dining (Lunch)	Myself	25-April-19 lunch time (11:00 am- 1:00 pm)	community room	6700 W Appleton Ave	Fernwood Court Apartments	subsidized
160	Milwaukee	Glendale	Community Room	Subsidized_Housing	none-by appointment	Myself	16-March-2020 10:30 am-1:15 pm	community room	Glen Court Apartments, 6101 N Green Bay Ave, Glendale, WI 53209	Glen Court Apartments	subsidized
161	Milwaukee	Glendale	Community Room	Subsidized_Housing	none-by appointment	Myself	16-March-2020 10:30 am-1:15 pm	community room	Glen Court Apartments, 6101 N Green Bay Ave, Glendale, WI 53209	Glen Court Apartments	subsidized
162	Milwaukee	Glendale	Community Room	Subsidized_Housing	none-by appointment	Myself	16-March-2020 10:30 am-1:15 pm	community room	Glen Court Apartments, 6101 N Green Bay Ave, Glendale, WI 53209	Glen Court Apartments	subsidized
163	Milwaukee	Glendale	Community Room	Subsidized_Housing	none-by appointment	Myself	16-March-2020 10:30 am-1:15 pm	community room	Glen Court Apartments, 6101 N Green Bay Ave, Glendale, WI 53209	Glen Court Apartments	subsidized
164	Milwaukee	Milwaukee	Building Hallway	Subsidized_Housing	Annual Health, Safety & Awareness Fair	Myself	21-June-2019 12:00 pm- 3:30 pm	hallway	She is the resident of C.G. Robinson Terrace. The address: 2020 N. 15th St., Milwaukee, WI 53205	C.G. Robinson Terrace (total of units:24) but St Mark has total units of 50.	subsidized
165	Milwaukee	Milwaukee	Building Hallway	Subsidized_Housing	Annual Health, Safety & Awareness Fair	Myself	21-June-2019 12:00 pm- 3:30 pm	hallway	*The interviewee is the resident of St Mark Place. But I interviewed the person at:C.G. Robinson Terrace,	C.G. Robinson Terrace (total of units:24) but St Mark has total units of 50.	subsidized

									2020 N. 15th St., Milwaukee, WI 53205		
166	Milwaukee	Milwaukee	Building Hallway	Subsidized_Housing	Annual Health, Safety & Awareness Fair	Myself	21-June-2019 12:00 pm- 3:30 pm	hallway	*The interviewee is the resident of St Mark Place. But I interviewed the person at:C.G. Robinson Terrace, 2020 N. 15th St., Milwaukee, WI 53205	C.G. Robinson Terrace (total of units:24) but St Mark has total units of 50.	subsidized
167	Milwaukee	Milwaukee	Building Hallway	Subsidized_Housing	Annual Health, Safety & Awareness Fair	Myself	21-June-2019 12:00 pm- 3:30 pm	hallway	*The interviewee is the resident of C.G. Robinson Terrace. The address: 2020 N. 15th St., Milwaukee, WI 53205	C.G. Robinson Terrace (total of units:24) but St Mark has total units of 50.	subsidized
168	Milwaukee	Milwaukee	building's patio	Subsidized_Housing	none-by appointment	Myself	09-Aug_2019 11:00 am	building's patio	Bradford Place Apartments, 2323 E Bradford Ave, Milwaukee, WI 53211	Bradford Place Apartments	subsidized
169	Milwaukee	Milwaukee	Private room	Subsidized_Housing	none-by appointment	Myself	12-July_2019 1:00 pm	her unit	Bradford Place Apartments, 2323 E Bradford Ave, Milwaukee, WI 53211	Bradford Place Apartments	subsidized
170	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	none-by appointment	Myself	27-02-2020 10:00 am-11:30 am	community room	State Street Apartments, 955 N 14th St, Milwaukee, WI 53233	State Street Apartments	subsidized
171	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	none-by appointment	Myself	27-02-2020 10:00 am-11:30 am	community room	State Street Apartments, 955 N 14th St, Milwaukee, WI 53233	State Street Apartments	subsidized
172	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	none-by appointment	Myself	27-02-2020 10:00 am-11:30 am	community room	State Street Apartments, 955 N	State Street Apartments	subsidized

									14th St, Milwaukee, WI 53233		
173	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Laundry	Myself	12-April-19 time: 10 am-1:00 pm	community room	Walnut Park Apartments, 1551 N 9th St, Milwaukee, WI 53205	Walnut Park Apartments	subsidized
174	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Laundry	Myself	12-April-19 time: 10 am-1:00 pm	community room	Walnut Park Apartments, 1551 N 9th St, Milwaukee, WI 53205	Walnut Park Apartments	subsidized
175	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Laundry	Myself	12-April-19 time: 10 am-1:00 pm	community room	Walnut Park Apartments, 1551 N 9th St, Milwaukee, WI 53205	Walnut Park Apartments	subsidized
176	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Laundry	Myself	12-April-19 time: 10 am-1:00 pm	community room	Walnut Park Apartments, 1551 N 9th St, Milwaukee, WI 53205	Walnut Park Apartments	subsidized
177	Milwaukee	Milwaukee	coordinator's office (by phone)	Subsidized_Housing	Laundry	Myself	12-April-19 time: 10 am-1:00 pm	coordinator's office	Walnut Park Apartments, 1551 N 9th St, Milwaukee, WI 53205	Walnut Park Apartments	subsidized
178	Milwaukee	Milwaukee	Community Room	Subsidized_Housing	Laundry	Myself	12-April-19 time: 10 am-1:00 pm	community room	Walnut Park Apartments, 1551 N 9th St, Milwaukee, WI 53205	Walnut Park Apartments	subsidized

Appendix F: Informed Consent for Research Participation

UNIVERSITY of WISCONSIN
UWMILWAUKEE

Informed Consent for Research Participation
IRB #: 19.117
IRB Approval Date: March 25, 2019

Study title	Assessing the Impact of Urban and Suburban Settings on Seniors' Travel Behavior in Milwaukee County, Waukesha County and Ozaukee County
Researcher[s]	Hamideh Moayyed/ Doctoral Student/ Urban Studies Programs

We're inviting you to participate in a research study. Participation is completely voluntary. If you agree to participate now, you can always change your mind later. There are no negative consequences, whatever you decide.

What is the purpose of this study?

I want to study how the neighborhood you live in impacts your daily travel. I also want to see how your travel preferences have modified or changed throughout time.

What will I do?

I will ask you some basic demographic questions about the trips that you usually make for example for shopping, visiting your friends/family, recreation, etc. and the type of transport that you usually use. Also, I will ask you some questions regarding your past travel experiences. The questions are related to travel mode and the facilities of your living environment. (10-15 min)

Risks

Possible risks	How we're minimizing these risks
Some questions may be very personal	You can skip any questions you don't want to answer.
Breach of confidentiality (your data being seen by someone who shouldn't have access to it)	• The survey is audio recorded. However, the audio recording is optional. I will not record your voice without asking your permission. If you agree to be audio recorded, I will audio record your verbal consent. • If we quote you, we will use a pseudonym (fake name).

Other Study Information

Possible benefits	Our study doesn't have any individual benefits for taking part in the study. However, your contribution in this study brings a lot of benefits to the society including: • Helping understand about the elderly's travel preferences • Helping understand how the living environment impacts elderly's travel behavior • Helping to find solutions for the elderly's travel needs
Estimated number of participants	# approximately 340 people
How long will it take?	The survey takes about 10-15 minutes.
Costs	None

Give a copy of this form to the research participant 1

Compensation	None
Future research	The data will be used in future research. If the data is used in future research, it will be de-identified (i.e. no name).

Confidentiality and Data Security

I'll collect the following identifying information for the research: the closest intersection to your current and previous home. This information is necessary since I want to collect information about the urban facilities of your neighborhood.

Where will data be stored?	The survey responses are stored in a locked cabinet at home. After entering the responses into my computer, I'll destroy the survey forms. The audio recordings and transcriptions are stored in my password-protected computer and cell phone.
How long will it be kept?	Once the transcriptions are complete, the audio recordings will be removed from the computer and cell phone (about 4 months after doing the surveys). The transcriptions are kept until publishing the research results in academic journals (about 2 years).

Who can see my data?	**Why?**	**Type of data**
The researcher	To analyze the data and conduct the study	-De-identified (no names, birthdate, address, etc.)
The IRB (Institutional Review Board) at UWM The Office for Human Research Protections (OHRP) or other federal agencies	To ensure we're following laws and ethical guidelines	-De-identified (no names, birthdate, address, etc.)
Anyone (public)	If we share our findings in publications or presentations	• Aggregate (grouped) data • De-identified (no names, address, etc.)

Contact information:

For questions about the research	Hamideh Moayyed Robert James Schneider	Phone: 414-458-2632 Email: hmoayyed@uwm.edu Phone: 414-229-384 Email: rjschnei@uwm.edu
For questions about your rights as a research participant	IRB (Institutional Review Board; provides ethics oversight)	414-229-3173 / irbinfo@uwm.edu
For complaints or problems	Hamideh Moayyed Robert James Schneider	Phone: 414-458-2632 Email: hmoayyed@uwm.edu Phone: 414-229-384 Email: rjschnei@uwm.edu
	IRB	414-229-3173 / irbinfo@uwm.edu

Agreement to Participate
If you have had all your questions answered and would like to participate in this study, we can start the survey. Remember, your participation is completely voluntary, and you're free to withdraw from the study at any time.

Agreement to Audio Recording
If you agree to have your survey audio recorded, I will audio record your verbal consent. Please say "I agree" if you allow me to audio record your responses.

Appendix G: Results of the Hausman-McFadden test

Hausman-McFadden test

data: setV2

chisq = 0.8848, df = 4, p-value = 0.9267

alternative hypothesis: IIA is rejected