University of Alberta

An Exploration of the Relationship between Socio-Demographic, Physical, and Mental Health Factors and the Ratings of Importance that Older Adults Place upon Different Attributes of Alternate Transportation for Seniors Services

by

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Abstract

The primary objectives of the research were to explore the underlying factor structure of the 5 A's (Availability, Acceptability, Accessibility, Adaptability, Affordability) of senior friendly transportation and to identify variables (e.g., sex, age, location, income, health status, etc.) associated with older adults' ratings of importance of different features of each of the 5 A's. Exploratory Factor Analyses revealed three underlying latent factors: Essential Features; Non-Essential Features; and Demand Response Scheduling. Composite measures were developed to represent the ratings of importance that older adults place upon different features of senior friendly transportation. Based on multiple regression analyses, significant variables associated with older adults' ratings of importance included driving status, sex, age, and income with the patterns of findings varying across the three factors. These results can be used to inform on more responsive models of alternate transportation for seniors.

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List of Abbreviations and Symbols

General Abbreviations

AARP	American Association of Retired Persons
AASRO	Association of Academic Survey Research Organizations
ACE	Angiotensin Converting Enzyme
ACTIVE	Advanced Cognitive Training for Independent and Vital Elderly
ADL	Activities of Daily Living
AHEAD	Asset and Health Dynamics Among the Oldest Old
AMA	Alberta Motor Association
ATS	Alternate Transportation for Seniors
CATI	Computer Assisted Telephone Interviewing
CCHS	Canadian Community Health Survey
ECA	Epidemiologic Catchment Area
EFA	Exploratory Factor Analysis
EPESE	Established Populations for Epidemiologic Studies of the Elderly
FARS	Fatality Analysis Reporting System
FOIPP	Freedom of Information and Protection of Privacy Act
GSS	General Social Survey
HREB	Health Research Ethics Board
MARD	Medically At-Risk Driver
NHANES	National Health and Nutrition Examination Survey
NHTS	National Household Travel Survey
NPTS	Nationwide Personal Transportation Survey
NSAID	Non-Steroidal Anti-Inflammatory Drug
OECD	Organisation for Economic Co-operation and Development
PHAC	Public Health Agency of Canada
PRL	Population Research Laboratory
RDD	Random Digit Dialing
RHA	Regional Health Authority
SPSS	Statistical Package for the Social Sciences
WHO	World Health Organization
YHAP	Yale Health and Aging Project

Mathematical Abbreviations and Symbols

B	Represents unstandardized values of regression coefficients
CI	Confidence Interval
HR	Hazard Ratio
n	denotes the number of members in a portion of the total sample
N	denotes the number of members in the total sample
OR	Odds Ratio
p	p Value
RR	Relative Risk
R^2	Coefficient of Determination
SD	Standard Deviation
α	Alpha (denotes Cronbach's coefficient of internal consistency)
β	Beta (denotes standardized values of regression coefficients)
>	Greater than
≥	Greater than or equal to
<	Less than
≤	Less than or equal to

Chapter 1. Introduction, Background Issues, and Literature Review of Older Adults and Mobility

1.1 General Introduction

Out-of-home mobility can be understood as movement that occurs beyond the home and involves the use of some form of transportation. It provides older adults (individuals 65 years of age and older) with opportunities in which to access essential services and to remain connected, involved, and active within society. In their report on aging and transportation alternatives, the Organisation for Economic Co-operation and Development (OECD) (2001) stressed that mobility is strongly related to independence and is a significant factor that contributes to the welfare of older adults.

Out-of-home mobility and transportation are intimately intertwined as transportation often serves as the vehicle by which mobility is achieved (Finlayson & Kaufert, 2002). An individual's out-of-home mobility is strongly linked to the availability and accessibility of different modes of transportation. The World Health Organization (WHO) (2007) has outlined that available transportation is a characteristic feature of age-friendly cities. It also stressed the importance of transportation in promoting active aging and enabling social and community participation, as well as continued access to resources and services within the community among older adults (WHO, 2007). Furthermore, as noted in the Public Health Agency of Canada (PHAC) (2010) report, social connectedness and social engagement are significant to the experience of healthy aging among older adults. The authors also stressed that accessible transportation alternatives are a fundamental aspect of age-friendly cities and age-friendly environments.

The vast majority of older adults today rely on the private vehicle to meet their mobility needs (Alsnih & Hensher, 2003; OECD, 2001). Increasing proportions of older adults are aging in place, with those living in suburbs and in rural locations requiring a high degree of private vehicle use for out-of-home mobility (D'Ambrosio, Coughlin, Pratt, & Mohyde, 2012; Rosenbloom, 2003; Suen & Sen, 2004). As both of these environments have not been configured to

support other forms of transportation, it is expected that future cohorts of older adults will continue to rely on the private vehicle as the dominant mode by which they travel (Burkhardt & McGavock, 1999; Turcotte, 2012). When no longer able to drive, older adults will be faced with having to depend on alternate modes of transportation to satisfy their mobility needs.

According to Dobbs, Lee, and Song (2011), there are two primary categories of transportation services that are available to older adults: conventional public transportation and alternate transportation. Public transportation can be sub-categorized into for-profit (i.e., taxis, limousines, van pools, motorcoaches) and not-for-profit (i.e., buses, light rail transit, specialized transportation) services (Dobbs et al., 2011). Use of public transportation as an alternative to the private vehicle has long been thought of as an attractive solution for older adults who do not drive, choose not to drive, or are no longer able to drive. Unfortunately, it has been consistently demonstrated that only a very small proportion of older adults rely on public transportation and often, it is considered the "mode of last resort" (Alsnih & Hensher, 2003, p. 910). This is because for-profit and not-for-profit public sector transportation programs and services have not been designed to meet the unique needs and challenges of many older adults, including those with medical impairments. Specifically, research has demonstrated that individuals with mobility issues or older adults who have given up driving due to sensory, motor, and/or cognitive impairments face many barriers to using conventional public transportation options (Harris & Tapsas, 2006; Kostyniuk & Shope, 2003; Oxley & Whelan, 2008; Rosenbloom, 2003; Suen & Sen, 2004). Barriers of public transportation that make it a less attractive alternate to the private vehicle include its availability, scheduling and frequency of trips, reliability, cost, accessibility, as well as concerns about safety (Dobbs et al., 2011; Peck, 2010).

For many older adults, the transition away from the private vehicle, along with the barriers associated with conventional public transportation use, give rise to the importance of alternate transportation for seniors (ATS) services for meeting their mobility needs. ATS services are modes of transportation that exist outside of public transportation programs and include both for-profit and not-for-profit paratransit (i.e., private vehicles, buses, handivans, minivans) services

(Dobbs et al., 2011). These types of transportation services are designed and tailored specifically to meet the mobility needs of older adults who face challenges in driving personal vehicles or using conventional public transportation services (Freund, 2004; Oxley & Whelan, 2008).

The relationship between out-of-home mobility, independence, and autonomy among older adults has been well documented and a significant body of literature now exists. Research has shown that access to transportation is a particularly salient issue among older adults in that it influences and impacts quality of life and well-being (Banister & Bowling; 2004; Burkhardt, 1999; Carp, 1988; Eisenhandler, 1990; Oxley & Whelan, 2008; Owsley, 2002; Whelan, Langford, Oxley, Koppel, & Charlton, 2006). Given the changing demographics and health status of older adults in developed nations, it is expected that an increasingly larger proportion of older adults will face reductions in mobility as 'giving up the car keys' becomes inevitable. With this, among older adults a shift from reliance on the private vehicle to reliance and dependence on others or on alternate forms of transportation to maintain mobility will likely occur.

Reduced out-of-home mobility and lack of access to transportation among older adults is an individual, family, and public health issue that results in substantial consequences for all those affected. As noted previously, traditional public transportation services have not been designed towards meeting the mobility needs of a substantially larger proportion of older adults. Suen and Sen (2004) noted that the mobility problems faced by many older adults often result from a lack of suitable, accessible, and available alternatives to driving. They also outlined that transportation planners are largely unaware of the mobility needs of an ever growing population of older adults and that the traditional transportation philosophy tends to be supply or operator oriented. Barring changes to traditional transportation services, it can be expected that the role of ATS services for older adults will gain in importance over the next few decades.

1.2 Background Review of Issues Relevant to Mobility in Older Adults

1.21 Population Aging and the Anticipated Impact on Transportation Services

Developed nations around the globe currently are experiencing a significant demographic change characterized by accelerated population aging. The result has been an upward shift in the age structure and composition of these nations. On a global level, the WHO (2011) noted that the proportion of individuals aged 65 years and older is projected to increase from 8% of the world's population in 2010 to almost 12% of the world's population by 2030. In 2010, the United States Census Bureau reported that there were 40 million Americans aged 65 and older, accounting for over 13% of the population and future projections suggest that the number and proportion of older Americans will increase to 72 million, or 20% of the population by 2030 (Federal Interagency Forum on Aging-Related Statistics, 2012). Like other developed nations, Canada also is experiencing a demographic transition and shift toward an aging society. For example, in 1960, older adults (individuals aged 65 years or older) comprised 8% of the Canadian population; however, by 2010 the proportion of older adults had increased to 14% (Statistics Canada, 2011). The most current Census data indicate that in 2011 almost five million individuals, or approximately 15% of the Canadian population, were 65 years of age or older (Statistics Canada, 2012a). Population projections suggest that by 2030, older adults will account for almost 23% of Canada's population (Statistics Canada, 2010).

The graying of developed nations has been attributed to three factors: declining fertility, increased life expectancy, and the aging of the baby boomers (Chappell, McDonald, & Stones, 2008). In Canada, the fertility rate in 2011 was reported to be 1.6 births per woman, a rate well below the population replacement level of 2.1 births per woman (Statistics Canada, 2013a). As a comparison, at the height of the baby boom in 1959, the fertility rate on average was reported to be 3.9 births per woman (Statistics Canada, 2008). As a nation's fertility declines, the absolute number and proportion of children in a population declines which subsequently leads to an increase in the proportion of older individuals. Similar trends with respect to declining fertility rates have been

reported in the United States and in many developed European nations as well (Population Reference Bureau, 2013).

Moreover, the trend for increased life expectancy among individuals in developed nations has impacted population aging substantially. During the 20th century, gains of almost 30 years in life expectancy have been reported in many developed nations (Christensen, Doblhammer, Rau, & Vaupel, 2009). Among member countries of the OECD, significant gains have occurred where on average, life expectancy at birth is reported to be 80 years which is an increase of over 10.0 years since 1960 (OECD, 2013). In Canada alone, life expectancy has continued to increase for both sexes since 1961 (OECD, 2011; PHAC, 2010). As an illustration, Canadian statistics for life expectancy at birth for the three-year period between 1960 and 1962 reported that on average, men could be expected to live 68 years and women to 74 years. In comparison, between 2007 and 2009, life expectancy at birth for men was almost 79 years, women could be expected to live to 83 years, and the overall average for both sexes combined was reported to be 81 years. This corresponds to an increase of 0.2 years in life expectancy from the 2006 to 2008 reporting period alone (Statistics Canada, 2012b).

An upward trend in life expectancy has also been reported for seniors (adults aged 65 and older). Data from the United States in 2009 indicated that individuals surviving to 65 years of age could expect to live an additional 19 years. For those surviving to 85 years of age, women could expect to live an additional seven years and men an additional six years (Federal Interagency Forum on Aging-Related Statistics, 2012). In Canada, during the three-year period from 2007 to 2009, an older adult 65 years of age could expect to live an additional 20 years, up more than 2 years from 1992 to 1994 (Statistics Canada, 2012b).

Additionally, increased life expectancy among the older adult population will specifically contribute to unprecedented growth amongst the oldest-old (those individuals aged 85 years and older). The United Nations (2011) has outlined that with increased life expectancy at birth, the proportion of individuals 85 years of age is projected to increase by 351% between 2010 and 2050 and the proportion of individuals 100 years of age and older is projected to increase by 1004%

during this same time period. In Canada in 2009, there were 1.3 million individuals 80 years of age or older, which was twice as many as what was reported in 1990 (Statistics Canada, 2010). Growth in the proportion of older adults in each of the five year increment blocks from age 85 to age 99 ranged from 23% to almost 26% in 2011 (Statistics Canada, 2012a). Furthermore, current Canadian statistics indicate that in 2011, the second most rapidly growing age group after those aged 60 to 64 years was the centenarians (Statistics Canada, 2012a). Based on 2011 Census data, the number of centenarians in Canada rose over 25%, from 4,635 individuals 100 years of age and older in 2006 to 5,825 in 2011 (Statistics Canada, 2012c).

According to Canadian population projections under a medium-growth scenario, by 2036 the proportion of individuals 80 years of age or older among the population 65 years of age and older will be almost 33%. By 2061, this proportion is expected to increase to almost 40% (Statistics Canada, 2010). Similar trends are expected in the United States with data from the United States Census Bureau indicating that in 2010, there were 5.5 million Americans 85 years of age and older, with this number projected to increase to 19 million by 2050 (Federal Interagency Forum on Aging-Related Statistics, 2012).

Until the 1920's, most gains in life expectancy occurred at younger ages and were propelled by increased childhood survival. However, reductions in old age mortality today have resulted in the continued gains in life expectancy experienced at older ages (Christensen et al., 2009; Fries, 1980; Kannisto, Lauritsen, Thatcher, & Vaupel, 1994). The gains in life expectancy observed among developed nations often are attributed to increased health care spending, raised living standards, lifestyle changes, increased public health and educational measures, as well as environmental improvements (OECD, 2013). It has been suggested that if these gains continue throughout the 21st century, most babies born in developed countries will live to see their 100th birthday (Christensen et al., 2009).

Along with declining fertility and gains in life expectancy, the progressive growth of the elderly population among developed nations has been largely influenced by the aging of the baby boomers. In Canada, the term 'baby boomer' defines the generation of individuals born between 1946 and 1965 and

represents the largest birth cohort in Canadian history. During this 20 year period, 8.2 million births were recorded, representing an average 412,000 babies born per year. Based on recent Census data, in 2011, almost three of every 10 (29%) Canadians were baby boomers (Statistics Canada, 2012d).

With the first of the baby boomers reaching their senior years in 2011, Canada's population will continue to experience a significant demographic shift and accelerated population aging, with older adults accounting for an even increasingly larger proportion of the population over the next three decades. As an illustration and noted previously, current census data indicates that in 2011, almost 15% of the Canadian population was 65 years of age and older (Statistics Canada, 2011). However, based on a medium-growth scenario, Canadian population projections suggest that by 2036, the proportion of older adults will range between 23% and 25% and by 2061 when the last of the baby boomers enter their senior years, it is expected that older adults will account for 24% to 28% of the population (Statistics Canada, 2010).

Population aging will not only affect the delivery of health care and social programs and create issues within the workforce (Wiener & Tilly, 2002), it will influence and have a significant impact on the development of ATS services and programs that aim to keep older adults mobile long into their senior years. Specifically, it is anticipated that the aging of the baby boomers, along with increased longevity, will result in increased recognition for, and development of, ATS services. The graying of the population will lead to special challenges faced by transportation planners in that the future cohort of older adults will be substantially larger than what has been previously recognized. However, understanding the transportation needs of this increasingly larger cohort of older adults is essential and a precursor for being able to develop appropriate ATS models for future generations of older adults.

Additionally, the saliency of mobility and its relationship to independence, well-being, and quality of life (Carp, 1988) will be highlighted not only by the unprecedented growth in the older adult population but by the anticipated changing characteristics and travel demands of an aging society. The transition toward a predominantly older population may impact the delivery of ATS services as with the aging of the baby boomers there may be new demands for mobility

and transportation that will differ substantially from the mobility needs of previous cohorts of older adults. Coughlin (2009) highlighted that "for more than six decades the boomer generation has forged the very shape and operation of America's transportation system" (p. 301) and it can be expected that this cohort will continue to exert its influence on the provision of ATS services well into the future.

1.22 The Health Status of Older Adults

In addition to the present and projected increases in the proportion of older adults, the health status of the current, as well as future cohorts, of older adults have implications for the development of ATS policies and delivery of ATS programs. Overall, the current cohort of older adults is more educated, wealthier, active, healthier, and living longer than older adults from previous generations (Canadian Institute for Health Information, 2011a; Chen & Millar, 2000; Coughlin, 2009; He, Sengupta, Velkoff, & Barros, 2005; Rosenbloom & Stahl, 2002). Data collected between 2008 and 2010 as part of the National Health Interview Survey in the United States reported that 76% of individuals 65 years of age and older rated their health as *good*, *very good*, or *excellent*. Specifically, 79% of older adults aged 65 to 74 years reported that their health was *good* or better and 67% of older adults aged 85 years and older reported that their health was *good* or better (Federal Interagency Forum on Age-Related Statistics, 2012). Similarly, data from the 2009 Canadian Community Health Survey (CCHS) – Healthy Aging indicated that among older adults who participated, 44% rated their current health to be *very good* or *excellent* and 37% reported that they had recently engaged in some kind of action to improve their health (PHAC, 2010). The affluent and active lifestyle of this healthy cohort of older adults will likely yield increasingly greater demands for responsive modes of transportation in the future to support independent living when they are no longer able to drive and it is likely that the mobility expectations of this cohort will be greater than what was previously recognized in past generations (Coughlin, 2009).

Although a number of baby boomers will be healthier than previous cohorts of older adults, there also will be a significant number of baby boomers with chronic medical conditions mainly due to modifiable lifestyle factors (Canadian Institute for Health Information, 2011a, 2011b). This is not surprising as globally,

the world has undergone an epidemiological transition from the leading cause of death being infectious disease to the leading cause of death now being chronic, degenerative, and man-made diseases (Goulding, Rogers, & Smith; 2003; Harper & Armelagos, 2010; Omran, 1971). Rising rates of modifiable risk among older adults across different health status indicators also have been reported in the United States. Using data from the National Health and Nutrition Examination Survey (NHANES), King, Matheson, Chirina, Shankar, and Broman-Fulks (2013) compared baby boomers (NHANES data collected from 2007 to 2010) to a previous generation of older adults (NHANESIII data collected from 1988 to 1994) on variables such as health status, healthy lifestyle characteristics, and presence of chronic disease. With respect to health status, over 13% of baby boomers reported having excellent health compared to 32% of older adults from the previous generation. However, baby boomers were less active than the previous cohort where over half (52.2%) of baby boomer respondents reported engaging in no regular physical activity compared to just over 17% of older adults from the previous generation. Additionally, rates of obesity were higher among baby boomers with almost 39% of this cohort being characterized as obese compared to just over 29% of older adults from the previous cohort.

Similar trends in rising rates of modifiable risk among older adults across different health status indicators also have been reported in Canada. According to the PHAC (2006), a large proportion of Canadian older adults are physically inactive and with advancing age, there is a trend toward decreasing physical activity levels. Data collected in 2009 indicated that over half (57%) of older adults in Canada were considered to be physically inactive (PHAC, 2010). As well, rising rates of obesity also are evident among the current cohort of older adults in Canada. Specifically, from 1979 to 2004, the prevalence of obesity among older adults 65 to 74 years of age increased from 20% to 25%. For older adults 75 years of age and older, the prevalence of obesity increased from 11% to 24% (Turcotte & Schellenberg, 2007). Not only is obesity among older adults associated with a higher risk for cardiovascular disease, it is associated with lower life expectancy, higher morbidity, a greater risk of developing chronic medical conditions, and increased risk for functional limitations and mobility impairments (Davison, Ford, Cogswell, & Dietz, 2002; Galanos, Pieper, Cornoni-Huntley, Bales, & Fillenbaum, 1994; Harris et al., 1997; Reed et al., 1998). The

demographic shift toward an aging society, along with increased longevity and the trend toward rising rates of risk across modifiable lifestyle factors will result in significant increases in the prevalence of chronic medical conditions and illnesses among the older adult population (Denton & Spence, 2010; King et al., 2013; PHAC, 2011).

Research has demonstrated that the likelihood of having at least one chronic medical condition increases with advancing age and the proportion of older adults with multiple chronic medical conditions, or co-morbidity, increases as well (Anderson & Horvath, 2004; Broemeling, Watson, & Prebtani, 2008; Canadian Institute for Health Information, 2011b; Naughton, Bennett, & Feely, 2006). Data from the 2008 Canadian Survey of Experiences with Primary Health Care showed that 76% of older adult respondents reported having at least one of 11 chronic conditions and 24% of older adults in the same sample reported being diagnosed with three or more chronic conditions (Canadian Institute for Health Information, 2011b). Subsequent research conducted in 2009 indicated that the vast majority (89%) of Canadian older adults reported having at least one chronic condition and 25% of older adults aged 65 to 79 years reported having four or more chronic conditions. For older adults aged 80 years and older during the same time period, the proportion reporting four or more chronic conditions increased to 37% (PHAC, 2010). Similar findings demonstrating this trend toward increased prevalence of chronic medical conditions among older adults and increased likelihood of co-morbidity with advancing age also have been reported in the United States and Europe (Bonneux & Looman, 2003; Flegal, Carroll, Ogden, & Curtin, 2010; Lafortune & Balestat, 2007; Leveille, Wee, & Iezzoni, 2005; Marengoni, Winblad, Karp, & Fratiglioni, 2008; Martin, Freedman, Schoeni, Schellevis, & Andreski, 2009; Parker, Ahacic, & Thorslund, 2005; Puts, Deeg, Hoeymans, & Nusselder, 2008; Vogeli et al., 2007).

In addition to the likelihood of being diagnosed with a single chronic medical condition or multiple chronic conditions, older adults are more likely to be prescribed and to take multiple medications to manage their illnesses (Ray, Gurwitz, Decker, & Kennedy, 1992; Naughton et al., 2006; Vogeli et al., 2007). A study of 3,005 community-dwelling older adults conducted in the United States between 2005 and 2006 demonstrated that 81% of older adults up to 85 years of

age were taking at least one prescription medication; 29% of the entire sample was taking five or more prescription medications; and among older adults between the ages of 75 and 85 years, 36% were taking five or more prescription medications (Qato, Alexander, Conti, Schumm, & Lindau, 2008). Data from 1998/1999 showed that among Canadians aged 65 years of age and older with three or more chronic conditions, almost 30% reported taking five or more medications compared to just over 2% of older adults with no or one chronic condition (Ramage-Morin, 2009). Based on analyses of the National Prescription Drug Utilization Information database, the Canadian Institute for Health Information (2010) noted that the majority of older adults were using multiple medications and 62% of older adults in Canada on public drug programs were using at least five or more drug classes. Older adults taking multiple medications are more likely to suffer adverse drug effects as characterized by impairments in cognition and everyday functioning because of age-related changes in the pharmacokinetics (i.e., absorption, distribution, metabolism, and excretion) of drugs and because of the physiologic effect of the drug on the body (i.e., pharmacodynamics) itself (Boparai & Korc-Grodzicki, 2011; Qato et al., 2008; Williams, 2002).

1.23 The Relationship between Health Status and Driving Competence among Older Adults

The health status of individuals has important implications for competency to drive. This is because many illnesses can negatively impact the sensory, motor, and/or cognitive functions needed for safe driving. As well, some medications used to treat different illnesses also can negatively impact the functional abilities needed for safe driving apart from the effects of the medical condition for which it is prescribed (Sagberg, 2006).

Elevated Motor Vehicle Crash Risk among Older Adults

Research has consistently reported that when exposure (e.g., mileage driven) is taken into consideration, the motor vehicle crash rates of older drivers are comparable to those of high-risk younger drivers whose crash rates exceed the rates of all other age groups (Baldock & McLean, 2005; Cross et al., 2009; Dellinger, Langlois, & Li, 2002; Dobbs, 2008; Lyman, Ferguson, Braver, & Williams, 2002; Massie, Campbell, & Williams, 1995; McGwin Jr. & Brown, 1999;

OECD, 2001; Ryan, Legge, & Rossman, 1998). Given the aging of the population and increased longevity among older adults, the issue of older drivers' crash rates is expected to grow. Specifically, using current crash rates per licensed driver and using projections of population growth to estimate the expected number of older drivers in the future, Lyman and colleagues (2002) suggested that by 2030, older driver involvement in police reported crashes is expected to increase by 178%, accounting for 40% of the expected increase in all crashes, and older driver involvement in fatal motor vehicle accidents is expected to increase by 155%, accounting for more than 50% of the expected increase in fatalities.

The personal and public health impact of motor vehicle crashes among older drivers are great. Extensive research has highlighted the higher fatality risk and increasing risk of fatality with advancing age of older drivers involved in motor vehicle crashes. Evans (2001), using as a sample 252,564 fatally injured subjects from the Fatality Analysis Reporting System (FARS), demonstrated that after controlling for the severity of crash impact, older drivers consistently had more fatal crash outcomes compared to younger age groups and they were more likely to be fatally injured. Specifically, when comparing 70 year old individuals to 20 year old individuals, the risk of death for males 70 years of age was 250% greater than for males 20 years of age. With respect to female drivers, the risk of death for females 70 years of age exceeded the risk of death for females 20 years of age by 190%. Additionally, when involved in motor vehicle crashes of equal magnitude, 70 year old males were 3.52 times as likely to die compared to 20 year old males; with older females 2.95 times as likely to die compared to 20 year old females. Furthermore, research has suggested that the fatal crash rate of drivers aged 85 years and older is amongst the highest of all age groups (Baldock & McLean, 2005).

In a more recent study, Hanrahan, Layde, Zhu, Guse, and Hargarten (2009) demonstrated similar results as noted above. Using data from the Wisconsin Crash Outcome Data Evaluation System, the authors calculated Odds Ratios (OR) and Relative Risks (RR) to explore the association of driver's age with risk of injury, fatality, and experiencing injuries of different severity when involved in a motor vehicle crash. Excluding motor vehicle crashes in which the

driver was not injured, older adults aged 65 to 74 years involved in a motor vehicle crash had an OR for fatality of 3.03 (95% Confidence Interval [CI] 2.35, 3.93) compared to drivers 25 to 44 years of age; among older adults 75 to 84 years of age, the OR for fatality was 6.46 (95% CI 5.13, 8.14) and; older drivers aged 85 years and older had an OR for fatality of 10.55 (95% CI 7.48, 14.86). Moreover, the increased risk that older drivers face with respect to motor vehicle crash fatality is not expected to dissipate in the future. Future projections from the United States suggest that by 2030, older drivers are expected to account for almost 25% of total fatalities as compared to 14% in 1999 (Lyman et al., 2002). Furthermore, when involved in motor vehicle crashes, older drivers are more likely to be injured and sustain serious injuries (Baldock & McLean, 2005; Dellinger et al., 2002; Evans, 2001; Hanrahan et al., 2009; Langford & Koppel, 2006; Li, Braver, & Chen, 2003; Lyman, McGwin Jr., & Sims, 2001; Massie et al., 1995; Newgard, 2008; Ryan et al., 1998; Thompson, Baldock, Mathias, & Wundersitz, 2013), require hospitalization (Beuchner, 1999; Cook, Knight, Olson, Nechodom, & Dean, 2000), or die as a result of their injuries (Cook et al., 2000; Dulisse, 1997; Evans, 1988; Li et al., 2003). Age-related and physiological changes, including an increased risk of frailty among older adults, often are used as explanations to explain the deleterious consequences experienced by older drivers when involved in motor vehicle crashes (Ball et al., 1998; Li et al., 2003; Lyman et al., 2001).

Medical Conditions and Driving Competence

The elevated crash risk seen among older drivers is not an issue of aging or a so called ‘older driver problem’. Dobbs and Carr (2005) noted that “it is unlikely that the increase in crash rates of older drivers, in comparison to middle-age drivers, is caused by changes associated with normal aging” (p. 7). Among older adult drivers, the salient issue that must be considered is one of declining health status and subsequent medical impairment while driving. Motor vehicle crash involvement among older drivers has been linked to the presence of medical conditions prevalent with age and the functional impairments that result (Baldock & McLean, 2005; OECD, 2001).

The driving task and abilities needed for safe driving involve the use and interplay of sensory and perceptual skills, motor abilities, as well as cognitive and

executive functioning (Anstey, Wood, Lord, & Walker, 2005; Baldock & McLean, 2005; Yale, Hansotia, Knapp, & Ehrfurth, 2003). Chronic medical conditions such as cardiovascular disease, cerebrovascular disease, dementia, diabetes mellitus, and arthritis have been shown to have a strong relationship with functional limitations. The ensuing impairments that present across sensory, motor, and cognitive functions can have a substantial negative impact on driving capacity and performance (Anstey et. al., 2005; Charlton et al., 2010; Dobbs, 2005; Whelan et al., 2006). Of interest is the fact that not all older adults diagnosed with the same chronic medical conditions will have their driving abilities affected in the same way; that is, the relationship between medical conditions and driving safety is complex and diagnosis alone does not guarantee impaired driving performance and/or increased motor vehicle crash risk. Millar (1999) highlighted that the degree of functional impairment associated with any given medical condition "may be quite variable, as the same conditions can have markedly different functional consequences for different individuals" (p. 63). Declines in driving competency depend on the degree of functional impairment and disability caused by the medical condition which in turn is influenced by disease stage, severity, and other characteristics of the conditions such as clinical manifestation, treatment response rates, and complication rates (Baldock & McLean, 2005; Charlton et al., 2010; Janke, 2001; Klavora & Heslegrave, 2002; Wallace & Retchin, 1992).

A substantial body of literature now exists that documents the relationship between chronic medical conditions, impaired driving performance, and increased motor vehicle crash risk among older adults (Dobbs, 2005; Charlton et al., 2010; Diller et al., 1999; Hanna, 2009; Marshall, 2008; Marshall & Man-Son-Hing, 2011; McGwin Jr., Sims, Pulley, & Roseman, 2000; Sagberg, 2006; Staplin, Lococo, Stewart, & Decina, 1999; Vaa, 2003; Vernon et al., 2002). For instance, in a population-based case-control study of 901 older drivers, McGwin Jr. and colleagues (2000) demonstrated that after adjusting for age, gender, race, and annual mileage driven, when comparing at-fault drivers to drivers not involved in crashes, the OR for crashes was 1.5 (95% CI 1.0, 2.2) for individuals with heart disease compared to individuals without the condition and the adjusted OR for crashes for individuals who had suffered a stroke was 1.9 (95% CI 1.0,

3.9) in this same study. Vernon et al. (2002) conducted a retrospective case-control study in the state of Utah that compared the rates of adverse driving events (i.e., crashes, at-fault crashes, and citations) of drivers reporting medical conditions across unrestricted and restricted licensing categories with age, sex, and location-matched controls. Unrestricted drivers reporting a single medical condition showed elevated rates of citations, with an RR of 1.09 (95% CI 1.07, 1.12) compared to controls. As well, elevated rates for crashes were seen for both unrestricted (RR = 1.33; 95% CI 1.30, 1.37) and restricted (RR = 1.26; 95% CI 1.08, 1.44) drivers compared to controls. Additionally, when compared to controls, both unrestricted drivers (RR = 1.49; 95% CI 1.44, 1.55) and restricted drivers (RR = 1.74; 95% CI 1.49, 2.04) had elevated at-fault crash rates. Similarly, compared to controls, both unrestricted (RR = 1.41; 95% CI 1.33, 1.45) and restricted (RR = 1.28; 95% CI 1.04, 1.58) drivers reporting multiple medical conditions had higher rates of crashes. As well, unrestricted drivers reporting multiple medical conditions also had higher rates of at-fault crashes compared to controls (RR = 1.60; 95% CI 1.49, 1.71). The same elevated rates for at-fault crashes was seen among restricted drivers (RR = 1.67; 95% CI 1.31, 2.13) compared to controls.

In his review of the driving literature, Vaa (2003) ascertained the crash risk associated with aging and different medical conditions via a large-scale meta-analyses with 298 results from 62 reports spanning 19 different medical conditions (i.e., vision impairments, hearing impairments, cardiovascular disease, diabetes mellitus, arthritis/locomotor disability, neurological diseases, etc.). Results of the meta-analyses indicated that drivers with cardiovascular disease had a RR of 1.23 (95% CI 1.09, 1.38) for motor vehicle crash involvement relative to drivers without the condition. A comparison of individuals with diabetes to individuals without showed that older drivers with diabetes had a 56% higher risk (95% CI 1.31, 1.86) of being in a motor vehicle crash. Further, individuals with neurological diseases had a RR of 1.75 (95% CI 1.61, 1.89) for crash involvement compared to controls. Specifically, across all categories of medical conditions included in the meta-analyses and review, the weighted RR was reported to be 1.33 (95% CI 1.28, 1.37) which indicates that older drivers with any of the given medical conditions included in the meta-analyses could expect a 33% higher risk of accident involvement as compared to older drivers without the

given condition. More recently, in their review of the driving literature, Charlton et al. (2010) provided evidence for the influence of chronic medical conditions and functional impairments on motor vehicle crash involvement among older drivers. The authors demonstrated that certain chronic medical conditions associated with aging consistently have higher associated motor vehicle crash risk among older adults (e.g., cardiovascular disease, cerebrovascular disease, dementia, diabetes mellitus, musculoskeletal disorders, etc.).

Medication Use and Driving Competence

Research also has demonstrated that many classes of medications taken to treat different medical conditions produce substantial central nervous system effects that have the potential to negatively impact the abilities needed for safe driving. Medications can influence visual, cognitive, and psychomotor performance (Marshall, 2008; Ray et al., 1992) in individuals of any age. Older adults are more susceptible and more likely to experience these central nervous system effects because of age-related changes and the impact that these changes have on pharmacokinetics (i.e., absorption, distribution, metabolism, and excretion) and pharmacodynamics (i.e., the action of the drug on the body) (Dobbs, 2005; Ray et al., 1992). McGwin Jr. and colleagues (2000) demonstrated that after controlling for age, gender, race, and annual mileage driven, when comparing at-fault drivers to drivers not involved in crashes, the OR for crashes for individuals taking non-steroidal anti-inflammatory drugs (NSAIDs) was 1.7 (95% CI 1.0, 2.6) as compared to individuals reporting no NSAID use. Elevated rates of automobile crashes also were observed for individuals taking benzodiazepines (OR = 5.2; 95% CI 0.9, 30.0), anticoagulants (OR = 2.6; 95% CI 1.0, 7.3), angiotensin converting enzyme (ACE) inhibitors (OR = 1.6; 95% CI 1.0, 2.7), and hypertension medication (OR = 1.3; 95% CI 0.6, 2.8). When comparing at-fault drivers involved in crashes to not-at-fault drivers involved in crashes, elevated rates of involvement in motor vehicle crashes was demonstrated for individuals taking NSAIDs (OR = 1.4; 95% CI 0.7, 2.5) and ACE inhibitors (OR = 1.6; 95% CI 0.8, 3.2). Subsequent analyses exploring two-way interactions between all the medications considered in the study revealed that older drivers taking both NSAIDs and ACE inhibitors were 3.4 times more likely to be involved

in a motor vehicle crash as compared to older drivers taking neither of these drugs.

Based on a review of 11 epidemiological studies conducted in the United States and Canada between 1991 and 2001, Wilkinson and Moskowitz (as cited in Lococo & Staplin, 2006) further outlined that use of benzodiazepines, cyclic antidepressants, and opioid analgesics was associated with increased risk of motor vehicle crashes among older drivers. Based on 68 results included in a meta-analysis, Vaa (2003) showed an elevated risk for motor vehicle crashes among individuals taking drugs and medicinal products (RR = 1.58; 95% CI 1.45, 1.73). Specifically, subgroup analyses showed that there was significantly increased motor vehicle crash risk among individuals taking antidepressants (RR = 1.42; 95% CI 1.33, 1.52), opioid analgesics (RR = 1.21; 95% CI 1.08, 1.36), and benzodiazepines (RR = 1.54; 95% CI 1.24, 1.90). Similarly, in her review of the driving literature, Dobbs (2005) concluded that there was increased risk for motor vehicle crash involvement among users of older tricyclic antidepressants, older generation antihistamines, and benzodiazepines with long half-life compounds.

Conclusions

The impact of medical impairment/impairments and the effects that certain medications have on driving abilities clearly is an important issue of safety for both the individual older driver and society at large. Further, chronic medical conditions and increased medication use will significantly impact mobility for a substantial proportion of older adults. This is because a significant proportion of older drivers will experience driving cessation as a result of 'giving up their car keys' voluntarily or involuntarily due to mandated licensing removal by transportation officials.

Previous research has suggested that men will outlive their driving careers by seven years with women surpassing their driving life expectancy by 10 years (Foley, Heimovitz, Guralnik, & Brock, 2002). In 1998, Burkhardt, Berger, Creedon, and McGavock (1998) estimated that almost 8.4 million older adults 65 years of age and older were without a driver's licence. Subsequent research conducted by Foley et al. (2002) suggests that annually, more than 600,000 older adults, aged 70 years and older, give up their car keys and subsequently become

dependent on others to meet their mobility needs. As increasingly larger proportions of older adults outlive their driving careers, it is expected that they will subsequently come to depend on others or alternate forms of transportation to maintain their mobility. This shift and projected increased demand for alternate modes of transportation has important implications for the delivery of ATS services for older adults in the future.

1.3 Conceptual Framework Relevant to Mobility in Older Adults

1.31 Carp's Congruence Model of Adaptation

In 1988, Carp developed a congruence model of adaptation to explain the role of mobility and independence, life satisfaction, and well-being among older adults. In this model, mobility is central to the ability to adapt to life situations and is essential for emotional and social well-being which ultimately contributes to quality of life. Carp explains that social and emotional well-being are marked by the presence of variables such as positive self-esteem, maintaining feelings of usefulness, happiness, and the absence of loneliness, anxiety, and depression. Well-being is experienced when an individual is able to successfully meet his or her own needs and has a sense of personal control while doing so. In relation to older adults, this is largely determined by mobility resources. As such, mobility is a major determinant of psychological health and well-being among this demographic cohort.

Carp's (1988) model posits that well-being among older adults depends on the satisfaction of life-maintenance needs which include basics such as food, clothing, pharmaceuticals, attending medical appointments, or fulfilling banking requirements. In order to fulfill these needs, older adults must be able to access community resources such as grocery stores, pharmacies, doctors' offices, and banks. Success in meeting life-maintenance needs ultimately enables independent living which in turn positively influences well-being. Additionally, well-being also depends on the satisfaction of higher-order needs which include socializing, recreation, worship, and maintaining feelings of usefulness. To fulfill these specific needs, older adults again require access to community resources such as recreational places, churches, and volunteer services. Success in the

achievement of higher-order needs give life “an acceptable and positive quality” (p. 4) and directly influences well-being among older adults. Although satisfaction of life-maintenance needs is important for independent living, it is through the social interactions associated with the fulfillment of higher-order needs that older adults are able to maintain conceptions of personal identity and thus sustain psychological well-being.

Carp (1988) emphasized that well-being is determined by the degree of fit or congruence between an older adult’s needs and the ability to access those community resources that enable satisfaction of needs. *Mobility* is the key factor as it enables older adults to have access to those community resources that enable the fulfillment and satisfaction of both life-maintenance and higher order needs. According to the model, qualities of mobility such as its feasibility or the degree to which the older adult is able to perform the activities involved, as well as its safety and the sense of personal control that it affords, facilitate the meeting of needs and thus influence and support the overall effect on emotional and social well-being. These qualities also are affected by moderators which include socioeconomic status, physical characteristics of the site, and transportation technology. Transportation and mobility serve as a way of ensuring that an older adult’s basic needs are met as well as ensuring that they remain integrated and connected into the social world of others (Eisenhandler, 1990).

For older adults who have experienced reductions in mobility as a result of driving cessation, fulfillment and satisfaction of both life-maintenance and higher-order needs becomes more difficult. The absence of meaningful alternatives to driving often leads to the beginning of dependence on others for mobility and a reduction in personal identity among older adults (Eisenhandler, 1990). Fulfillment of life-maintenance needs often is ensured by family, friends, and caretakers of older adults. However, among older adults, satisfaction of higher-order needs often go unrecognized. This is problematic in that it is the fulfillment of these needs that ultimately contributes to quality of life.

Although public transportation services exist as a source of mobility, they often are not tailored to satisfy the needs of older adults and have not been designed to address the challenges faced by older adults who no longer drive

(Burkhardt, 2000; Coughlin, 2001; Hendrickson & Mann, 2005). That is, public transportation is primarily focused and designed toward meeting the mobility needs of working individuals and individuals who are healthy and mobile (Glasgow & Blakely, 2000; Turcotte, 2012). Carp's (1988) conceptual model thus provides a means for interpreting the negative consequences associated with reductions in mobility and driving cessation. It also serves as a framework by which to evaluate transportation options and services, their associated characteristics, and the impact that these have on older adult's ability to satisfy both life-maintenance and higher-order needs.

1.32 The 5 A's of Senior Friendly Transportation

Recognizing the importance of extending the dialogue on how to improve transportation for seniors beyond the professional community, The Beverly Foundation conducted focus group research with older adults and lay caregivers to obtain their opinions and views about transportation and what actions they believed would be most beneficial for meeting the mobility needs of older adults in the future (Kershner & Aizenberg, 1999). The focus groups consisted of three target groups: transportation-rich seniors; transportation-deprived seniors; and transportation-concerned family and friends. Transportation-rich seniors were defined as individuals 65 years of age and older who lived in areas known to have access to transportation at least six days of the week and within one mile of the individual's home. Transportation-deprived seniors were defined as individuals 65 years of age and older who lived in areas known to not have access to transportation at least six days of the week within one mile their home. Transportation-concerned family and friends, often lay caregivers providing transportation assistance, were individuals who concerned about an older person's driving or ability to get around.

In total, The Beverly Foundation conducted 22 focus groups with nine of the groups comprised of transportation-rich seniors (n = 84), seven of the groups comprised of transportation-deprived seniors (n = 70), and the remaining six focus groups comprised of transportation-concerned family and friends (n = 49). Across the three target groups (transportation-rich seniors, transportation-deprived seniors, and transportation-concerned individuals), the majority of participants were female (67%, 67%, and 76%, respectively). As well, the

majority of participants in each of the three target groups were younger than 85 years of age (84%, 75%, and 93%, respectively). Using traditional focus group methodology, discussions with transportation-rich and transportation-deprived seniors were comprised of 12 to 15 open-ended questions about older adults' general views on transportation; their transportation priorities; general problems about seniors' transportation; pedestrian problems; public transit use problems; driver problems for older adults; driving limitation and cessation; indicators of unsafe driving; licensing renewal and driver assessment; and transportation options. Focus group discussions with transportation-concerned family and friends were centered on questions related to transportation and care giving roles; triggers of involvement; concerns about being involved; and concerns about their own transportation in the future.

To supplement the focus group data, a survey questionnaire with 25 mostly closed-ended questions was developed. Survey questions covered the following areas: transportation concerns; driving assistance; reasons for driving cessation; transportation patterns and preferences; trip patterns; transportation responsibilities; information needs, sources, and preferred terminology; current and future perceptions of the transportation system; and priority transportation issues. The transportation-rich and transportation-deprived groups received identical questionnaires whereas a modified version of the survey questionnaire was administered to the transportation-concerned family and friends group. Following survey completion, participants were engaged in a post-survey discussion where they were provided with the opportunity to vote on transportation actions they believed should have priority for older adults. Participants also were given the opportunity to suggest new ideas on how to better address the transportation needs of older adults.

Results from the focus group research highlighted that many older adults have problems accessing and utilizing ordinary forms of public transportation (Kerschner & Aizenberg, 1999). Discussions with transportation-rich seniors, transportation-deprived seniors, and transportation-concerned family and friends led to an intuitive conceptualization of the features that directly contribute to older adults' mobility. Through investigations of different transportation features that impact older adults' mobility, The Beverly Foundation identified five factors as

being essential to responsive transportation services designed specifically to meet the mobility needs of older adults. Collectively, these factors came to be known as the 5 A's of senior friendly transportation and include the features of Availability, Accessibility, Acceptability, Adaptability, and Affordability (The Beverly Foundation, 2001, 2005). Table 1-1 illustrates the features of each of the 5 A's of senior friendly transportation as articulated by The Beverly Foundation. As conceptualized by the Beverly Foundation, these features have been thought as and deemed to be essential for responsive transportation services designed specifically to meet the mobility needs of older adults who do not drive, no longer drive, or are unable to use conventional public transportation services. These features also have been used as criteria for assessing the usability of transportation options by older adult passengers (The Beverly Foundation, 2010). The Beverly Foundation has highlighted that it is the degree of senior friendliness found in transportation services that ultimately determine whether older adults are able to utilize community-based transportation alternatives (The Beverly Foundation, 2010).

Table 1-1

The 5 A's of Senior Friendly Transportation and Corresponding Features

The 5 A's of Senior Friendly Transportation	Feature
Availability	Service provider provides transportation to seniors The transportation service can be reached by the majority of seniors in the community Service provider provides transportation anytime (day, evenings, weekends, 24/7) Service provider can take riders to destinations beyond city limits and city boundaries Service provider maintains organizational relationships with human service agencies
Acceptability	Service provider uses vehicles that are easy for seniors to access Service provider offers 'demand response' with no advance scheduling requirement Service provider offers driver 'sensitivity to seniors' training Service provider adheres to narrow 'window of time' for home and destination pickup Service provider ensures cleanliness and maintenance of vehicles
Accessibility	Service provider can accommodate the needs of a majority of elders in the community Service provider has information program for improving senior transportation knowledge Service provider can provide 'door-through-door' transportation when needed Service provider can provides services to essential and non-essential activities Service provider can link seniors with more 'appropriate' transportation options
Adaptability	Service provider will provide transportation escorts when needed Service provider can provide multiple stop trips for individual passengers Service can access vehicles that can accommodate wheelchairs and walkers Service provider maintains a policy of "adapting the system to meet needs of seniors" Service provider undertakes annual senior customer survey for service improvement
Affordability	Service provider offers reduced fares (or free transportation) to senior passengers Service provider secures funding specifically to support senior transit services Service provider offers opportunity to purchase monthly pass instead of paying cash Service providers offers options for purchasing tickets by mail or the internet Service provider uses volunteer drivers to reduce costs for providing 'extra' services

Note. Table is adapted from "*Beverly Foundation Fact Sheet Series Vol.2(4)"* by The Beverly Foundation, 2010. Copyright 1010 Beverly Foundation.

To be considered senior friendly, an ATS service must be available in that the service is offered when needed (e.g., days, evenings; weekdays, weekends). Acceptability encompasses standards of quality such as vehicle cleanliness, safety (e.g., transit stops are in safe areas; drivers are courteous and helpful), advance scheduling, and driver sensitivity training on issues pertaining to older adults. As well, transportation needs to be accessible, where services can be reached and used. This relates specifically to transportation in which 'door-to-door' and 'door-through-door' services are available and in which trips are provided for both essential and non-essential activities. Further, formal ATS services need to be adaptable in that they are able to be modified or adjusted to meet the specific and special needs of older adults (e.g., accommodate trip chaining; offer fixed and client response routes; offer single and group passenger services; can accommodate mobility aids such as scooters, wheelchairs, and walkers; escorts can be provided). Lastly, affordability, as delineated by The Beverly Foundation (2001, 2005), relates to costs associated with the services and methods of payment.

The 5 A's of senior friendly transportation (The Beverly Foundation, 2001, 2005) can further be conceptualized as relating to and influencing those qualities of mobility (i.e., feasibility, safety, and personal control) that facilitate the meeting of needs and contributing to and enhancing well-being as outlined in Carp's (1988) congruence model of adaptation and mobility. Utilization of ATS services are directly affected by an older adult's perception of feasibility, safety, and personal control and it is these qualities of mobility that ultimately facilitate the meeting of needs and thus support emotional and social well-being (Carp, 1988). As such, it can be postulated that transportation services that encompass the senior friendly features of Availability, Acceptability, Accessibility, Adaptability, and Affordability help to maximize the degree of congruence between an older adult's life-maintenance and higher-order needs and the resources available to meet those needs. It can be hypothesized that those ATS services that come the closest to offering the same degree of mobility as is afforded by the private vehicle encompass not only those qualities of mobility that contribute to well-being (i.e., feasibility, safety, personal control) but also the 5 A's of senior friendly transportation (i.e., Availability, Acceptability, Accessibility, Adaptability, and Affordability).

1.4 Literature Review of Older Adults and Mobility

1.41 The Meaning of Mobility

In general, mobility involves the physical action of movement. In relation to older adults, it often is measured in terms of specific physical movements (i.e., gait, speed, posture, balance, etc.) or in terms of component maneuvers (i.e., dressing, bathing, shopping, etc.) (Stalvey, Owsley, Sloane, & Ball, 1999). Varying definitions and conceptualizations of mobility have been proposed in the transportation literature. A review of the conceptualizations is informative in the sense that it allows for the development of a succinct operational definition that adequately reflects older adults' movement outside the home in relation to the provision of and availability of transportations services. Stalvey and colleagues (1999) defined mobility broadly as "the spatial extent of one's travel within the environment" (p. 461). They also outlined that as a construct, it encompasses travel in, around, and outside of the home. In contrast, Metz (2000) argued that "in the field of transport studies, mobility is not at present an operational concept capable of quantification" (p. 150). Although the term is widely used in transportation studies and across the literature, it is employed in many different contexts and with many different meanings such that, there is a general lack of consensus as to an agreed upon operational definition. According to Metz (2000), the concept of mobility should be articulated in such a way that would allow for empirical measurement and should encompass elements such as: 1) travel to achieve access to desired people and places; 2) the psychological benefits of movement; 3) the exercise benefits of physical movement; 4) continued involvement in the community, and; 5) the potential to travel even if trips are not actually undertaken.

In 2002, Owsley described mobility as "a person's purposeful movement through the environment from one place to another" (p. 220) and suggested that mobility was the factor that facilitated the accomplishment of tasks and achievement of goals that exist outside of an individual's home. In their study of travel patterns among older adults, Giuliano, Hu, and Lee (2003) defined mobility as the ability to travel which is subsequently dependent on the availability of individual resources (i.e., time, money, availability of a private vehicle, functional capacity), transportation alternatives, and the spatial distribution of activity

destinations. Given the trend toward increased suburbanization and dispersed land use patterns, the authors noted that a difference exists between mobility and accessibility and defined the latter as “ease of movement between places, and hence . . . a function of spatial structure and transportation supply” (p. 4). According to the authors, accessibility, or the availability and supply of transportation alternatives, thus becomes increasingly important with advancing age as an individual’s mobility declines. In contrast to Giuliano and colleagues’ conceptualization of mobility, Suen and Sen (2004) expanded on the concept and stressed that mobility should encompass more than just travel alone. According to the authors, mobility includes being able to travel where and when an individual wants; being informed about available travel options; knowing how to use the travel options that are available as well as being able to use them; and having the means to pay for their use. Based on this conceptualization, Suen and Sen suggested that in terms of travel modes, the private vehicle comes closest to providing an individual with full mobility.

More recently, Webber, Porter, and Menec (2010) outlined that mobility can take many forms (i.e., walking, driving, use of ATS services, etc.) and broadly defined the term as “the ability to move oneself within environments that expand from one’s home to the neighborhood and to regions beyond” (p. 444). In their framework, mobility is conceptualized via life-spaces that include concentric areas of locations or mobility zones starting from the home and expanding further into the environment. With this, mobility zones further away from the home have more requirements to sustain independent mobility. Webber and colleagues further suggested that mobility can be understood holistically through five fundamental and interrelated categories of determinants (i.e., cognitive, psychosocial, physical, environmental, and financial). As an older adult’s mobility environment expands away from the home and becomes increasingly more complex, each category of determinants subsequently becomes influenced by an increasing number of factors. Gender, culture, and personal history also are taken into consideration as additional factors that act as “crosscutting influences on mobility” (p. 446) in that they each have an effect on an older adult’s experiences, opportunities, and behaviours. The framework highlights the importance of a multi-factorial view to explain limitations and impairments in mobility among older adults.

The notion of out-of-home mobility includes not only movement that occurs beyond the home but also involves the utilization of different modes of transportation. It provides the means by which older adults remain active and integrated within society. Out-of-home mobility also is essential not only for continued access to essential services and resources but it has been consistently linked to well-being and quality of life (Banister & Bowling, 2004; Carp, 1988; Oxley & Whelan, 2008). Given the importance of mobility to independence and well-being among older adults, a succinct operational definition that involves both the action of movement and transportation as the means by which the action occurs is essential for being able to explore the changing mobility needs and transportation preferences of an aging population.

1.42 Older Drivers

Current Statistics and Projected Licensing Trends

Changes in the age structure of many developed nations also will be reflected in changes to the driving population as indicated by a projected increase in both the number and proportion of older drivers (Alsnih & Hensher, 2003; Dobbs, 2008). In the United States alone, in 2009 drivers over the age of 65 accounted for 15% of the driving population; an increase of one percentage point from 2001 (Lynott & Figueiredo, 2011). As shown in Table 1-2, data compiled from the 2009 National Household Travel Survey (NHTS) indicate the vast majority of older American males and females at the time of the survey were indeed drivers.

Table 1-2

Percentage of the American Population that Drive, by Age and Sex, 2009 NHTS Data

		Age Group (Years)				
		16–24	25–49	50–64	65–74	75+
Sex (%)	Males	78.3	94.5	95.1	92.9	82.9
	Females	79.6	91.5	89.0	84.1	60.5
	Both	78.9	93.0	91.9	88.0	69.4

Note. Table is adapted from "*How the travel patterns of older adults are changing: Highlights from the 2009 National Household Travel Survey*" by J. Lynott and C. Figueiredo, 2011, p. 4. Copyright 2011 by the AARP Public Policy Institute.

Similarly, data from the 2009 CCHS reported that almost three quarters of all older adults in Canada, over 3.25 million individuals, had a valid driver's licence (Turcotte, 2012). Results from the survey also indicated that males were more likely than females to be licensed to drive although the gap between the sexes is not as substantial as what was recognized in previous generations of older adults. Table 1-3 indicates that the difference between the proportion of males and females with a valid driver's licence is greatest among adults 85 years of age and older.

Table 1-3

Proportion of Older Adults with a Valid Driver's Licence, by Age Category and Sex, 2009 CCHS Data

		Age Group (Years)				
		65–74	75–79	80–84	85–89	90+
Sex (%)	Males	93.6	90.1	80.7	72.0	45.5
	Females	76.8	64.9	46.3	29.6	16.0
	Both	84.8	76.1	61.3	45.1	25.3

Note. Table is adapted from "*Profile of senior's transportation habits* (Catalogue No. 11-008-X)" by M. Turcotte, 2012, p. 9. Copyright 2012 by Statistics Canada.

Future projections suggest that with the baby boomers entering their senior years, the number and proportion of licensed drivers are expected to increase significantly over the next three decades. Research conducted in the United States has suggested that by 2025, one in five drivers will be over the age of 65 (Lynott & Figueiredo, 2011). According to Dobbs (2012), the number of older adults with a driver's licence in the United States is expected to increase by 59% over the next three decades and similar trends in licensing rates also are expected in Canada.

This increase in licensing rates among older adults can be attributed to the absolute increase in the older adult population, as well as the trend toward increased licensing and vehicle utilization among older women as compared to previous cohorts (Collia, Sharp, & Giesbrecht, 2003; Foley et al., 2002). Relying on secondary data from the Federal Highway Administration, Eberhard and Mitchell (2009) indicated that in 2006, almost 85% of females 65 to 69 years of age in the United States were licensed to drive compared to less than 80% of comparably aged females in 1997. The trend toward increased licensing among

females also was apparent in the upper age categories. In 2006, 65% of females aged 80 to 84 years were licensed to drive compared to 55% of comparably aged females in 1997 (Eberhard & Mitchell, 2009). Among females 85 years of age and older, 41% were licensed to drive in 2006 compared to 32% in 1997. Furthermore, the trend and future expectation for similar proportions of males and females to be holding licences will result in a larger number of older female drivers than what was previously recognized in past cohorts. Rosenbloom (2001) has highlighted that the differences in licensing rates between males and females have been narrowing over the years and the trend is expected to continue into the future, especially among the baby boomer cohort. In 1950 licensing rates were at a 20:1 male/female ratio; this is projected to decrease to a ratio of 1:1 in 2023 (Rosenbloom, 2001). According to Burkhardt and McGavock (1999), females born after 1950 will have been drivers for most of their lives unlike females born in previous generations when licensing among females was not the norm. Current licensing rates for baby boomer males and females are quite comparable and the expectation is that baby boomer women who have been driving their whole adult lives will continue to drive past retirement and well into their later senior years. This will result in a narrowing of the gap between the proportion of males and females who drive (Coughlin, 2009; Mattson, 2012; Rosenbloom & Herbel, 2009).

Hakamies-Blomqvist and Siren (2003) suggested that the driving *patterns* of baby boomer females will come to resemble and parallel a male-like driving history. Baby boomer females, as compared to previous cohorts, will have gained substantial driving experience from having driven the majority of their adult lives and they will continue to exhibit higher levels of mileage driven and vehicle utilization as they age. Subsequently, the driving behaviour of these females will come to parallel that of comparably aged males. Of interest, an increase in the overall number of older females in the population, as well as increased licensing rates and a greater propensity toward vehicle utilization, have led to older female drivers becoming the fastest growing segment of the driving population (Rosenbloom, 2004, 2006; Rosenbloom & Winsten-Bartlett, 2002). Turcotte (2012) has further suggested that as female licensing rates and vehicle utilization increases, there will be a subsequent decline in the dependence of older females on spouses, relatives, and friends for transportation.

Dependence on the Private Vehicle

In developed nations around the globe, the vast majority of older adults are dependent on the private vehicle, either as a driver or as a passenger, for their transportation and mobility needs (Alsnih & Hensher, 2003; OECD, 2001; Rosenbloom, 2001, 2004, 2006). Driving has become synonymous with transportation and mobility and, although driving is a fundamental means of transportation, it also holds powerful symbolic value among older adults as well (Cobb & Coughlin, 2000). For older adults who can drive, the private vehicle depicts power; allows for independence and self-reliance; and provides older adults with a sense of identification and personal control (Eisenhandler, 1990; Freund, 2004; Gillins, 1990; Whelan et al., 2006).

Several studies have used travel survey data to demonstrate older adults' dependence and increasing reliance on the private vehicle to satisfy mobility needs. Rosenbloom (2004) reported that in 1983, adults 70 years of age and older took 75% of their travel trips in a private vehicle, either as the driver or as a passenger. By 1995, the proportion of adults 70 years of age and older using the private vehicle to satisfy their travel demands and mobility needs had increased to 90%. Collia and colleagues (2003), using data from the 2001 NHTS, demonstrated that almost 90% of adults 65 years of age and older conducted their daily travel in a private vehicle. Kostyniuk and Shope (2003) conducted a telephone survey of drivers and former drivers, aged 65 years and older, in the state of Michigan to collect information on transportation mode choice. Almost 90% of current drivers in the sample reported relying on the private vehicle as their primary form of transportation and close to 95% of former drivers said they relied on the private vehicle as a passenger instead of a driver for their mobility needs. Rosenbloom (2006), using data from the 2001 NHTS, demonstrated that males are substantially more likely than females of a comparable age to be driving the car; females are overwhelmingly the passenger when they travel in a private vehicle. Based on the survey results, of males older than 85 years of age, almost 90% did the majority of their travelling in a private vehicle and were drivers close to 70% of the time. Similarly, females older than 85 years of age took the vast majority of their trips by car but were the drivers only 41% of the time. Based on a recent analysis of data collected between 2008 and 2009 for

the CCHS, Turcotte (2012) reported that almost 80% of males and 44% of females 65 years of age and older who held a valid driver's licence and had driven in the previous month also said that driving was their main form of transportation. Results from the survey also indicated that with advancing age, travelling as a passenger in a vehicle replaces driving a private vehicle as the main form of transportation used by older adults. For instance, among older adults 85 years of age and older, both with and without a driver's licence, almost 50% reported that their main form of transportation was riding as a passenger in a private vehicle compared to about 30% of older adults 75 to 84 years of age, and just over 20% of older adults 65 to 74 years of age (Turcotte, 2012).

Incorrectly, it often is assumed that when older adults are no longer able to drive, they come to depend on public transit and other forms of transportation to serve their mobility needs (Rosenbloom, 2003). However, walking, public transit, and other alternate modes of transportation are infrequently used by older adults to satisfy mobility needs, even when they lack other options. Data from the 2001 NHTS revealed that less than 10% of older adults walked and less than two percent used public transit to conduct their daily trips and satisfy their travel demands (Collia et al., 2003; Rosenbloom, 2006). Based on results from a survey of current older drivers in Michigan, Kostyniuk and Shope (2003) reported similar trends where less than one percent reported using public transit or walking to satisfy their mobility needs and only a small proportion of former drivers relied on special transit services to remain mobile. Alsnih and Hensher (2003) noted that among older adults, public transit is often "the mode of last resort" (p. 910) and Rosenbloom (2003) further highlighted that use of alternate forms of transportation (i.e., specialized paratransit services, subsidized taxis, etc.) has been dropping among older adults since 1995. An examination of more recent data from Canada (see Table 1-4) showed a similar trend. Less than 10% of older adults across all age categories relied on public transportation to satisfy their travel needs and an even smaller proportion relied on walking, bicycling, taxis, or accessible transit (Turcotte, 2012). However, the trend is for a slight increase in use of public transit and walking or bicycling in the 85+ age group compared to those 65 to 74 years of age and those 75 to 84 years of age, with a significant increase for use of taxi or accessible transit for those 85 years of age and older. It has been suggested that other forms of transportation do not offer

older adults the individualized convenience, flexibility, safety, and level of mobility that is associated with the private vehicle (Taylor & Tripodes, 2001).

Table 1-4

Main Form of Transportation Use by Age Group, 2009 CCHS Data

		Age Group (Years)		
		65–74	75–84	85+
Transportation Use (%)	Driving Private Vehicle	67.9	55.9	31.2
	Passenger in a Vehicle (with driver's licence)	13.3	11.5	8.6
	Passenger in a Vehicle (without driver's licence)	9.0	19.5	40.6
	Public Transit	5.5	6.8	7.5
	Walking or Bicycling	3.2	3.6	4.7
	Taxi or Accessible Transit	1.1	2.7	7.4

Note. Adapted from "*Profile of senior's transportation habits* (Catalogue No. 11-008-X)" by M. Turcotte, 2012, p. 13. Copyright 2012 by Statistics Canada.

A number of reasons can be advanced to explain older adults' dependence on the private vehicle. Based on Carp's (1988) congruence model of adaptation, for older adults who are able to drive, the private vehicle offers the best fit between access to community resources and the satisfaction of life-maintenance and higher-order needs. According to Yassuda, Wilson, and von Mering (1997), "contemporary urban zoning practices and public transportation policies have catapulted the private car into its role as the preeminent means of individual transportation" (p. 525). Giuliano et al. (2003) and Rosenbloom (2004) suggested that low-density and dispersed land use patterns resulting in decentralization and suburbanization have made it necessary for older individuals to rely on the private vehicle as walking, biking, or public transit services are not a viable means in which to remain mobile. According to Freund (2004), drivers are market place consumers that have come to depend on the private vehicle because of the flexibility and convenience it affords and the gratification it brings in being able to satisfy multiple travel and mobility demands instantly. Rosenbloom and Stahl (2002) have outlined that dependence on the private vehicle is a complex issue

that is not only the product of how individuals want to live their lives but also a direct result of how communities are planned and designed.

Older Adults' Travel Behaviour and Future Trends

The travel behaviour of older adults today differs from the travel patterns observed among younger adults. It also differs significantly from the travel behaviour of older adults from previous generations. Research has demonstrated that on average, older drivers travel less, conduct less long distance travel, and make fewer and shorter daily trips than younger cohorts of drivers, with these declines increasing with advancing age (Collia et al., 2003; O'Fallon & Sullivan, 2009; Truong & Somenahalli, 2011). Using data from the 2001 NHTS, Collia and colleagues (2003) demonstrated that over 91% of adults between the ages of 19 and 64 years travelled daily as compared to only 75% of adults 65 years of age and older. Further, 48% of younger adults participated in long distance travel as compared to 35% of older adults. Results from their survey indicated that younger males travelled an average of 42.1 miles daily whereas males 65 years of age and older travelled an average of 27.2 miles; younger females travelled an average of 25.0 miles daily whereas females aged 65 years and older travelled an average of only 9.5 miles. Results from the 2001 NHTS also revealed that younger adults on average made 4.4 trips per day whereas older adults, on average, made only 3.4 trips per day. Using data from the Ongoing New Zealand Household Travel Survey conducted from 2004 through 2007, O'Fallon and Sullivan (2009) demonstrated a similar trend in that adults aged 25 to 64 years of age on average made 4.5 trips daily compared to older adults 65 to 74 years of age who on average made about 3.8 trips per day.

Research has further demonstrated that with advancing age, older adults travel less overall and smaller distances (Alsnih & Hensher, 2003). Using data from the 1995 Nationwide Personal Transportation Survey (NPTS) conducted in the United States, Rosenbloom (2001) showed that males 65 to 69 years of age on average took 4.4 trips daily and travelled an average of 37.4 miles daily. In comparison, males between the ages of 75 to 79 years made an average of 3.5 trips daily and travelled 23.8 miles; males between 80 to 84 years made an average of 3.4 trips daily and travelled an average of 19.0 miles; and males 85 to 89 years of age made an average of 2.1 daily trips and travelled an average of

13.1 miles daily. The declines in mobility with advancing age were even more pronounced among females from the same cohort. Truong and Somenahalli (2011) using travel survey data collected from older adults in Adelaide, Australia, reported similar results in that the average number of daily trips and mean distance travelled for older adults in their sample also decreased with advancing age. Specifically, older adults 65 to 74 years of age on average made 3.88 trips per day and travelled an average of 24.85 kilometers daily whereas older adults 85 years of age and older made an average of 2.36 trips per day and travelled an average of 12.46 kilometers daily.

Although older adults may travel less, take fewer trips, and travel shorter distances than younger cohorts of drivers, the current cohort of older adults is travelling more and longer distances than comparably aged groups several decades ago (Alsnih & Hensher, 2003; Burkhardt et al., 1998; Tacken, 1998). As noted by Rosenbloom (2004) “for the last two decades, every automobile-related travel indicator for the elderly has increased, in terms of vehicle miles, licensing, daily trips, daily miles, time spent driving, and more” (p. 16). Burkhardt and McGavock (1999), using information from the 1983 and 1990 NPTS, showed that during this time period, adults aged 65 years and older experienced a 26% increase in their total annual person-miles of travel as compared to the 14% increase that was experienced by the population as a whole. They further outlined that the increase in miles travelled by older adults can be attributed to the 6% increase in the number of trips and the 19% increase in the average trip length experienced by older adults during the same time period. Similarly, using data collected from the 1983 and 1995 NPTS, Rosenbloom (2001) reported that in 1995, older adults made 77% more vehicle trips; spent almost 40% more time behind the wheel of a private vehicle; and drove 98% more miles than they did in 1983. More recently, in 2009, data from the NHTS revealed that travel by older adults accounted for 12% of all trips taken in the United States as compared to 11% in 2001 (Lynott & Figuieredo, 2011). Further, results from this survey also indicated that the total number of miles travelled annually by individuals 65 years of age and older increased by 7% from 2001 to 2009. Given the increase in the proportion of older adults in the population, the trend toward increased activity among a proportion of the baby boomers, and the trend toward increased licensing rates among older adults, it is expected that the number of vehicle miles

travelled by older adults will more than double in the coming years (Dobbs, 2012). Although much of the data presented are from travel surveys conducted among older adults in the United States, research has shown that the travel behaviour and patterns of older adults in the United States are generalizable to other developed nations such as Canada (Newbold, Scott, Spinney, Kanaroglou, & Paez, 2005).

The majority of trips conducted by older adults are for purposes other than work. Using data from the 1995 NPTS, Rosenbloom (2004) reported that older adults make the majority of their trips for shopping purposes. Additionally, trips related to family and personal business as well as trips for social or recreational outings constituted a high proportion of the travel made by older adults. Data from the 2001 NHTS survey reported similar results in that Collia and colleagues (2003) reported that the greatest proportions of older adults' trips were conducted for social and recreational purposes; with trips conducted for the purpose of shopping following close behind. Compared to previous generations of older adults, the trips and travel undertaken by the current cohort of older adults is more varied in terms of trip purpose (Alsnih & Hensher, 2003).

The travel demands and increased expectations for mobility among older adults are not expected to subside in the coming decades; rather, travel behaviour and mobility expectations among older adults of the baby boomer cohort are expected to differ from previous cohorts of older adults. In addition to significant increases in the number and proportion of older adults licensed to drive, the current cohort of older adults are travelling more miles, making more trips, and driving longer into their senior years as compared to previous cohorts of comparably aged adults. Burkhardt and McGavock (1999) suggested that between 1990 and 2020, the total annual mileage driven will increase 465% for older males and over 500% for older female drivers. With a focus on trip making, Bush (2003) projected that baby boomer Americans between the ages of 65 and 84 years of age will take more trips daily in contrast to comparably aged adults from previous generations. Specifically, baby boomers are projected to make an average of about 3.0 trips per day as compared to an average of 2.3 trips per day undertaken by older adults in 1995.

Moreover, research has demonstrated that over time, a greater proportion of older adults are retaining their drivers' licences for longer into their senior years and the baby boomers are not expected to be an exception to this trend. The increase in the proportion of drivers over the age of 75 years, and especially the increase in the number of drivers 85 years of age and older, is more dramatic than that of younger age groups (Burkhardt & McGavock, 1999; Griffin, 2004; Meuleners, Harding, Lee, & Legge, 2006). Burkhardt et al. (1998) reported that from 1983 to 1996, the percentage of males 85 years of age and older with a licence increased by almost 24% and females of the same age category saw an increase of almost 17%. Recent data from the United States also support this trend. After comparing drivers of different age categories with the population of the United States in 1990, 2000, and 2009, the Federal Highway Administration (2011) reported that there was a trend toward a greater proportion of older drivers retaining their licences. In 2009, 84% of individuals 70 years of age and older had drivers' licences as compared to 74% of individuals the same age in 2000, versus 66% in 1990. With increased longevity, improved health, and greater dependence on the private vehicle for travel needs, a significant proportion of baby boomers are expected to retain their licences for longer into their senior years as compared to past cohorts of older adults.

D'Ambrosio and colleagues (2012) suggested that key forces such as retirement or work plans; demand for health services and the degree to which medical trips are required; demand for goods and services; and the need for social outlets and activities will significantly impact the mobility expectations and travel demands of baby boomers as they age. Given the trend toward suburbanization and the desire to age-in-place among baby boomers (Alsnih & Hensher, 2003; Rosenbloom, 2001, 2004), dependence on the private vehicle and increased travel among this cohort are likely as low-density areas are not well supported by public transportation. Further, although a proportion of the baby boomer cohort has more economic resources than past generations of older adults (Cobb & Coughlin, 2000; Coughlin, 2009), a significant proportion of baby boomers is expected to continue to work past the traditional age of retirement (D'Ambrosio et al., 2012). This is likely to result in increased travel demands and mobility for work-related trips among baby boomers as compared to that incurred by previous generations of older adults. Further, a proportion of

the baby boomers is expected to fare worse on various health status indicators as indicated by increased prevalence of chronic diseases among this cohort (Canadian Institute for Health Information, 2011a, 2011b), indicating that they will likely require increased travel for medical purposes (D'Ambrosio et al., 2012).

Many of today's baby boomers have an affluent and active lifestyle (Cobb & Coughlin, 2000; Coughlin, 2009). It is expected that this lifestyle will translate into increased travel and demand for shopping, recreational activities, and outings by this cohort as it ages. Research undertaken by AARP (formerly known as the American Association of Retired Persons) (2004) highlighted that in the United States, older adults accounted for more than half the market share in spending for housing, food, health, and transportation. With the aging of the baby boomer population, this proportion of expenditures is unlikely to change. Subsequent research conducted by the AARP (2005a) indicated that baby boomers are likely to remain active as they age and will likely conduct more trips for leisure and adventure. Thus, the trend and expectation for increased mobility among this cohort are only expected to increase as baby boomers enter their senior years over the next three decades.

1.43 Heterogeneity among Older Adults, Predictors of Driving Cessation and Reduced Mobility, and Transportation Disadvantaged Subgroups

Older adults are a heterogeneous group. As such, members of this population differ across socio-demographic and physical variables (Alsnih & Hensher, 2003). Furthermore, older adults belonging to the baby boomer cohort are even less homogeneous as there are substantial differences across not only members of this group (The National Older Driver Safety Advisory Council, 2012), but baby boomers approaching their senior years differ in many ways from comparably aged older adults from previous generations. For instance, as previously mentioned, a proportion of baby boomers is more active and healthier than previous cohorts (Coughlin, 2009) but there are also members of this cohort that are in poorer health as indicated by increased incidence and prevalence of chronic medical conditions (Canadian Institute for Health Information, 2011a, 2011b; Denton & Spence, 2010; PHAC, 2011) and disability (Davison et al., 2002; Galanos et al., 1994; Harris et al., 1997; Reed et al., 1998). As well,

licensing rates among baby boomers have increased from previous generations of older adults, especially among females, and the mobility and travel demands of baby boomers differ substantially from previous generations of older adults (Alsnih & Hensher, 2003; Burkhardt et al., 1998; Collia et al., 2003; Rosenbloom, 2004). The trend toward increased diversity among members of the older adult cohort is not expected to diminish with the aging of the population. Furthermore, recognition needs to be given toward the heterogeneity that exists in the older adult population in terms of out-of-home mobility needs.

As the vast majority of older adults rely on the private vehicle to meet their transportation and mobility needs, it is important to recognize that there are subsets of the older adult population who have never driven, choose not to drive, or are no longer able to drive. As such, these older adults face challenges in satisfying their travel demands and subsequently experience reduced out-of-home mobility (Rosenbloom, 2003, 2004). Giuliano (2004) characterized transportation disadvantaged older adults as “those who do not have access to a car or who are unwilling or unable to drive” (p. 192). Research has shown that not having a driver’s licence or access to a private vehicle is associated with a reduction in the number and length of trips that older adults make (Rosenbloom, 2003). Eberhard and Mitchell (2009) noted that when older adults are no longer able to drive, their mobility and subsequent independence are reduced. Their data from the United States indicated that older adults 50 to 74 years of age who did not drive made, on average, 2.1 trips per day as compared to an average of 4.3 trips per day for comparably aged drivers. Similarly, Rosenbloom (2012), using data from the 2001 NHTS, reported that males and females 65 years of age and older who did not drive made far fewer trips than males and females of a comparable age who did drive. Specifically, non-driving males 65 years of age and older made 66% fewer trips than comparably aged males who continued to drive. Further, a study undertaken by the AARP (2005b) indicated that when compared to older drivers, older adults who did not drive were 15 times more likely to report that they frequently missed or were unable to participate in activities because they lacked transportation. Although transportation from family or friends, public transportation, and alternate transportation services may be available to older adults, it has been consistently shown that older adults who no longer drive often are reluctant and do not utilize these forms of transportation

(Burkhardt et al., 1998; Dickerson et al., 2007; Glasgow & Blakely, 2000; Kostyniuk & Shope, 2003).

It is informative to consider the predictors of driving cessation and factors likely to influence licensure among older adults to highlight those subsets of the population who, because of their dependence on the private vehicle, are likely to experience reduced mobility and be transportation disadvantaged when faced with driving cessation.

Functional Limitations and Health Status

A substantial body of literature exists that demonstrates that certain physical characteristics influence and impact whether an older adult has a driver's licence and/or the ability to operate a private vehicle. For instance, older adults with disabilities, those in poorer health, and older drivers with functionally impairing chronic medical conditions are more likely to give up driving and be transportation disadvantaged (Campbell, Bush, & Hale, 1993; Dellinger, Seghal, Sleet, & Barrett-Connor, 2001; Gilhotra, Mitchell, Ivers, & Cumming, 2001; Marottoli et al., 1993; O'Neill, Bruce, Kirby, & Lawlor, 2000). Foley and colleagues (2002), using data collected in 1993 and 1995 for the Asset and Health Dynamics Among the Oldest Old (AHEAD) study, demonstrated that poor functional status was a significant factor associated with driving cessation among older adults. Specifically, among older adults with chronic activities of daily living (ADL) limitations, the OR for driving cessation was 5.91 (95% CI 4.02, 8.68) and among older adults with incident ADL limitations, the OR for driving cessation was 3.59 (95% CI 2.61, 4.94). Based on survey data from the Bureau of Transportation Statistics, Sweeney (2004) found that older adults with disabilities conducted travel outside of the home less often than older adults without disabilities. As well, 31.9% of disabled older adults reported that they needed special assistance or additional mobility equipment in order to travel outside of the home. Anstey, Windsor, Luszcz, and Andrews (2006) conducted a prospective study of men and women, 70 years of age and older, to examine the psychological, medical, and sensorimotor predictors of driving cessation over a five year interval. Their results demonstrated that participants' self-rated health of *poor* or *fair* at baseline was significantly associated with driving cessation at wave 2 (OR = 5.40; 95% CI 1.97, 10.27), wave 3 (OR = 4.15; 95% CI 1.94, 8.91),

and wave 4 (OR = 2.68; 95% CI 1.45, 4.97) of the study. Furthermore, data from Rosenbloom (2003) indicated that with the aging of the baby boomers, a substantial proportion of older adults will face increasing disabilities, which in turn will result in more dependence and reliance on others for assistance with travel needs.

Based on an analysis of the 2001 NHTS data, Collia et al. (2003) demonstrated that among adults 65 years of age and older, 35.8% of those with medical conditions reported that they had given up driving altogether and 52.3% of those with medical conditions reported that they had asked and relied on others for rides. More recently, Mattson (2012) using data from the 2009 NHTS, explored the travel patterns of individuals with medical conditions. His results are informative in that they showed older adults with medical conditions took fewer trips than older adults without such conditions. Specifically, among older adults 65 to 74 years of age, the average number of trips dropped to 2.4 per travel day for those with medical conditions, from an average of 3.9 trips per travel day for comparably aged older adults without medical conditions. Further, 37% of older adults aged 65 to 74 years with medical conditions reported that they stayed in the same place all day compared to only 16% of comparably aged older adults without such conditions. Additionally, among older adults 65 to 74 years of age not making a trip in the past week, 58.7% of those with medical conditions reported that they would have liked to get out more often as compared to 48.9% of those older adults with no impairing medical conditions. Not only do older adults in poorer health face reductions in mobility because of driving cessation, their limited functional status makes it more difficult for them to utilize other means of transportation to satisfy their mobility needs. Among older adults with poor functional status and medical conditions, a proportion will come to depend on alternate means of transportation (Burkhardt, McGavock, Nelson, & Mitchell, 2002). It also has been shown that the same medical conditions or disabilities that impair driving performance also negatively impact an individual's ability to use other modes of transportation (Dickerson et al., 2007; Harris & Tapsas, 2006; Kostyniuk & Shope, 2003; Oxley & Whelan, 2008; Rosenbloom, 2003; Suen & Sen, 2004). Thus, older adults who cease driving due to functional limitations most often due to medical conditions are likely to experience

substantial reductions in their out-of-home mobility given the barriers they face in utilizing alternate forms of transportation.

Advancing Age

Across many studies, advancing age also has been associated with driving cessation and subsequent reductions in mobility among older adults. Using data from the AHEAD study, Foley and colleagues (2002) demonstrated that among older adults 75 to 79 years of age, the OR for cessation of driving was 1.62 (95% CI 1.15, 2.27), whereas among older adults 80 years of age and older, the OR for driving cessation was 2.76 (95% CI 1.86, 4.08). As well, Burkhardt and colleagues (2002) suggested that adults 85 years of age and older, the oldest-old, face the most substantial barriers to driving and transportation use. The authors noted that with advancing age, older adults and especially the oldest-old, face increasing disability and functional impairment, a decreasing reliance on the private vehicle, and a dramatic decline in the amount of travel undertaken by this group. Similarly, in a survey of Finnish males and females, 65 years of age and older, Siren and Hakamies-Blomqvist (2004) demonstrated that fewer trips were made by the oldest-old and this subset of the older adult population consistently reported having unfulfilled travel needs. More recently, Edwards and colleagues (2008) conducted a prospective analysis of predictors of driving cessation over a five year period using participants from the Advanced Cognitive Training for Independent and Vital Elderly (ACTIVE) study. After controlling for days driven per week at baseline, as well as participation in a cognitive training intervention, their results demonstrated that older age was a significant predictor of driving cessation over the five year interval (Hazard Ratio [HR] = 1.09). Rosenbloom (2004) suggested that among older adults who live to be very old, there will be a dramatic increase in the number and proportion of individuals who will experience chronic medical conditions, limiting illnesses, and disabling conditions and this will likely translate into an increased proportion of older adults who are dependent on others for their mobility needs. Further, she noted that with advancing age, physical and medical conditions are likely to worsen and compromise functioning even more. As such, the oldest-old are likely to require more services and face substantial reductions in mobility as compared to the younger-old.

Income

Other research has demonstrated the association between low household income, driving limitations, and driving cessation among older adults. In their analyses of men and women 65 years of age and older who participated in the Yale Health and Aging Project (YHAP), Marottoli and colleagues (1993) demonstrated that after controlling for sex and housing stratum, lower household income was an independent predictor of driving cessation. Specifically, when compared to older adults with higher household incomes, the OR for driving cessation among older adults with low incomes was 1.21 (95% CI 1.01, 1.46). Further, their analyses showed that low household income among older adults also was a predictor of low miles driven annually. Older adults who drove less than 5,000 miles annually were more likely to have low household incomes (OR = 1.28; 95% CI 1.04, 1.56). Similarly, results from a cross-sectional study of community-dwelling older adults conducted by Dellinger and colleagues (2001) revealed that among the top reasons reported for the transition to driving cessation by former drivers were the costs associated with keeping an automobile. Ragland, Satariano, and MacLeod (2004) examined self-reported reasons for driving limitations among older adults, 55 years of age and older from the Study of Physical Performance and Age-Related Changes in Sonomans. Their results indicated that an important predictor, and often a reason given for driving limitations and avoidance among older men and women, was low household income. More recently, Turcotte (2006) highlighted that certain socio-economic factors are associated with an increased likelihood of older adults lacking sufficient access to transportation. His analyses, based on data from the 2005 General Social Survey (GSS), showed that 13% of older adults with household incomes under $20,000 reported having limited access to transportation. Conversely, 90% of older adults with household incomes over $40,000 reported owning a vehicle and having access to that vehicle as a driver. Furthermore, it can be expected that among older adults with low household incomes, additional reductions in mobility are likely as these individuals often lack the financial resources to utilize alternate means of transportation (Rosenbloom, 2003).

Living Arrangements

Older adults who live alone are more likely to face constraints in mobility or driving cessation and thus be transportation disadvantaged as compared to older adults with different living arrangements. According to Burkhardt and colleagues (1998), older adults who live alone have less access to immediate transportation and transportation alternative as compared to older adults living in multi-person households. As such, they often suffer reduced mobility. Furthermore, older adults who live alone are much more likely to have low household incomes and not have the financial resources to operate a private vehicle or utilize alternate modes of transportation (Burkhardt et al., 2002). Mollenkopf and colleagues (2004) analyzed data from the Enhancing Mobility in Later Life: Personal Coping, Environmental Resources, and Technical Support to examine whether personal and structural characteristics could differentiate between groups of older adults with differing levels and satisfaction with mobility. Their results demonstrated that compared to high mobility groups, a greater proportion of older adults in the group reporting the lowest levels and least satisfaction with mobility lived alone. Edwards and colleagues (2008), using data from the ACTIVE study, demonstrated that after controlling for baseline driving status and participation in a cognitive training intervention, older adults who lived alone had increased risk (HR = 1.21) for driving cessation over a five year period. Mezuk and Rebok (2008) highlighted characteristics of continuing and former drivers from participants 60 years of age and older who participated in the population-based Baltimore Epidemiologic Catchment Area (ECA) study. Among older adults who were 60 years of age and older at wave 3 of the study (data collected from 1993 to 1996), 39.1% of former drivers lived alone as compared to only 29.8% of continuing drivers. Research suggests that the association between driving cessation and living arrangement often is a function of marital status (Kostyniuk & Shope, 2003; Rosenbloom, 2003). Using participants 65 years and age and older from the ACTIVE study, Edwards and colleagues (2008) demonstrated that relative to married older adults, the HR for driving cessation among older adults who were unmarried was 1.56 over a five year interval. Older adults living with spouses not only have greater financial resources but also have others in the household who are thus able to provide transportation.

Ethnicity

Over the last few decades, there has been rapid growth in the proportion of older adults from ethnic minorities in the United States population (Burkhardt et al., 2002; Rosenbloom, 2003, 2004). Data from the United States show that in 2010, non-Hispanic Whites accounted for 80% of the population 65 years of age and older; this proportion is projected to decrease to 58% by 2050 (Federal Interagency on Aging-Related Statistics, 2012). In comparison, the proportion of African American older adults is projected to increase from 9% in 2010 to 12% by 2050; and the proportion of Hispanic older adults is projected to increase from 7% in 2010 to 20% by 2050 (Federal Interagency on Aging-Related Statistics, 2012). Rosenbloom (2003) demonstrated that even after controlling for income and residential location, variations in travel patterns are evident among older adults as a function of ethnicity. Her research, based on data from the 1995 NPTS, indicated that compared to White older adults, older adults of Hispanic and Asian descent make shorter and fewer trips and travel less often in a private vehicle. In their secondary analysis of data from a study conducted by the University of Alabama at Birmingham Center on Aging, Park and colleagues (2010) illustrated that compared to White older adults, a greater proportion of Black older adults reported having difficulties with transportation (11.6% vs. 24.7% respectively, $p < .05$). Furthermore, research has shown non-White ethnicity is a predictor of driving cessation among older adults (Gallo, Rebok, & Lesikar, 1999). Using data from the Baltimore ECA study, Mezuk and Rebok (2008) revealed a statistically significant association between ethnicity and driving status. Their research indicated that at waves three and four of the studies, relative to continuing drivers, former drivers were more likely to be of non-White descent. Choi, Mezuk, Lohman, Edwards, and Rebok (2012) reported similar results. Using data from the ACTIVE study, the authors reported that compared to continuing drivers, former drivers were more likely to be of non-White ethnicity.

Moreover, research also has shown that older adults of non-White ethnicity are less likely to be licensed to drive. Using data from the 1995 NPTS, Rosenbloom (2004) showed that 91.9% of White older adult males were licensed to drive as compared to 87.2% of Hispanic, 83.6% of Asian, and 70.3% of African

American males of the same age. An even larger discrepancy in licensing rates by ethnicity was observed among older adult females. In 1995, among White older adult females, 74.0% were licensed to drive as compared to 47.2% of Hispanic, 42.0% of Asian, and 37.4% of African America females of comparable ages. Similar results were reported by Choi and Mezuk (2012). Using data from the 1993 wave of the AHEAD study and the 2008 wave of the Health Retirement Study, the authors showed that older adults who had never driven were more likely to be of a non-White ethnic minority. In 2008, relative to Whites, the OR for never driving among Black older adults was 2.21 (95% CI 1.29, 3.79) and the OR for never driving among Hispanic older adults was 2.91 (95% CI 1.51, 5.60).

Many social and demographic factors likely overlap and influence the likelihood of ethnic minority older adults experiencing driving cessation or, alternatively, the likelihood of older adults from these minorities being licensed to drive. According to Rosenbloom (2003), travel patterns, driving cessation, and licensing rates among older adults from ethnic minorities are likely a combination of demographic factors, current and historical discrimination, and ethnic/cultural differences in mobility attitudes and preferences.

Place of Residence

In addition to functional and/or health status, advancing age, income, living arrangements, and ethnicity, place of residence has been shown to be associated with reductions in mobility among older adults. In many developed nations, there is a greater proportion of older adults residing in suburban and rural areas, with this proportion of the population growing faster than in urban centres (Dandy & Bollman, 2008; Giuliano, 2004; Rosenbloom, 2004; Turcotte & Schellenberg, 2007). Relative to their urban counterparts, older adults residing in rural areas are even more dependent on the private vehicle for transportation and the maintenance of mobility needs because of the increased travel distances to services, facilities and resources. This dependence also is exacerbated because of the lack of suitable public and alternate transportation options (Dickerson et al., 2007; Dobbs & Strain, 2008; Rosenbloom & Stahl, 2002; Suen & Sen, 2004; Turcotte, 2006). Canadian data suggest that a greater proportion of older adults residing in rural areas are licensed to drive, and do in fact drive, as compared to older adults in urban areas. Bess (1999) reported that 72% of older

adults 65 years of age and older from rural areas were licensed to drive and close to 60% of those from small towns did indeed drive. In comparison, only 52% of older adults who resided in cities with populations over 500,000 were licensed drivers and 46% of older adults from cities of this size reported driving. More recent Canadian data from the 2005 GSS demonstrated that a greater proportion of older adults residing in rural areas owned a vehicle and were able to drive it (Turcotte, 2006). Among rural older adults, factors such as declining or poorer health, older age, and lower economic status have been associated with an increased likelihood of driving cessation and reduced access to private vehicles (Molnar, Eby, St. Louis, & Neumeyer, 2007; Park et al., 2010; Roff & Klemmack, 2004; Rosenbloom 2004). However, older adults residing in rural areas are more likely to hold on to their drivers' licences even when they no longer have the adequate skills needed in order to operate a vehicle safely (Alsnih & Hensher, 2003; Hanson & Hildebrand, 2011; Kostyniuk, St. Louis, Zanier, Eby & Molnar, 2012). Research has shown that rural drivers, and especially older rural drivers, are at increased risk for motor vehicle crashes, serious injury, and fatality as compared to similarly-aged urban drivers (Boufous, Finch, & Hayen, & Williamson, 2008; Thompson et al., 2013; Zwerling et al., 2005).

Due to the lack of public or alternate transportation services, the private vehicle serves a critical role in facilitating the fulfillment of out-of-home mobility needs among older adults residing in rural areas. Driving cessation or lack of access to a private vehicle often results in mobility constraints and unmet needs across both essential and social domains for older adults in rural areas (Kostyniuk et al., 2012). A Finnish survey of over 1500 older men and women showed that, after controlling for interactions among demographic variables, rural residence negatively affected travel behaviour, with older adults residing in rural areas having more unfulfilled travel needs than their urban counterparts (Siren & Hakamies-Blomqvist, 2004). Mollenkopf and colleagues (2004) explored the personal and structural factors related to levels and satisfaction with mobility among older adults. Their results demonstrated that rural residence was among the factors that were associated with belonging to the lowest mobility group. Hanson and Hildebrand (2011) conducted a multi-day travel survey of rural older drivers from New Brunswick, Canada. Results from their analyses indicated that

among older adults residing in rural areas, if access to a private vehicle was no longer available, participants would not make 34% of the trips that they normally made.

Specifically, research has consistently shown that many older rural residents have unmet health care needs resulting from the lack of available public and alternate transportation services (Arcury et al., 2005; Arcury, Quandt, Bell, McDonald, & Vitolins, 1998; Gesler et al., 2001; Pesata, Geri, & Webb, 1998). Compounded with the lack of public or alternate transportation services, the availability of medical services is limited in rural areas. Moreover, older rural residents have to travel farther to access health care services and programs (Arcury, Preisser, Gesler, & Powers, 2005; Clark & Dellasega, 1998; Forti & Koerber, 2002; Martin, Wright, Barnett, & Roderick, 2002; Magilvy, Congdon, & Martinez, 1994; Vrabec, 1995). In 2010, Mattson conducted a survey of 543 men and women 60 to 95 years of age. Results from his survey demonstrated that health care utilization was lower among older rural residents as compared to similarly aged urban residents. Additionally, distance to services and access to transportation was cited as impacting the likelihood that older rural residents missed or delayed health care appointments.

Further, older adults residing in rural locations also face challenges in remaining socially connected. According to Glasgow and Blakely (2000), given the lack of available transportation arrangements and alternatives to the private vehicle, older adults in rural areas face a diminished capacity to participate in community activities and to remain socially integrated. As well, older rural residents unable to drive or without access to a private vehicle are particularly at risk for social isolation and lower quality of life and well-being. The private vehicle thus serves a critical role in facilitating the fulfillment of travel needs among older adults residing in rural areas (Dobbs & Strain, 2008).

Sex and the Impact of Interactions among Social and Physical Demographic Factors

There are varied and wide differences in the mobility needs of different sub-groups of older adults. Interactions among different socio-demographic and physical factors are likely to make specific sub-sets of older adults even more transportation disadvantaged than others. This is especially true among females.

Research examining sex differences show that older females are at increased risk for experiencing driving cessation and reductions in mobility compared to older males (Mezuk & Rebok, 2008; Oxley & Whelan, 2008). Using data from the 2001 NHTS, Collia and colleagues (2003) found that among survey participants, older females were the least likely to drive. Further, compared to males, older females reported travelling less and shorter distances. They also reported more medical conditions that imposed limitations upon their travel needs and desires. Additionally, older females are more likely to cease driving prematurely. As a result, they are more likely to be dependent on others for transportation and be burdened by a lack of suitable transportation alternatives (Alsnih & Hensher, 2003; Burkhardt & McGavock, 1999; Gallo et al., 1999; Rosenbloom & Herbel, 2009; Siren, Heikkinen, & Hakamies-Blomqvist, 2001). Based on data from the 2001 NHTS, Rosenbloom (2006) reported that among females 85 years of age and older, 40% were licensed to drive compared to almost 92% of males 85 years of age and older being licensed to drive. When considering older adults 55 to 59 years of age, almost 93% of females and 98% of males were licensed to drive. Similar results have been reported in Canada as well. Turcotte (2012), using data from the 2009 CCHS, reported that among older adults 65 to 74 years of age, differences existed between the proportion of females and males with valid driver's licences (77% and 94%, respectively). As well, with advancing age, a greater proportion of females were no longer licensed to drive compared to males. Specifically, among older adults 75 to 79 years of age, 65% of females and 90% of males were licensed to drive; among older adults 80 to 84 years of age, 47% of females and 81% of males were licensed to drive; and among older adults 85 to 89 years of age, only 30% of females were licensed to drive as compared to 72% of males licensed to drive. The results suggest that with advancing age, a greater proportion of older females are relinquishing the car keys compared to males. The implications that this has for continued mobility among females is significant.

Furthermore, the interaction of sex with other socio-demographic factors makes females especially likely to experience driving cessation, with subsequent reductions in mobility. Burkhardt and colleagues (2002) suggested that because females are more likely to live longer, they also are more likely to be frail, widowed, living alone, and with inadequate financial resources to assist them

with mobility issues. It also has been suggested that because baby boomer females are less likely to have married and have fewer children than previous cohorts, they subsequently are more likely to have fewer children and family members that are able to provide support for them in their senior years (Alsnih & Hensher, 2003; Rosenbloom, 2003, Rosenbloom & Stahl, 2002; Rosenbloom & Winsten-Bartlett, 2002; Siren et al., 2001). In a study of 839 adults aged 75 years and older, Dupuis, Weiss, and Wolfson (2007) revealed that 88% of their sample that reported problems with transportation were females. Based on multivariate analyses, they demonstrated that lower income and income satisfaction were associated with an increased odds of self-reported transportation problems among females (OR = 1.6; 95% CI 1.1, 2.2). According to Finlayson and Kaufert (2002), older females 75 years of age and older who are unable to drive and lack access to a private vehicle are the most transportation disadvantaged sub-set of the older adult population. The results from the research demonstrate that across many different factors, a clear age by sex difference exists where older females are faced with substantially more disparities in travel and out-of-home mobility.

With the graying of developed nations, it is expected that the heterogeneity among older adults will become even more significant in the coming years (Burkhardt et al., 2002; Rosenbloom, 2004; Siren & Hakamies-Blomqvist, 2004). Moreover, given this heterogeneity in socio-demographic factors, it is reasonable to assume that older adults also will have heterogeneity in their travel needs. Focused efforts that recognize that different sub-sets of the older population are more likely to be transportation disadvantaged and to experience reduced mobility are needed to ensure that the mobility needs of all older adults are fulfilled.

1.44 The Negative Consequences of Reduced Mobility and Driving Cessation among Older Adults

Given the saliency of mobility to quality of life and well-being (Banister & Bowling, 2004; Carp, 1988; Metz, 2000), and older adults' increasing dependence on the private vehicle for travel needs, it is not surprising that reductions in mobility and the loss of driving privileges often result in deleterious outcomes. A substantial body of research exists that point to the negative effects of reduced mobility on social participation and the psychological consequences

associated with voluntary or involuntary driving cessation among older adults. Reductions in mobility or the loss of driving privileges can compromise older adults' access to essential and non-essential services. Burkhardt and colleagues (1998), using interview and focus group methodology, reported that driving cessation results in reductions in health, well-being, and consumption of essential services among older adults. Similarly, in their study of 315 drivers, 65 years of age and older whose licences had been revoked due to dementia, Taylor and Tripodes (2001) reported that 38% of respondents in their study had difficulty in accessing shopping destinations and medical appointments and 50% reported difficulty in accessing social and recreational activities after the revocation of their drivers' licences. According to Carp's (1988) mobility framework, satisfaction of basic life-maintenance needs enables older adults to live independently. Inability to access community resources or satisfy the most basic of needs compromises an older adult's independence, which can result in a reduced sense of well-being and a lower quality of life.

Furthermore, research also has demonstrated that reductions in mobility or the loss of driving privileges can adversely affect social integration and community participation among older adults. Social engagement and community participation among older adults have been associated with successful and healthy aging (Dahan-Oliel, Mazer, Gelinas, Dobbs, & Lefebvre, 2010) and have been linked to improved mental health, physical functioning, reduced mortality, and increased longevity (Badger, 1998; Barnes, Mendes de Leon, Wilson, Bienias, & Evans, 2004; Berkman & Syme, 1979; Engelhardt, Buber, Skirbekk, & Prskawetz; 2010; Herzog, Ofstedal, & Wheeler, 2002; Hsu, 2007; Lovden, Ghisletta, & Lindenberger, 2005; Wang, Karp, Winblad, & Fratiglioni, 2002; Wilkins, 2003). Mollenkopf and colleagues (1997) conducted interviews with 1400 adults, 55 years of age and older, from Italy, Finland, and Germany to explore the mobility needs of older adults and identify the main factors that impeded upon desired mobility. Their results indicated that mobility is a fundamental pre-requisite for participation in social relationships and activities and the ability to drive significantly influences overall participation levels among older adults. Marottoli and colleagues (2000), using participants from the New Haven site for the Established Populations for Epidemiologic Studies of the Elderly (EPESE), found that after controlling for socio-demographic and health-

related factors, driving cessation was strongly related to a decrease in out-of-home activity levels among older adults. In their longitudinal cohort study (*N* = 1316), for each three year follow-up period, the magnitude of the decline in activity levels due to driving cessation was more than three times higher than the reported average decline in activity levels for the cohort. Gilmour (2012), using data from the 2009 CCHS, reported that almost 25% of older adult Canadians said they would have liked to have participated in more social and recreational activities in the past year with 3.7% of males and 11.2% of females reporting that transportation problems prevented them from more social participation. Reduced mobility and driving cessation can prevent older adults from being able to fully integrate themselves within society and participate in those community activities that facilitate the satisfaction of higher-order needs (i.e., socializing, worship, recreation, etc.), with these higher-order needs specifically relevant to well-being and quality of life among older adults (Carp, 1988). When faced with an inability to remain connected within the social sphere, older adults often may experience isolation and loneliness.

In addition, research has demonstrated that reductions in mobility and driving cessation among older adults can result in negative psychological consequences. Driving not only provides older adults with the means by which to access community resources and services (OECD, 2001) and to remain integrated within society (Glasgow & Blakely, 2000), it is a symbol of autonomy, independence, continued competence, and personal identity for older adults (Adler & Rottunda, 2006; Shope, 2003; Yassuda et al., 1997). When faced with reduced mobility or the transition toward driving cessation, an individual's independence, autonomy, self-identity, and personal control often are jeopardized. Carp (1988) noted that qualities of mobility, such as personal control, directly influence emotional and social well-being, thus contributing to overall quality of life. According to Eisenhandler (1990), possession of a valid driver's licence serves as a foundation for personal beliefs about competence, independence, and psychological well-being and acts as a dis-identifier of the stigmatized identify of old age. Lister (1999) reported that driving cessation caused older adults to feel like they lacked a sense of control over their lives; the loss of driving privileges resulted in reductions in spontaneity which was linked to a loss of independence among older adults. Fonda, Wallace, and Herzog (2001)

suggested that events like driving cessation convey to older adults that they lack personal control and this ultimately results in negative perceptions of self-concept. Mobility and driving thus allow older adults a means by which to continue to feel effective and competent (Ralston et al., 2001). Reductions in mobility and the loss of a driver's licence often mean that older adults come to rely and depend on others for their travel needs even when other alternatives to driving are available (Burkhardt, 1999; Donorfio, Mohyde, Coughlin, D'Ambrosio, & Coley, 2008; Dupuis et al., 2007; Fonda et al., 2001; Taylor & Tripodes, 2001). Mobility is a major determinant of psychological health. Loss of mobility and dependence on others for travel needs often result in lower overall perceptions of personal independence, competence, life-satisfaction, and well-being (Carp, 1988).

Among older adults, the loss of autonomy, personal independence, sense of control, and self-identity that result from reduced mobility or no longer being able to drive have been associated with increased depressive symptoms (Harrison & Ragland, 2003). Marottoli and colleagues (1997), conducted a longitudinal cohort study of older adults, 65 years of age and older who participated in the New Haven EPESE. Their analyses demonstrated that after controlling for demographic, psychosocial, and health-related factors, over a six year interval participants who had stopped driving experienced an increase in depressive symptoms as compared to participants who continued to drive. Using data from three waves of the AHEAD study, Fonda et al. (2001) revealed similar results in that participants who had stopped driving were 1.44 time more likely to experience depressive symptoms as compared to participants who continued to drive. Ragland, Satariano, and MacLeod (2005) conducted a cohort study of adults, 55 years of age and older to assess the impact of driving cessation on depressive symptoms. The authors demonstrated that at baseline, the mean depression scores of former drivers, as measured by the Center for Epidemiological Studies Depression Scale, were higher than current drivers even after controlling for age, sex, education, health, and marital status. Three years later the authors compared depression measures between participants who were still driving with depression measures of participants who had stopped driving during the follow-up period. Their analyses showed that after controlling for changes in health status and cognitive function, those who had transitioned to

driving cessation during the three year interval had higher levels of depressive symptoms as compared to participants who continued to drive. Windsor, Anstey, Butterworth, Luszcz, and Andrews (2007) used data from the Australian Longitudinal Study of Aging to assess the relationship between driving cessation, personal control, and depressive symptoms. The results of their analyses indicated that relative to drivers, older adults who had transitioned to driving cessation showed a significant increase in depressive symptoms between baseline and follow-up. The authors further suggested that driving cessation among older adults negatively impacts perceptions of control and this in turn is associated with an increase in depressive symptoms.

Given the multitude of negative outcomes that are associated with driving cessation and reduced mobility, it is important to develop ways in which to ensure that older adults remain safely mobile long into their advanced years. Alternate modes of transportation, such as ATS services, can potentially serve as a mediator between driving cessation and loss of independence and freedom, social isolation, decreased social integration, and reduced quality of life and well-being among older adults.

1.5 Summary and Statement of Purpose

Recognition has been given toward the importance and influence of mobility on quality of life and well-being among older adults. Out-of-home mobility, supported by available transportation, facilitates the satisfaction of both basic life-maintenance needs and higher-order needs such as socialization and recreation among older adults (Carp, 1988). The aging of the population and the trend toward declining health status among a significant proportion of older adults is expected to have a substantial impact on the provision of alternate means of transportation in the future. Moreover, the increased licensing rates, travel demands, and mobility needs of today's older adults as compared to previous generations, give rise to serious implications for the development of sustainable transportation services in the future.

Currently, there are few ATS services available that rival the private vehicle in terms of the flexibility, convenience, and independence it affords older adults in

satisfying their travel demands and needs. Given the heterogeneity that exists among older adults, a single 'one size fits all' model of alternate transportation services will not adequately meet the mobility needs of vulnerable transportation disadvantaged sub-groups of the senior population. It has been suggested that we are ill-prepared to provide transportation for an increasingly diverse and larger number of older adults (Millar, 2005). It also is the case that little progress has been made in terms of developing and implementing new transportation programs and policies that would serve to enhance the mobility needs of older adults in the future (Coughlin, Mohyde, D'Ambrosio, & Gilbert, 2004).

The 5 A's of senior friendly transportation (Availability, Acceptability, Accessibility, Adaptability, and Affordability) (The Beverly Foundation, 2001, 2005) are features of transportation services that have been established as useful criteria by which to assess the usability of different modes of alternate transportation for seniors (ATS) services. However, there is a paucity of research on the underlying factors that encompass these attributes of transportation services. Furthermore, little research has been undertaken to explore older adults' preferences, perceptions, and needs in terms of alternate transportation services. As well, there is a lack of understanding toward the mobility preferences that vulnerable transportation disadvantaged subgroups place upon different attributes of ATS services. As such, this thesis will investigate and test two distinct research questions:

- Does the underlying factor structure of the 5 A's of senior friendly transportation, as articulated by The Beverly Foundation (2001, 2005), include five independent senior friendly dimensions?
- Is there a relationship between different socio-demographic, physical health, and mental health factors and the ratings or degree of importance that older adults place upon the 5 A's of senior friendly transportation as features that are essential for ATS services?

Specifically, the first research question concerning the dimensionality of the 5 A's of senior friendly transportation will be explored via Exploratory Factor Analyses (EFA). To assess the relationship between different socio-demographic, as well as physical and mental health factors, and the ratings of importance older adults place upon different attributes of ATS services, multivariate linear regression

analyses will be undertaken. Given the heterogeneity and growing diversity among older adults, recognition of the preferences that different sub-groups of the older adult population have in relation to different aspects of ATS is important in that the results can be used to inform on the development of new ATS services and enhance existing ATS services. Having policies, transportation programs, and ATS services that are responsive and cognizant of older adults' heterogeneity and mobility preferences will become increasingly important as Canada's and the world's population continues to gray.

Chapter 2. Methods

2.1 Data Source

The data used for this thesis are from a cross-sectional survey of older adults in Alberta, Canada that was carried out in 2011 by the Medically At-Risk Driver (MARD) Centre at the University of Alberta in Edmonton, Alberta, Canada. Funding for this project was provided by the Alberta Motor Association (AMA) Foundation for Traffic Safety. The survey was conducted with the overarching goal of providing knowledge about what older adults deemed to be important with respect to alternate transportation in order to address the strengths and gaps in ATS service provision in the province of Alberta.

2.2 Questionnaire Design and Data Collection

The survey questionnaire was designed by the research staff at the MARD Centre at the University of Alberta. The MARD Centre is situated within the Department of Family Medicine, Faculty of Medicine and Dentistry at the University of Alberta in Edmonton. It is a research centre that is committed to enhancing the safety and mobility of medically at-risk drivers as well as reducing the social, health, and economic impacts of medically at-risk and medically impaired drivers. Additionally, the MARD Centre works with government, stakeholders, and community partners to develop innovative and responsive models of alternate transportation that support out-of-home mobility for older adults who do not drive or are no longer able to drive.

A preliminary survey questionnaire was initially developed by MARD research staff. Refinement of the preliminary questionnaire occurred through consultation with the Population Research Laboratory (PRL) research staff. The PRL was contracted to administer the survey. The PRL is a centre for social science research at the University of Alberta that employs different methodologies for collecting data for a wide range of research endeavors. As such, the PRL specializes in the gathering, analysis, and presentation of data

about demographic, social, and public issues. The PRL also is a member of the Association of Academic Survey Research Organizations (AASRO).

Overall, the questionnaire was designed to evaluate older adults': 1) awareness of public and alternate transportation options in the community; 2) use of both public and alternate transportation options in the community; 3) satisfaction with transportation services available in the community and; 4) ratings of the importance of the 5 A's of senior friendly transportation (Availability, Acceptability, Accessibility, Adaptability, and Affordability) (The Beverly Foundation, 2001, 2005) for ATS services. The final survey included a total of 93 questions and consisted of the following sections: a standardized introduction; assurance to respondents that participation was voluntary and any information collected would be confidential, anonymous, and protected under the Freedom of Information and Protection of Privacy Act (FOIPP); eligibility questions for participation; questions on respondents' awareness, use, and opinions of both public and ATS services; questions on respondents' ratings or the degree of importance they place upon the 5 A's of senior friendly transportation (The Beverly Foundation, 2001, 2005) as vital attributes of ATS services; and, questions relating to demographic information.

A total of 24 questions in the survey asked respondents about ATS services and the ratings of importance that they placed upon specific features of the 5 A's (Availability, Acceptability, Accessibility, Adaptability, and Affordability) of senior friendly transportation (The Beverly Foundation, 2001, 2005). Four questions in the survey related to Availability and how important respondents felt that these attributes were for ATS services. Responses to these questions were coded on a three point scale with 1 = *not at all important*; 2 = *somewhat important*; and 3 = *very important*. A total of six questions in the survey were about the degree of importance that respondents placed upon Acceptability attributes of ATS services. Four of the six questions about attributes of Acceptability related to advance scheduling and demand response transportation. These variables were coded on a three point scale with 1 = *not at all reasonable*; 2 = *somewhat reasonable*; and 3 = *very reasonable*. In order to retain consistency among the scales used for questions relating to the 5 A's of senior friendly transportation, these four questions were reverse coded so that 1

= *very reasonable*; 2 = *somewhat reasonable*; and 3 = *not at all reasonable*. The final two questions about attributes of Acceptability and the importance of those attributes for ATS services were coded on a three point scale with 1 = *not at all important*; 2 = *somewhat important*; and 3 = *very important*. With respect to Accessibility, the survey asked respondents six questions that also were coded on a three point scale with 1 = *not at all important*; 2 = *somewhat important*; and 3 = *very important*. Coded on the same three point scale were the five questions that were designed to explore the importance that respondents placed upon Adaptability attributes as vital for ATS services. Lastly, three questions were directly related to respondents' ratings of the importance of Affordability for senior friendly ATS services. Responses to these questions were coded as 1 = yes, and 2 = no. Again, to retain consistency among the scales used, the three questions relating to Affordability were reverse coded so that 1 = no and 2 = yes. For a full description and listing of questions in the survey relating to the 5 A's of senior friendly transportation please refer to Appendix A.

Prior to data collection, all interviewers at the PRL received extensive training that included: information with respect to FOIPP requirements, guidelines, and overarching ethical considerations; survey questionnaire content; and Computer Assisted Telephone Interviewing (CATI) system telephone instructions. The CATI system at the PRL facilitates the exchange of information among interviewer personal computer stations and supervisor stations that are linked using a file and database server during the recruitment period. Research staff from the MARD Centre also attended the training session in order to provide background information about older adults and mobility relevant to the research, and to answer questions posed by interviewers concerning the nature and scope of the study.

Before the main phase of data collection began, a pre-test was conducted by the PRL from its centralized CATI facilities at the University of Alberta in order to refine the study questionnaire further. The pre-test consisted of PRL interviewers administering the survey questionnaire to 10 older adults from both rural and urban locations in Alberta. Research staff from both the MARD Centre and PRL reviewed the pre-test data and then proceeded to modify the electronic survey questionnaire in the CATI system further to produce the final version of

the questionnaire. Additionally, a public service announcement encouraging older adults in the province of Alberta to participate in the survey if they received a telephone call from PRL interviewers was initiated by MARD research staff and sent out through the internet to community newspapers prior to commencing the main data collection.

The main data collection began in early February (2011) and was completed in mid-March (2011). The data collection procedure did not utilize refusal interviewing in which interviewers call respondents back in an attempt to convert an initial refusal to participate into a completed interview. On average, the survey questionnaire took 21.4 minutes to complete and data collection took place during the day, in the evenings, and on the weekends. Interviewers from the PRL administered the survey to respondents between the hours of 0900 to 1400 hours and between the hours of 1400 to 2100 hours Monday through Friday; survey questionnaire administration taking place on Saturday occurred between the hours of 1000 to 1600 hours; with interviews conducted between the hours of 1400 to 2000 hours on Sunday.

All respondents were initially screened by PRL interviewers for eligibility in the study. Interviewers asked structured questions from their script to determine a respondent's eligibility based on the pre-defined criteria. To be eligible for participation, a respondent had to be 65 years of age or older, English speaking, and a resident of Alberta, Canada. Respondents were sampled from each of the nine former regional health authorities (RHA) (Chinook, Palliser, Calgary, David Thompson, East Central, Capital, Aspen, Peace Country, and Northern Lights) in Alberta.

Ethics approval for the study was provided by the Health Research Ethics Board – Panel B (HREB – Panel B) at the University of Alberta in Edmonton, Alberta. Of the screened individuals where contact was established, 901 respondents completed the survey, 46 did not complete the survey, 93 individuals had language problems, 2,607 refused to participate, and 7,422 were ineligible. Based on these statistics, the response rate for the survey

questionnaire was 24.7%[1]. Of the 25,296 allocated numbers, it took an average of 2.08 call attempts to obtain the final sample of 901 respondents.

2.3 Sampling Design

As mentioned previously, a total of 901 older adult respondents, 65 years of age and older and residing in Alberta, were surveyed by the PRL interviewers. A random digit dialing (RDD) approach was used to recruit 891 older adults from eight of the nine former RHAs (Chinook, Palliser, Calgary, David Thompson, East Central, Capital, Aspen, and Peace Country). The RDD approach was utilized to ensure that respondents had an equal chance of being contacted regardless of whether their household was listed in the local telephone directory. Oversampling was undertaken in the rural-based former RHAs in Alberta to ensure that a representative sample was captured from older adults residing in rural locations. To account for the small percentage of seniors in the former Northern Lights region, established contacts in that region assisted with recruitment by explaining the study, displaying information and sign-up sheets, and then forwarding to the MARD researchers a list of potential participants who had consented to being contacted. Of the 24 identified and consenting older adults from this region, 10 were randomly selected by the MARD research staff to participate in the survey. Table 2-1 shows the distribution of respondents by former RHA in Alberta.

Table 2-1

Distribution of Survey Respondents by Former Regional Health Authority

Former Regional Health Authority	N (%)
Chinook	100 (11.1)
Palliser	95 (10.5)
Calgary	180 (20.0)
David Thompson	85 (9.4)
East Central	107 (11.9)
Capital	180 (20.0)
Aspen	80 (8.9)
Peace Country	64 (7.1)
Northern Lights	10 (1.1)

[1] Response rates are calculated percentages representing the number of people who participated in the survey divided by the number selected in the eligible sample. The method used was the number of completed interviews (N = 901) divided by the number of completed interviews, refusals, incompletes, and language problems (n = 3647).

2.4 Statistical Analyses

Initial analyses of the data were conducted by research staff at the MARD Centre and are published in Dobbs and Pidborochynski (2011). Included in those analyses was frequency statistics concerning respondents' awareness, use, and perceptions or opinions about ATS services by driving status (current driver and non-driver) and place of residence (rural and urban). For a full listing of frequency statistics with respect to older adults' ratings of importance of the different attributes of the 5 A's of senior friendly transportation (The Beverly Foundation, 2001, 2005), please see Appendix B.

For this thesis, secondary analyses of the data were completed to test the following research questions:

- Does the underlying factor structure of the 5 A's of senior friendly transportation, as articulated by The Beverly Foundation (2001, 2005), include five independent senior friendly dimensions?
- Is there a relationship between different socio-demographic, physical health, and mental health factors and the ratings or degree of importance that older adults place upon the 5 A's of senior friendly transportation as features that are essential for ATS services?

The purpose of the first research question was to assess and understand the dimensionality of the 5 A's of senior friendly transportation as outlined by The Beverly Foundation (2001, 2005). The second research question was concerned with exploring the relationship between different socio-demographic, physical health, and mental health factors and respondents' ratings of the importance of the 5 A's of senior friendly transportation as being vital attributes of ATS services.

Analyses of the data were undertaken with the Statistical Package for the Social Sciences (SPSS) version 21 software program. The major statistical analyses conducted were: 1) standard descriptive statistics to assess demographic sample characteristics and chi-square test used to examine the differences between specific categorical variables; 2) Exploratory Factor Analyses (EFA) to determine the underlying factor structure of the 5 A's of senior friendly transportation (The Beverly Foundation, 2001, 2005), and; 3) multivariate linear regression analyses to assess the relationship between different socio-

demographic, physical health, and mental health factors and respondents' ratings of the importance of different features of ATS services.

Analyses of the data began with an EFA of the 24 variables representing attributes of each of the 5 A's (Availability, Acceptability, Accessibility, Adaptability, and Affordability) of senior friendly transportation (The Beverly Foundation, 2001, 2005). Factor analysis allows for an examination of the underlying factor structure of the data (Matsunaga, 2010). With EFA, the analysis seeks to describe and summarize the data by grouping together variables that are related (Henson & Roberts, 2006; Matsunaga, 2010). It also is commonly used to reduce a large number of observed variables into a smaller number of factors (Tabachnick & Fidell, 2001). The observed factors are thought to represent the underlying processes that have created the observed correlations among the variables (Beavers et al., 2013; Tabachnick & Fidell, 2001). Although the 5 A's of senior friendly transportation are widely established as a useful criteria for assessing alternate transportation services, little is known about the dimensionality or the relationships that may exist among the attributes that correspond to these features. In this thesis, EFA was conducted to explore the underlying factor structure of the data and was utilized also as a data reduction technique in order to reduce the 24 variables encompassing attributes of each of the 5 A's of senior friendly transportation to a smaller number of factors or dimensions.

With EFA, based on the Kaiser-Guttman criteria (Guttman, 1954; Kaiser, 1960, 1970), factors with eigenvalues > 1.0 are retained. As explained by Pett, Lackey, and Sullivan (2003), the eigenvalue is a value associated with each factor; it describes the amount of variance in all the items which is accounted for by that factor. According to the Kaiser-Guttman (Guttman, 1954; Kaiser, 1960, 1970) criterion for factor retention, a factor with an eigenvalue > 1.0 accounts for more variance than would a single item and as such argues for the merit of combining items into factors (Beavers et al., 2013; Pett et al., 2003). Furthermore, with EFA, two main types of rotational methods, orthogonal or oblique, are used to allow for the interpretation of the results (Beavers et al., 2013). According to Loo (1979), orthogonal (i.e., varimax, quartimax, and equimax) rotation methods are appropriate when the theoretical hypotheses

about the nature of the factors concern uncorrelated dimensions. In comparison, oblique (i.e., direct oblimin, promax, orthoblique, and procrustes) methods are utilized when it is hypothesized that there are relationships between the factors (Beavers et al., 2013). No matter which rotational method is utilized, the final interpretation of the observed factor solution requires that each dimension be sufficiently identified (Beavers et al., 2013). According to Costello and Osborne (2005), a sufficiently identified factor that is a stable and solid should contain at least three to five items with significant loadings. Additionally, Beavers and colleagues (2013) suggest that the items and the factors should make sense on a conceptual level.

Utilization of this statistical method allowed not only for an exploration of the dimension of the 5 A's of senior friendly transportation (The Beverly Foundation, 2001, 2005), but it enabled a summarization of patterns of correlations among the variables associated each of the senior friendly features. The results from the EFA provided the basis for the construction of composite measures that represented the ratings of importance that respondents placed upon the overarching dimensions of the 5 A's of senior friendly transportation. The composite measures were constructed by summing the items or variables which loaded on to each factor. Only those items or variables with loadings ≥ .30 were retained and used to construct the composite measures for each overarching factor. An assessment of Cronbach's (1951) alpha (α) was undertaken to assess the reliability of each of the composite measures. Cronbach's α, or the coefficient of internal consistency, is an estimate of the reliability of a scale that indicates the degree to which a set of items measures the same construct (Tavakol & Dennick, 2011). The estimate is derived as a function of the number of items included in the scale and the average inter-correlation among the items (Bland & Altman, 1997). Cronbach's α can range between 0 and 1, with higher estimates indicating that the generated scale or measure is more reliable. According to the literature, an estimate of Cronbach's α ranging between .70 and .95 is considered acceptable (Bland & Altman, 1997; DeVellis, 2003; Nunnally, 1978; Nunnally & Bernstein, 1994; Streiner, 2003). These composite measures were then used as the dependent variables in the multiple regression analyses.

Multiple regression analyses were performed to identify and assess the relationship between different socio-demographic, physical health, and mental health factors and respondents' ratings of the importance of the 5 A's of senior friendly transportation (The Beverly Foundation, 2001, 2005) as essential attributes necessary for ATS services. The composite measures representing each factor served as the dependent variables under consideration. The purposeful selection method was used to construct models of the best covariates or independent predictors for each of the dependent variables under consideration.

Purposeful selection is a statistical model building technique that aims to minimize the number of covariates or independent variables in a statistical model until the most parsimonious main effects model that describes the data is found (Bursac, Gauss, Williams, & Hosmer, 2008). This statistical model building method begins with a univariate analysis of each independent variable considered for inclusion in the model. Each covariate that has a significant univariate test as determined by an arbitrary alpha level is selected as a candidate to be included in the multiple regression analysis (Bursac et al., 2008). With purposeful selection, the recommended *p* value cut-off for a significant univariate test is an alpha level of .20 or higher (Hosmer & Lemeshow, 2000). This is because the tradition alpha level of ≤ .05, when used for statistical model building, can fail to identify variables that are known to be important (Bendel & Afifi, 1977; Bursac et al., 2008; Mickey & Greenland, 1989). Covariates in the regression analysis are included in the final main parameters model if they are statistically significant at an alpha level of ≤ .05. Non-significant covariates in the regression analysis are evaluated as potential confounders before excluding them from the final main parameters model. A covariate is a confounder if, after its removal from the regression model, there is a change in any remaining parameter estimates greater than 15% (Bursac et al., 2008). As noted by Bursac and colleagues (2008) "a change in a parameter estimate above the specified level indicates that the excluded variable was important in the sense of providing a needed adjustment for one or more of the variables remaining in the model" (p. 2). In this thesis, independent predictor variables were: 1) driving status (current driver vs. non-driver); 2) age; 3) sex (male vs. female); 4) place of residence (urban vs. rural); 5) marital status (married/common-law vs. single); 6) living

arrangements (multi-person household vs. lives alone); 7) annual household income (≥ $20,000 vs. < $20,000); 8) current rating of physical health (ranging from *poor* to *excellent*); 9) current rating of mental health (ranging from *poor* to *excellent*); 10) degree to which current physical health interferes the with ability to carry out daily tasks (ranging from *never* to *all the time*); 11) degree to which current mental health interferes with the ability to carry out daily tasks (ranging from *never* to *all the time*); and 12) use of mobility aids (use no mobility aids vs. uses one or more mobility aids).

Chapter 3. Results

3.1 Demographic Sample Characteristics

Demographic information for the overall sample of respondents is reported in Table 3-1. The average age of the 901 respondents was 73.4 years (standard deviation [*SD*] = 6.8 years). Although the oldest respondent to complete the survey was 97 years old, the majority (60.9%) of respondents were between 65 to 74 years of age. Of all respondents, the majority was female (61.3%). The percentage of individuals completing the survey in urban and rural areas was almost equal, with 51.9% of responses from urban locations. The majority of survey respondents were married or living in a common-law relationship (58.6%). Not surprisingly, a greater proportion of respondents reported living in a multi-person household (62.5%). Of all survey respondents, 15.3% reported having an annual household income under $20,000.

The vast majority of survey respondents described their current physical health status as either *good* or *excellent*, with only a cumulative proportion of 28.2% describing their current physical health as *poor* or *fair*. Additionally, the majority (82.1%) of older adults who completed the survey questionnaire reported not using any mobility aids to support their movement through the environment. When asked about the degree to which their current physical health interfered with their ability to carry out daily activities, slightly more than half (52.3%) of the sample indicated *never*; 40.0% reported *sometimes*; and close to 8.0% of survey respondents reported *all the time*. With respect to respondents' mental health, the vast majority (91.3%) described their current mental health status as either *good* or *excellent*. Furthermore, the vast majority (88.8%) of respondents also indicated that their current mental health *never* interfered with their ability to carry out daily activities.

Table 3-1

Demographic Characteristics of Survey Respondents

Characteristic		*n* (%)
Age (Years) (*n* = 893)	65–74	544 (60.9)
	75–84	277 (31.0)
	85+	72 (8.1)
Sex (*n* = 901)	Male	349 (38.7)
	Female	552 (61.3)
Place of Residence (*n* = 901)	Rural	433 (48.1)
	Urban	468 (51.9)
Marital Status (*n* = 898)	Married/Common-Law	526 (58.6)
	Single	372 (41.4)
Living Arrangements (*n* = 897)	Lives Alone	336 (37.5)
	Lives in Multi-Person Household	561 (62.5)
Household Income (*n* = 691)	< $20,000	106 (15.3)
	≥ $20,000	585 (84.7)
Current Rating of Physical Health (*n* = 900)	Poor	45 (5.0)
	Fair	209 (23.2)
	Good	434 (48.2)
	Excellent	212 (23.6)
Use of Mobility Aids (*n* = 901)	No Mobility Aids	740 (82.1)
	Uses One or More Mobility Aids	161 (17.9)
Degree to which Current Physical Health Interferes with Ability to Carry out Daily Tasks (*n* = 897)	Never	469 (52.3)
	Sometimes	359 (40.0)
	All the Time	69 (7.7)
Current Rating of Mental Health (*n* = 898)	Poor	6 (0.7)
	Fair	72 (8.0)
	Good	452 (50.3)
	Excellent	368 (41.0)
Degree to which Current Mental Health Interferes with Ability to Carry out Daily Tasks (*n* = 896)	Never	796 (88.8)
	Sometimes	89 (10.0)
	All the Time	11 (1.2)
Driving Status (*n* = 901)	Current Driver	763 (84.7)
	Non-Driver	138 (15.3)

Close to 88% of all survey respondents were licensed to drive (data not shown in table) and almost 85% of the total sample indicated that they were current drivers (see Table 3-1). Non-drivers (15.3% of the total sample) included those respondents who reported that they currently did not drive and respondents who indicated that they had never driven. A comparison of females and males by driving status, shown in Table 3-2, indicated that a greater proportion of female respondents were non-drivers (20.7% vs. 6.9%; $p < .05$). As well, with advancing age, there was a subsequent increase in the proportion of survey respondents who reported being non-drivers (data shown in Table 3-3).

Table 3-2

Driving Status of Survey Respondents by Sex

Sex*		Current Driver (%)	Non-Driver (%)
Male	(*n* = 349)	93.1	6.9
Female	(*n* = 552)	79.3	20.7

* Using Chi-Square test, the differences between the two groups are statistically significant at $p < .05$.

Table 3-3

Driving Status of Survey Respondents by Age

Age (Years)*	Current Driver (%)	Non-Driver (%)
65–74 (*n* = 544)	92.1	7.9
75–84 (*n* = 277)	79.4	20.6
85+ (*n* = 72)	50.0	50.0

* Using Chi-Square test, the differences between the two groups are statistically significant at $p < .05$.

3.2 Exploratory Factor Analyses

3.21 Factor Solutions

The following results address the following research question: Does the underlying factor structure of the 5 A's of senior friendly transportation, as articulated by The Beverly Foundation (2001, 2005), include five independent senior friendly dimensions?

EFA with orthogonal varimax rotation was performed on the 24 variables that represented attributes of each of the 5 A's of senior friendly transportation (The Beverly Foundation, 2001, 2005). The initial analysis yielded a four-factor solution based on the Kaiser-Guttman criterion of retention of factors with eigenvalues > 1.0 (Guttman, 1954; Kaiser, 1960, 1970). The four-factor solution accounted for almost 85% of the variance. Although a high proportion of the variance was accounted for by this factor solution, it was not easily interpretable. Table 3-4 below illustrates the rotated factor structure with suppressed factor loadings (retention of variables with loadings ≥ .30) for the four-factor solution. When an item loaded on to more than one factor, it was considered to load on to the factor for which it had the highest loading. This decision was based upon the meaning of the item and the contribution in terms of variance that the item made to each factor. Presented in Appendix C is the rotated factor structure with unsuppressed factor loadings for the four-factor solution.

Table 3-4

*Suppressed Factor Loadings for the Exploratory Factor Analysis with Orthogonal Varimax Rotation for the Four-Factor Solution**

Senior Friendly Feature	Item	Factor 1	Factor 2	Factor 3	Factor 4
Availability	Importance of service during week/daytimes		.75		
	Importance of service during week/evenings		.77		
	Importance of service on weekends/daytime		.76		
	Importance of service on weekends/evenings		.74		
Acceptability	Reasonability of 24 hour advance scheduling			.69	
	Reasonability of 48 hour advance scheduling			.95	
	Reasonability of > 48 hour advance scheduling			.83	
	Reasonability of no advance scheduling required[+]				
	Importance of drivers with knowledge about seniors' health issues	.52			
	Importance of clean vehicles	.37			
Accessibility	Importance of door-to-door service	.72			
	Importance of door-through-door service	.78			
	Importance of rides to health-related appointments	**.51**	.50		
	Importance of rides to essential services	.39	**.48**		
	Importance of rides to social activities	.36	**.51**		
	Importance of rides to religious activities	.39	**.36**		
Adaptability	Importance of escorts for essential services	.68			
	Importance of escorts for health-related appointments	.63			
	Importance of trip chaining	**.39**	.36		
	Importance of accommodating wheelchairs	.64			
	Importance of accommodating scooters	.55			
Affordability	Will pay more for door-to-door service				.84
	Will pay more for door-through-door service	.30			**.80**
	Will pay more for trip chaining		.33		**.34**

Note. Factor loadings in boldface indicate which Factor the item was chosen to load on to when cross-loading was apparent.

* Variance accounted for = 84.9%.

[+] Item did not significantly load on to any factor.

As noted earlier, the four-factor solution was not easily interpretable. As such, the analysis was re-run, forcing the data into a three-factor solution. The three-factor solution accounted for over 76% of the variance. This three-factor solution is presented in Table 3-5. The first rotated factor accounted for almost 32% of the variance and was composed of nine items, with their loadings ranging from .43 to .79. Factor one appeared to represent the 'importance of features' for ATS services that are deemed as necessary for continued mobility. The factor was labeled as Essential Features to reflect this. Factor two accounted for almost 29% of the variance and was composed of 10 items with their factor loadings ranging from .35 to .74. This factor appeared to represent the 'importance of non-essential features' of ATS services that contribute to, but are not necessary, for continued mobility. The factor was labelled as Non-Essential Features as it was composed of items that contribute to mobility, but are not necessarily vital attributes (e.g., drivers with knowledge and training about seniors' health issues, clean vehicles, door-to-door and door-through-door service, provision of escorts, etc.) needed for responsive ATS services. Factor three, accounting for almost 16% of the variance, was composed of three variables related to scheduling. Factor loadings ranged from .69 to .95 for the three items. The factor appeared to represent the importance of not having to schedule transportation services 'too far' in advance. As such, it was labelled as Demand Response Scheduling. Because the three-factor solution was more easily interpretable than the four-factor solution, this factor solution was selected to construct the composite measures.

Table 3-5

*Suppressed Factor Loadings for the Exploratory Factor Analysis with Orthogonal Varimax Rotation for the Three-Factor Solution**

Senior Friendly Feature	Item	Factor 1	Factor 2	Factor 3
Availability	Importance of service during week/daytimes	.73		
	Importance of service during week/evenings	.79		
	Importance of service on weekends/daytime	.75		
	Importance of service on weekends/evenings	.75		
Acceptability	Reasonability of 24 hour advance scheduling			.69
	Reasonability of 48 hour advance scheduling			.95
	Reasonability of > 48 hour advance scheduling			.84
	Reasonability of no advance scheduling required[+]			
	Importance of drivers with knowledge about seniors' health issues		.43	
	Importance of clean vehicles		.35	
Accessibility	Importance of door-to-door service		.65	
	Importance of door-through-door service		.74	
	Importance of rides to health-related appointments	**.56**	.50	
	Importance of rides to essential services	**.53**	.33	
	Importance of rides to social activities	.58		
	Importance of rides to religious activities	.44		
Adaptability	Importance of escorts for essential services	.39	**.55**	
	Importance of escorts for health-related appointments	.31	**.52**	
	Importance of trip chaining	**.43**	.31	
	Importance of accommodating wheelchairs	.35	**.62**	
	Importance of accommodating scooters	.37	**.49**	
Affordability	Will pay more for door-to-door service		.63	
	Will pay more for door-through-door service		.69	
	Will pay more for trip chaining[+]			

Note. Factor loadings in boldface indicate which Factor the item was chosen to load on to when cross-loading was apparent.

* Variance accounted for = 76.3%.

[+] Item did not significantly load on to any factor.

3.22 Composite Measures

The results from the EFA were used to construct composite measures that served to represent respondents' ratings of the importance that they placed on items related to the 5 A's of senior friendly transportation (The Beverly Foundation, 2001, 2005). The first composite measure represented the ratings of importance that respondents' placed upon specific features as being 'integral attributes' of responsive ATS services. This composite measure was based on the sum of the nine variables that loaded on to Factor 1 known as Essential

Features for ATS services. Cronbach's alpha (α) for the nine items making up the composite measure of Essential Features was .79. Responses to items that loaded on to this factor were based on the following scale: 1 = *not at all important*; 2 = s*omewhat important*; and 3 = *very important*. Respondents' scores on this composite measure ranged between 9 and 27. The mean score of respondents on this composite measure was 19.64 (*SD* = 3.67).

The second composite measure, representing respondents' ratings of the importance placed upon 'not essential, but nice features' as vital components of responsive ATS services, was based on the sum of the 10 variables that loaded on to Factor 2 known as Non-Essential Features. Cronbach's α for the 10 items related to Non-Essential Features was .78. Responses to the first eight items that comprised Factor 2 were based on the following scale: 1 = *not at all important*; 2 = *somewhat important*; and 3 = *very important*. Responses to the final two items, willingness to pay for door-to-door and door-through-door services, were coded as 1 = no and 2 = yes. Respondents' scores on this composite measure ranged from 10 to 28. The mean score of respondents on the composite measure was 21.28 (*SD* = 3.86).

Lastly, the third composite measure, representing respondents' ratings of the importance they placed upon Demand Response Scheduling, was based on the sum of the three items that loaded on to Factor 3. Cronbach's α for the three items comprising Demand Response Scheduling was .71. Responses to these three items were based on the following scale: 1 = *very reasonable*; 2 = *somewhat reasonable*; and 3 = *not at all reasonable*. Respondents' scores on this composite measure ranged from 3 to 9. The mean score of respondents on the composite measure was 7.01 (*SD* = 1.59). The composite measures and the items used for constructing each composite measure are shown in Table 3-6.

Table 3-6

Composite Measures for the Three Overarching Dimensions of the 5 A's of Senior Friendly Transportation

Composite Measure	Included Items
Essential Features	Importance of service during week/daytimes
	Importance of service during week/evenings
	Importance of service on weekends/daytime
	Importance of service on weekends/evenings
	Importance of rides to health-related appointments
	Importance of rides to essential services
	Importance of rides to social activities
	Importance of rides to religious activities
	Importance of trip chaining
Non-Essential Features	Importance of drivers with knowledge about seniors' health issues
	Importance of clean vehicles
	Importance of door-to-door service
	Importance of door-through-door service
	Importance of escorts for essential services
	Importance of escorts for health-related appointments
	Importance of accommodating wheelchairs
	Importance of accommodating scooters
	Will pay more for door-to-door service
	Will pay more for door-through-door service
Demand Response Scheduling	Reasonability of 24 hour advance scheduling
	Reasonability of 48 hour advance scheduling
	Reasonability of > 48 advance scheduling

3.3 Multiple Regression Analyses

Three multiple regression models utilizing the purposeful selection method were developed to explore the relationship between different socio-demographic, physical health, and mental health factors and the ratings of importance that respondents place upon each of the composite measures, Essential Features; Non-Essential Features; and Demand Response Scheduling, as being vital attributes of responsive ATS services. The following variables served as predictors in each of the regression models: 1) driving status (current driver vs. non-driver); 2) age; 3) sex (male vs. female); 4) place of residence (urban vs. rural); 5) marital status (married/common-law vs. single); 6) living arrangements (multi-person household vs. lives alone); 7) annual household income (≥ $20,000 vs. < $20,000); 8) current rating of physical health (ranging from *poor* to *excellent*); 9) current rating of mental health (ranging from *poor* to *excellent*); 10) degree to which current physical health interferes the with ability to carry out daily

tasks (ranging from *never* to *all the time*); 11) degree to which current mental health interferes with the ability to carry out daily tasks (ranging from *never* to *all the time*); and 12) use of mobility aids (use no mobility aids vs. uses one or more mobility aids). For each composite measure, a univariate regression analysis of each independent variable was performed. In this study, predictors with a significant univariate test at an alpha level of ≤ .20 were considered for inclusion in the final model. Covariates were retained in the final main parameters model if after the multivariate regression analysis they were statistically significant at the traditional alpha level of ≤ .05. Non-significant covariates in the regression analysis were evaluated as potential confounders before being excluded from the final main parameters model. According to Bursac and colleagues (2008), a confounder is any variable that when after removing it from the model, there is a 15% or greater change in any of the remaining parameter estimates. The final main parameters model for each of the composite measures included statistically significant predictors and confounders.

3.31 Predictors of the Ratings of Importance that Respondents Place upon Essential Features for ATS Services

Results from the univariate regression analyses indicated that five variables, including driving status (p = .004); sex (p < .001); age (p < .001); income (p = .017); and current rating of mental health (p = .188) were statistically significant at an alpha level of ≤ .20. These covariates were then selected for inclusion in the regression model.

Results from the initial regression analysis showed that at the traditional alpha level of ≤ .05, only age and sex remained as statistically significant predictors of the ratings of importance that respondents place upon Essential Features of ATS services. The remaining covariates (driving status, income, and current rating of mental health) were assessed as potential confounders with every predictor variable included in the initial model. Both driving status and income proved to be confounders and were retained in the final main parameters model. Conversely, current rating of mental health was not identified as a confounder and was excluded from the final multiple regression model.

The final regression model exploring the relationship between different socio-demographic, physical health, and mental health factors and the ratings of

importance that respondents placed upon Essential Features included driving status, sex, age, and income as predictors. Table 3-7 shows the final main parameters regression model for the composite measure labelled as Essential Features, including the unstandardized (B) and standardized (β) coefficients, *t*-tests, significance, and lower and upper bounds of the 95% confidence interval.

Table 3-7

Main Parameters Model of the Predictors of the Ratings of Importance that Respondents Place upon Essential Features for ATS Services

Model	B	Std. Error	β	*t*	Sig.	95% CI Lower Bound	95% CI Upper Bound
Constant	26.861	1.633		16.446	.000	23.654	30.068
Driving Status	-0.590	0.443	-0.054	-1.331	.184	-1.460	0.281
Sex	1.222	0.284	0.167	4.300	.000	0.664	1.780
Age	-0.106	0.022	-0.185	-4.713	.000	-0.150	-0.062
Income	-0.816	0.405	-0.081	-2.014	.044	-1.612	-0.020
R^2	.070						
Adjusted R^2	.065						
$F_{(4, 644)}$	12.221*						

Note. CI = confidence interval.
* $p < .001$.

In addition to the coefficient of determination (R^2), the *F* value is also reported in Table 3-7. The *F*-statistic provides a measure of the overall significance of the regression model. For the main parameters model of predictors of the ratings of importance that respondents place upon Essential Features, the *F*-test was statistically significant ($F_{(4, 644)} = 12.221$; $p < .001$). Furthermore, the results of the regression indicated that 7% of the variance in respondents' ratings of the importance of Essential Features can be explained by the model ($R^2 = .07$). When taking into account the number of explanatory variables in the model, the adjusted R^2 indicated that again, close to 7% of the variance in respondents' ratings of importance of Essential Features for ATS services could be explained by the four predictor variables driving status, sex, age, and income.

The results from the final multiple regression analysis indicated that there was a statistically significant relationship between sex (t_{644} = 4.30; p < .001; B = 1.222; 95% CI 0.664, 1.780), age (t_{644} = -4.173; p < .000; B = -0.106; 95% CI -0.150, -0.062), and income (t_{644} = -2.014; p = .044; B = -1.612; 95% CI -1.612, -0.020) and respondents' ratings of the importance of Essential Features for ATS services. These independent variables are significant predictors of respondents' ratings of the importance placed upon Essential Features. After controlling for other variables in the model, the significant effect of sex indicates that on average, females give a higher rating to the importance of Essential Features as vital attribute of ATS services as compared to their male counterparts.

After controlling for other covariates in the regression model, there was a statistically significant inverse relationship between age and the ratings of importance that respondents placed upon Essential Features as integral attributes of ATS services. With increasing age, respondents' ratings of the importance of Essential Features decreased. Income also emerged as a significant predictor of the ratings of importance that respondents placed upon Essential Features. After controlling for other predictors in the model, the results indicated that compared to older adults with higher socio-economic standings, older adults with incomes below $20,000 annually placed less importance on Essential Features such as availability, the provision of service for all trip purposes (i.e., medical, essential, social, and religious), and the accommodation of trip chaining as necessary attributes needed for responsive ATS services.

3.32 Predictors of the Ratings of Importance that Respondents Place upon Non-Essential Features for ATS Services

Univariate regression analyses of each predictor revealed that of the 12 covariates under consideration, nine were statistically significant at an alpha level of ≤ .20. These predictors included: driving status (p = .013); sex (p < .001); place of residence (p = .064); marital status (p = .043); living arrangements (p = .023); age (p = .041); income (p = .012); current rating of physical health (p = .110); and degree to which current mental health interferes with the ability to carry out daily tasks (p = .127). These covariates were selected for inclusion in the multiple regression model.

The results of the initial multiple regression analysis showed that at the traditional alpha level of ≤ .05, driving status, sex, and income were statistically significant predictors of the composite measure. The remaining covariates in the regression model that did not reach statistical significance at that traditional alpha level were assessed as potential confounders. Based on the previously defined criteria, each of the remaining covariates in the model (place of residence, marital status, living arrangements, age, current rating of physical health, and degree to which current mental health interferes with the ability to carry out daily tasks) proved to be confounders. As such, these variables were retained in the final main parameters regression model. Table 3-8 shows the final main parameters regression model for the composite measure labelled as Non-Essential Features, including the unstandardized (B) and standardized (β) coefficients, *t*-tests, significance, and lower and upper bounds of the 95% confidence interval.

The value of the *F*-test indicated that the overall regression model of respondents' ratings of the importance for Non-Essential Features was statistically significant ($F_{(9, 622)} = 4.705; p < .001$). Just over 6% of the variation in respondents' ratings of the importance of Non-Essential Features for ATS services can be explained by the regression model as indicated by the R^2 value. The adjusted R^2, taking into account the number of explanatory variables in the model, indicated that 5% of the variance in respondents' ratings of the importance of Non-Essential Features could be explained by the predictor variables driving status, sex, place of residence, location, marital status, living arrangements, age, income, current rating of physical health, and degree to which current mental health interferes with the ability to carry out daily tasks.

Results of the analysis show that there was a statistically significant relationship between driving status ($t_{622} = -2.445$; $p = .015$; B = -1.231; 95% CI -2.220, -0.242) and the ratings of importance that respondents placed upon Non-Essential Features of ATS services. After controlling for other variables in the model, when compared to current older drivers, older non-drivers gave a lower rating to the importance of Non-Essential Features as being vital attributes of ATS services. The results also indicated that sex ($t_{622} = 4.671$; $p < .001$; B = 1.479; 95% CI 0.857, 2.101) was a significant predictor of respondents' ratings of

the importance of Non-Essential Features for responsive ATS services. After controlling for other covariates in the model, on average, females rated the importance of Non-Essential Features higher than males. The results from the multiple regression analysis also indicated that that there was a statistically significant relationship between income (t_{622} = -2.000; p = .046; B = -0.926; 95% CI -1.835, -0.017) and respondents' ratings of the importance of Non-Essential Features. Specifically, older adults with incomes below $20,000 annually rated Non-Essential Features to be less important attributes of responsive ATS services as compared to older adults with higher social economic standings.

Table 3-8

Main Parameters Model of the Predictors of the Ratings of Importance that Respondents Place upon Non-Essential Features for ATS Services

Model	B	Std. Error	β	*t*	Sig.	95% CI Lower Bound	95% CI Upper Bound
Constant	19.566	0.602		32.486	.000	18.383	20.748
Driving Status	-1.231	0.504	-0.107	-2.445	.015	-2.220	-0.242
Sex	1.479	0.317	0.191	4.671	.000	0.857	2.101
Place of Residence	0.288	0.305	0.038	0.946	.344	-0.310	0.887
Marital Status	-0.553	0.626	-0.071	-0.883	.378	-1.783	0.677
Living Arrange.	-0.103	0.635	-0.013	-0.163	.871	-1.350	1.143
Age	-0.137	0.170	-0.033	-0.802	.423	-0.471	0.198
Income	-0.926	0.463	-0.087	-2.000	.046	-1.835	-0.017
Rating of Physical Health	0.236	0.192	0.051	1.230	.219	-0.141	0.613
Mental Health Interfering	0.732	0.389	0.075	1.880	.061	-0.032	1.497
R^2	.064						
Adjusted R^2	.050						
$F_{(9, 622)}$	4.705*						

Note. CI = confidence interval.
* $p < .001$.

3.33 Predictors of the Ratings of Importance that Respondents Place upon Demand Response Scheduling for ATS Services

Univariate regression analyses of each predictor with the composite measure, Demand Response Scheduling, revealed that only two variables, place of residence ($p = .082$) and age ($p = .021$) were statistically significant predictors of the composite measure at an alpha level of ≤ .20. These covariates were selected for inclusion in the multiple regression model predicting respondents' ratings of the importance that they placed upon Demand Response Scheduling for ATS services. The results of the initial regression showed that at the traditional alpha level of ≤ .05, only age emerged as a statistically significant predictor. Before being removed from the final main parameters regression

model, place of residence was evaluated as a potential confounder based on the previously defined criteria. Place of residence was not a confounder and it was subsequently excluded from the final regression model.

The results from the regression analysis indicated that there was a statistically significant relationship between age (t_{865} = 2.314; p = .021; B = 0.018; 95% CI 0.003, 0.034) and the ratings of importance that respondents placed upon Demand Response Scheduling. On average, with increasing age respondents gave a higher rating to the importance of being able to receive transportation services on demand rather than having to schedule rides in advance. The value of R^2 indicated that less than 1% of the variation in respondents' ratings of the importance of Demand Respond Transportation for ATS could be explained by the predictor variable age. Table 3-9 shows the final regression model for the composite measure Demand Response Scheduling, including the unstandardized (B) and standardized (β) coefficients, *t*-tests, significance, and lower and upper bounds of the 95% confidence interval.

Table 3-9

Main Parameters Model of the Predictors of the Ratings of Importance that Respondents Place upon Demand Response Scheduling for ATS Services

Model	B	Std. Error	β	*t*	Sig.	95% CI Lower Bound	95% CI Upper Bound
Constant	5.661	0.588		9.621	.000	4.506	6.816
Age	0.018	0.008	0.078	2.314	.021	0.003	0.034
R^2	.006						
Adjusted R^2	.005						
$F_{(1, 865)}$	5.356*						

Note. CI = confidence interval.
* $p < .05$.

Chapter 4. Discussion

4.1 Summary of Findings and Interpretations

This thesis provides new information about the underlying factor structure of the 5 A's of senior friendly transportation (The Beverly Foundation, 2001, 2005) and provides insight into those socio-demographic, physical health, and mental health factors that are associated with the ratings of importance that older adults place upon different features of ATS services. Exploratory factor analyses were performed to investigate the underlying factors associated with the 5 A's of senior friendly transportation: Availability, Acceptability, Accessibility, Adaptability, and Affordability. These senior friendly features were initially identified through traditional focus group discussions with transportation-rich seniors, transportation-deprived seniors, and transportation-concerned family and friends of older adults. Discussions about mobility and transportation-related issues allowed for the gathering of information about the opinions that older adults and concerned family and friends of older adults had about existing transportation services (Kerschner & Aizenberg, 1999). From this research, an intuitive conceptualization of the transportation features that were important to older adults emerged. The results suggested that older adults view transportation services in terms of the 5 A's of senior friendly transportation and priority should be given to these features when designing effective transportation services for older adults (Kerschner & Aizenberg, 1999).

Although the 5 A's, as articulated by The Beverly Foundation (2001, 2005), have been widely accepted as useful criteria for assessing the 'senior friendliness' of alternate transportation services for older adults, little research has been undertaken to explore the underlying factor structure and dimensions of these features. The results from the EFA do not lend support to the conceptualization that senior friendly transportation is best defined by the five independent features of Availability, Acceptability, Accessibility, Adaptability, and Affordability. Rather, these independent features can best be explained by three underlying dimensions: Essential Features, Non-Essential Features, and Demand Response Scheduling. It may be that methodological differences

account for the variability in findings related to the underlying factors of the 5 A's of senior friendly transportation (The Beverly Foundation, 2001, 2005) found in the current research and that of the focus group research conducted by The Beverly Foundation.

The first methodological difference was in the wording of some of the features of the 5 A's of senior friendly transportation in the survey questionnaire vis a vis the Beverly Foundation's wording. Specifically, as articulated by the Beverly Foundation in 2001 and 2005, each of the 5 A's are defined by five senior friendly features (e.g., service provider provides 'door through door' transportation; provides multiple stops for individual passengers; etc.) (see Table 1-1). In the survey questionnaire, some of the features of senior friendly transportation as articulated by the Beverly Foundation, although important to service providers, were deemed to be less important in a survey of older adults (e.g., service provider provides transportation to seniors, service provider maintains organizational relationships with human service organizations, service provider secures funding specifically to support senior transit services, etc.). There also were features of senior friendly transportation that were articulated as a single feature, but were expanded upon in the survey questionnaire (e.g., provides transportation anytime was expanded to include transportation provision in weekday daytime, weekday evening, weekend daytime, and weekend evening). Thus, 19 of the 24 questions in the survey questionnaire closely paralleled the 25 senior friendly attributes that comprise the 5 A's of senior friendly transportation as articulated by The Beverly Foundation. Despite these differences, it is interesting to note that four of the Accessibility features and one of the Adaptability features, as defined by The Beverly Foundation, load on the same factor (Factor 1 – Essential Features) in the current research. It also is interesting to note that Factor 2 (Non-Essential Features) consists of attributes associated with The Beverly Foundation's Acceptability, Accessibility, Adaptability, and Affordability features. The final factor, Demand Response Scheduling, consists only of some of the features associated with Acceptability, as defined by The Beverly Foundation. This pattern of results suggests that minor changes in wording and/or elimination of some features are unlikely to account for the differences in findings between the factor loadings in the current

research versus the features for each of the 5 A's of senior friendly transportation as articulated by The Beverly Foundation.

A second methodological difference that may account for the discrepancy in the factor loadings from this research versus the original conceptualization of the 5 A's of senior friendly transportation by The Beverly Foundation (2001, 2005) is a difference in samples. As noted previously, 203 individuals participated in The Beverly Foundation's focus group research (Kerschner & Aizenberg, 1999) versus 901 participants in the current research. When comparing the transportation-rich and transportation-deprived groups to the current survey sample of older adults, of interest is the fact that the percentage of females (67%, 67%, and 61%, respectively), the percentages of individuals 85 years of age and older (16%, 20%, and 8%, respectively), and the percentage of individuals reporting *good* or *excellent* health (94%, 83%, and 72%, respectively) were similar. However, differences did exist in marital status across the two samples. Specifically, the majority of the transportation-rich and transportation-deprived seniors (71% and 71%, respectively) indicated that they were widowed, divorced/separated, or never married whereas in the current survey sample of older adults approximately 42% indicated that they were 'single' as defined by being widowed, divorced/separated, and/or never married. As such, the higher percentage of older adults who were 'single' in The Beverly Foundation's research (Kerschner & Aizenberg, 1999) may account for the differences in the pattern of findings given that older individuals who are single may be more transportation-dependent on outside service providers. However, further examination of The Beverly Foundation's data indicate that only 50 of the 154 older adults (33%) participating in The Beverly Foundation's focus groups were 'single' *and* transportation-deprived. Notably, there also were differences between the two samples in terms of driving status, with a greater proportion of older adults in The Beverly Foundation's sample 'no longer driving' or 'driving with limitations' (69% of the transportation-rich sample and 73% of the transportation-deprived sample, respectively). In comparison, 15% of older adults in the current survey sample indicated that they were non-drivers with the percentage with limitations on driving unknown as this question was not asked. The discrepancy in the proportion of non-drivers between the two samples of older adults does have the potential to affect the importance that participants

place on the different features of senior friendly transportation. Further research with a larger sample of non-drivers is needed to determine if the current factor structure replicates.

The resultant factor structure as mentioned above provided the basis for the construction of composite measures that represented the ratings of importance that respondents placed upon Essential Features, Non-Essential Features, and Demand Response Scheduling as necessary attributes of responsive ATS services. Three multiple regression models were constructed to explore the relationship between different socio-demographic, physical health, and mental health factors and the ratings of importance that older adults' give toward different senior friendly features of ATS services. Results from the first multiple regression model showed that an older adults' sex, age, and annual income level were associated with the ratings of importance that were placed upon Essential Features for ATS services. Specifically, females rate the importance of Essential Features higher than males do. They place greater importance on having ATS services that can accommodate all trip types, are available at all times, and allow for multiple stops or trip chaining behaviour. Extensive literature often indicates that females are the most transportation disadvantaged sub group of older adults (Dupuis et al., 2007; Finlayson & Kaufert, 2002; Mezuk & Rebok, 2008; Oxley & Whelan, 2008). The literature also suggests that females are at higher risk of being transportation disadvantaged in that they are likely to live longer, often live alone, are financially disadvantaged, and are likely to experience frailty and poor health (Burkhardt et al., 2002). All of these factors have been identified as predictors of driving cessation and reduced mobility among older adults. Furthermore, research has indicated that females are more likely to give up the car keys prematurely and as such are more likely to become dependent on alternate forms of transportation and be burdened by a lack of suitable transportation options (Alsnih & Hensher, 2003; Burkhardt & McGavock, 1999; Gallo et al., 1999; Mattson, 2011; Rosenbloom & Herbel, 2009; Siren et al., 2001). Given the many factors that increase the likelihood of females being transportation disadvantaged and subsequently dependent on alternate forms of transportation, it is not surprising that they place greater importance on Essential Features as vital aspects of ATS services.

Advancing age also was shown to be associated with older adults' ratings of the importance of Essential Features for ATS services. Results from the multiple regression model indicated that there was an inverse relationship between age and the ratings of importance that older adults place upon Essential Features. With advancing age, older adults gave a lower rating to the importance of Essential Features as attributes needed for responsive ATS services. Research has indicated that with advancing age, older adults are more likely to experience physical disabilities and health problems that impede upon their ability to carry out daily activities (Burkhardt et al., 2002). These impairments in functioning also serve as barriers to continued out-of-home mobility. Burkhardt and colleagues (2002) suggest that adults 85 years of age and older, the oldest-old, face the most substantial barriers to driving and transportation use. According to the authors, among the oldest-old, with increasing disability and functional impairment associated with aging, there is a dramatic decline in the amount of travel undertaken by this group. Subsequent research undertaken by Alsnih & Hensher (2003) also demonstrated that with advancing age, older adults often travel less overall and smaller distances. Results from a study of Finnish adults, 65 years of age and older, demonstrated a similar trend in that fewer trips were made by the oldest-old (Siren & Hakamies-Blomqvist, 2004). Given that trip frequency and travel behaviour decline with advancing age, it is not surprising that an inverse relationship existed between age and older adults' ratings of the importance of Essential Features for ATS services in this study. However, on the other hand, given that with advancing age older adults are more likely to 'give up the car keys' (Edwards et al., 2008; Foley et al., 2002) and are subsequently in greater need of alternate forms of transportation (Rosenbloom, 2004), it would have been expected that these individuals would have placed greater importance on Essential Features of ATS services.

With respect to the ratings of importance that older adults place upon Essential Features for ATS services, the results from the multivariate regression model also indicated that annual household income was a significant predictor. Compared to older adults with higher annual household incomes, older adults with annual incomes below $20,000 rated Essential Features as less important attributes needed for responsive ATS services. These results were unexpected as the literature often indicates that low income older adults often lack the

resources that would enable them to have access to a private vehicle (Dellinger et al., 2001; Marottoli et al., 2003; Ragland et al., 2004). Recently, Turcotte (2006) highlighted that certain socio-economic factors are associated with an increased likelihood of older adults lacking sufficient access to transportation. His analyses, based on data from the 2005 GSS, showed that 13% of older adults with household incomes under $20,000 reported having limited access to transportation whereas 90% of older adults with household incomes over $40,000 reported owning a vehicle and having access to that vehicle as a driver. Rosenbloom (2003) has also suggested that older adults who lack the financial resources to operate a motor vehicle also often lack the financial resources to utilize other alternate means of transportation. The results of the regression analysis may indicate that, although Essential Features are important aspects of ATS services to older adults with low annual household incomes, what is of greater importance is having transportation services that are affordable.

For Non-Essential Features of ATS services, the multivariate regression model indicated that driving status, sex, and income all were significantly associated with older adults' ratings of the importance of these features. There was a statistically significant relationship between driving status and the ratings of importance that older adults place upon Non-Essential Features of ATS services. Compared to drivers, non-drivers placed less importance upon Non-Essential Features as vital for responsive ATS services. These results were surprising given that individuals with mobility issues or older adults who have given up driving due to sensory, motor, and/or cognitive impairments face many barriers to using conventional public transportation options (Harris & Tapsas, 2006; Kostyniuk & Shope, 2003; Oxley & Whelan, 2008; Rosenbloom, 2003; Suen & Sen, 2004). It would have been expected that Non-Essential Features of ATS services such as drivers with knowledge and sensitivity training on seniors' health issues and having transportation services that can provide escorts or accommodate mobility aids would have been increasingly important to older adults who are non-drivers. Although Non-Essential Features of ATS services are likely to contribute to enhanced mobility among older adults, it may be that having *available* transportation services is of greater importance to older adults who do not drive, choose not to drive, or are no longer able to drive. Despite the lower rating of importance among non-drivers, the multiple regression model

indicated when the impact of other variables was not considered and all other things being equal, the mean rating of importance among the sample was that Non-Essential Features were 'somewhat important' attributes of ATS services. Given older adults' dependence on the private vehicle for mobility needs (Alsnih & Hensher, 2003; OECD, 2001), the higher rating of importance among current drivers may reflect their desire for alternate transportation services in the future that offer the same convenience, flexibility, safety, and level of mobility that is afforded to them by the private vehicle.

Additionally, results of the analysis indicated that sex was a significant predictor of the ratings of importance that older adults place upon Non-Essential Features of ATS services. Similar to the first multivariate regression model, when compared to males, females gave a higher rating to the importance of Non-Essential Features for ATS services. Attributes of Non-Essential Features of ATS services include: having ATS services that provide drivers with knowledge and training about seniors' health issues; having services that offer door-to-door and door-through-door transportation; having vehicles that are clean and well maintained; having services that are able to provide escorts for essential and health related trips; and having services that are able to accommodate mobility aids such as wheelchairs and scooters. With respect to the above mentioned attributes, the pattern of results are not surprising given that literature indicates that women are more likely to live longer, and as such, they also are more likely to be frail, experience functional disabilities, and have poorer health (Burkhardt et al., 2002). All of these factors have been cited as barriers among older adults, especially females, to being able to utilize conventional public transportation services (Harris & Tapsas, 2006; Kostyniuk & Shope, 2003; Oxley & Whelan, 2008; Rosenbloom, 2003; Suen & Sen, 2004). Furthermore, it also may be the case that females rate Non-Essential Features as more important than males because they may be more likely to place greater emphasis on the cleanliness of vehicles.

As well, income also proved to be a significant predictor of the ratings of importance that older adults place upon Non-Essential Features of ATS services. The results from the multiple regression analysis indicated that there was a statistically significant relationship between annual household income and the

ratings of importance placed upon Non-Essential Features. Compared to older adults with annual incomes over $20,000, lower income older adults placed less importance upon Non-Essential Features of ATS services. Similar to the lower ratings of importance given to Essential Features by low income older adults, the underlying explanation may be that priority is given to having transportation services that are ultimately affordable rather than enhanced with features that are 'nice, but not essential' to mobility.

It is important to note that 23% of the survey sample elected not to answer the question on income, a percentage that has the potential to impact the results of the multivariate regression models for both Essential Features and Non-Essential Features. To assess the impact of the missing income data, a multivariate regression analysis for each of the main parameters models for both Essential Features and Non-Essential features was conducted with income excluded as a predictor. For Essential Features, removing income from the multivariate regression model did not result in any change in the significance of the overall model or R^2 but did result in driving status becoming a statistically significant predictor (t_{820} = -2.752; p = .006; B = -1.036; 95% CI -1.775, -0.297). It is interesting to note that in the initial regression model, driving status shared a significant amount of variance with income. Thus, with income excluded from the most recent regression model, it is not surprising that driving status became a statistically significant predictor. The remaining variables in the model (sex and age) remained statistically significant predictors of the ratings of importance that older adults place upon Essential Features. With respect to Non-Essential Features, excluding income as a predictor did not result in any change in the overall significance of the model or R^2, nor did it change the pattern of significance for the remaining variables in the model.

With respect to the ratings of importance placed upon Demand Response Scheduling by older adults, only age emerged as a significant predictor. With advancing age, older adults gave a higher rating to the importance of having transportation services that could accommodate Demand Response Scheduling rather than having to schedule rides well in advance. The greater rating of importance of Demand Response Scheduling with increasing age may be a function of activity planning among older adults. In a recent survey of older adults

residing in the Chicago metropolitan area, Mohammadian, Frignani, and Auld (2011) demonstrated that although 26.9% of activities undertaken by the elderly are routine and planned in advance, a similar proportion of activities (25.9%, respectively) are decided upon and performed the same day, and only 9.1% of older adults plan their activities more than one week in advance. Additionally, research indicates that with advancing age, older adults are more likely to experience physical disabilities and health problems that impede upon their ability to carry out daily activities (Burkhardt et al., 2002). These impairments in functioning also serve as a barrier to continued out-of-home mobility, driving, and conventional public transportation use. Burkhardt and colleagues (2002) suggest that adults 85 years of age and older, the oldest-old, face the most substantial barriers to driving and transportation use. With respect to conventional public transportation, it may be that older adults with age-associated impairments in functioning may find it increasingly difficult to have to walk or wait for transportation services. Furthermore, as an individual's health status can be variable and may change from day to day, older individuals with disabilities and health problems may be less willing to schedule transportation services far in advance. More research is needed to explore the underlying relationship between advancing age and ATS service responsiveness.

4.2 Strengths and Limitations of the Research

The present study had a large sample size with a wide sampling frame that included older adult participants across the province of Alberta, Canada. In addition, oversampling was undertaken in the rural areas of the province. These factors strengthen the external validity that the results could be generalized to other populations of older adults in Canada. Furthermore, results from the EFA showed that the underlying factors (Essential Features, Non-Essential Features, and Demand Response Scheduling) of the 5 A's of senior friendly transportation (The Beverly Foundation, 2001, 2005) had Cronbach's alpha (α) values that ranged from .71 to .79. This suggests that the items loading on to each factor had a high degree of internal consistency thus indicating that there was an acceptable degree of validity amongst the identified factors.

Despite the inherent strengths of the study, there are several important limitations that are worthy of mention. First, the overall survey response rate was 24.7%. Non-response in a survey has the potential to lead to selection bias. The issue that arises is that those individuals who chose to participate may differ systematically on the variables of interest from those individuals who are theoretically eligible or from those individuals who chose not to participate (Mann, 2003). As noted by Kohut and colleagues (2012), the response rate of a typical telephone survey was 36% in 1997 and is only 9% today. As such, the response rate of the telephone survey that provided the data for this study is considerably higher than that of the typical telephone survey today. Literature also indicates that non-response rates are a much smaller threat to survey estimates than once were thought because the magnitude of non-response bias and the impact that this has on results ultimately depends on the relationship between the level of non-response and the distinctiveness of non-respondents (Curtin, Presser, & Singer, 2000; Groves, 2006; Keeter, Miller, Kohut, Groves, & Presser, 2000). In the current study, little information is available about the individuals who chose not to participate. As such, the impact that non-response bias may have had on the study results is difficult to determine.

Additionally, the outcomes measured in the survey were subjective in nature and thus could have an impact on the study results. Responses were such that older adults answered questions on the different attributes of the 5 A's of senior friendly transportation (The Beverly Foundation, 2001, 2005) using ordinal responses (e.g. *not at all important*; *somewhat important*; or *very important*). It has been suggested that ordinal response categories lack clear operationalization of the differences between each category and as such, researchers can only hope that respondents attach the same meaning to the categories of the ordinal variable (Kampen & Swyngedouw, 2000). Furthermore, the lack of equidistance between the ordinal categories makes the use of analytic techniques for quantitative data more difficult and the results harder to interpret (Donicar & Grun, 2007). Subjective responses based on ordinal categories may lack depth and detail of respondents' opinions (Kampen & Swyngedouw, 2000).

To circumvent the limitations surrounding use of ordinal response categories, numerical rating scales could have been employed. Sangster and

colleagues (2001) suggest that numerical rating scales that employ low-to-high positive coding present a simple continuum to respondents. However, use of numerical rating scales may lack face validity for older adults (Zhou, Petpichetchian, & Kitrungrote, 2011). Future research could employ both quantitative and qualitative methodologies to gain a greater understanding of older adults' opinions concerning attributes of ATS services and to gain greater insight into the alternate transportation needs of older adults.

Another potential limitation of this study is the fact that the magnitude of the coefficient of determination (R^2) values for each regression model exploring the relationship between different socio-demographic, physical health, and mental health factors and respondents' ratings of importance were quite low (.07, .06, and .006, respectively). The R^2 statistic can be interpreted as the proportion of variation in the dependent variable that is explained by the variation in the independent variables included in the model or more generally, how well the linear model fits a set of observations (Kennedy, 2008; Moore & McCabe, 2009; Schroeder, Sjoquist, Stephan, 1986). It often is used as a statistic that evaluates the goodness-of-fit or the utility of a regression model where high R^2 values often are preferred and are thought to be indicative of regression models with a good fit to the data (Anderson-Sprecher, 1994). The low values observed for each of the R^2 statistics would suggest that overall the ability of each of the regression models to predict the dependent variables was poor. However, much criticism exists concerning the use of R^2 to evaluate regression models (Achen, 1977; Anderson-Sprecher, 1994; Figueiredo Filho, Silva, & Rocha, 2011). According to King (1986), R^2 should be considered as a measure of the spread of data points around the regression line and should thus be considered as a poor statistic for evaluating the goodness-of-fit of regression models. Instead, Figueiredo Filho and colleagues (2011) suggest that the *F*-statistic serves as a more appropriate measure by which to evaluate regression models. As well, different factors such as the variance in the population that the sample was drawn from and the nature of the variable being measured may influence the magnitude of the R^2 statistic (Achen, 1977; King, 1986; Newman & Newman, 2000). Research also has suggested that regression models with low R^2 values are not inherently bad and regression models with high R^2 values should not be thought of as inherently good (Figueiredo Filho et al., 2011). It has been suggested that in the early

stages of research, or when not enough research has been done to identify all the variables that would account for the variance, R^2 values often are low (Newman & Newman, 2000). Furthermore, in the social sciences, the measurement of underlying constructs and the subjective nature of responses often can result in measurement error which can impact the magnitude of the coefficient of determination (Newman & Newman, 2000). According to Newman and Newman (2000), if the value of the R^2 statistic is low but there are statistically significant predictors in the regression model, it is still possible to draw important conclusions about how changes in predictor variables are associated with change in the dependent variable. The results reported herein indicate that although the R^2 statistic for each of the regression models were low, statistically significant predictors did emerge. As such, the results of this research add to the existing body of literature in this area and can thus be used to inform on policies and practices related to ATS service provision.

Also of concern is the fact that the sample of respondents may not be completely representative of the larger population of older adults in need of ATS services. The sample of survey respondents was relatively healthy. Almost 72% of older adult respondents rated their current physical health as either *good* or *excellent*; 82% reported that they did not use mobility aids; and the majority (52.3%) said that their current physical health *never* interfered with their ability to carry out daily tasks. Similarly, the vast majority (91.3%) rated their current mental health as *good* or *excellent* and 88% reported that their current mental health *never* interfered with their ability to carry out daily tasks. Given that research indicates that healthy older adults are less likely to experience driving cessation and reductions in mobility (Anstey et al., 2006; Collia et al., 2003; Foley et al., 2002), the mean ratings of importance placed on different aspects of senior friendly transportation by survey respondents may not be reflective of transportation disadvantaged individuals who would ultimately depend more on alternate forms of transportation for their mobility needs. Furthermore, the majority (84.7%) of survey respondents were current drivers. Exploring the opinions and alternate transportation needs of older adults who do not drive, choose not to drive, or are no longer able to drive is important given that these individuals are likely to experience reductions in their mobility due to their lack of access to a private vehicle to satisfy their mobility needs.

Although the generalizability of the study's results to those in need of alternate transportations services may be in question, survey respondents appear to be representative of the larger population of older adults in Alberta, Canada. Annual demographic statistics reported that in 2009, individuals between 65 to 74 years of age accounted for 53.7% of Alberta's older adult population; individuals between 75 and 84 years of age comprised 33.4% of Alberta's older adult population; and individuals 85 years of age and older accounted for 12.9% of the total older adult population (Government of Alberta, 2010). Comparably, the majority (60.9%) of survey respondents for this research were between the ages of 65 to 74 years; 31.0% of respondents reported were between the ages of 75 to 84 years; and only a small proportion (8.1%) of survey respondents reported that they were 85 years of age or older. Furthermore, females accounted for 55% of the older adult population in Alberta in 2009, with males making up the remaining 45% of the older adult population (Government of Alberta, 2010). Again, this is similar to the demographic characteristics of survey respondents in this study in that females comprised the majority (61.3%) of the sample. As well, recent demographic statistics for Albertans reported that 57.4% of older adults were married (Government of Alberta, 2010). Similarly, 58.6% of survey respondents in this study reported being married or in a common-law relationship. In terms of health status, in 2009, 61.4% of Albertans reported that their physical health was *very good* or *excellent* with 73.8% reporting that their mental health as *very good* or *excellent* (Government of Alberta, 2010). Comparably, the vast majority of survey respondents in this study reported that their physical and mental health was either *good* or *excellent* (71.8% and 91.3%, respectively). With respect to driving status, data from the 2009 CCHS reported that 83.0% of Albertans were licensed to drive and 88.4% did indeed drive (Turcotte, 2012). The results of the current survey also revealed that similar percentages of older adult Albertans reported being licensed to drive (88.0%) and did indeed drive (84.7%) at the time of the survey.

Chapter 5. Future Directions and Conclusions

5.1 Policy Implications

The need for responsive and available transportation for older adults will increase significantly over the next three decades. Although, conventional public transportation services may provide many older adults with the means to meet their travel demands, there are many barriers that prevent many older adults from being able to utilize these services. As such, alternate modes of transportation outside the conventional public transportation system are needed. The results of this research can be used to aid in the development of future programs of alternate transportation services that are tailored to meet the mobility needs of older adults. Recognition of the underlying factors (Essential Features, Non-Essential Features, and Demand Response Scheduling) that encompass the attributes of senior friendly transportation and knowledge of those socio-demographic, as well as physical and mental health factors, that are associated with older adults' ratings of importance toward these dimensions of ATS services are useful in that this information can direct and shape future ATS services. Specifically, policy makers and transportation providers can use this information to develop more responsive alternate transportation services for older adults. Results from this study indicate that, at a minimum, ATS services need to incorporate Essential Features (i.e., availability, provision of service for all trip purposes, can accommodate trip chaining), offer Demand Response Scheduling (i.e., provision of service does not require advanced scheduling), and be affordable. Moreover, models of ATS services that incorporate Non-Essential Features such as drivers with sensitivity training, clean vehicles, door-to-door and door-through service, the provision of escorts, and the ability to accommodate mobility aids, may provide older adults with a greater choice of transportation services, which in turn might lead to greater independence and empowerment. Transportation programs and services developed with these priorities in mind can be expected to adequately reflect the needs and preferences that older adults have regarding alternate forms of transportation for maintaining their mobility needs.

However, developing more responsive ATS services will require collaboration between different transportation stakeholder including the government, transportation officials, services providers, other community stakeholders, and older adults. Policy makers and transportation program developers need to recognize that different sub-sets of the older adult population face different mobility challenges and have different abilities, with these issues pointing towards greater diversity in the transportation needs of older adults. As such, alternate transportation solutions will need to take into account the heterogeneity that exists among older adults and will to need to recognize that a single 'one size fits all' model of transportation is insufficient in meeting the out-of-home mobility needs for an increasingly large and diverse group of older adults.

5.2 Future Research

This study provides insight into the ratings of importance that older adults give toward different attributes of ATS services. Despite the large sample size of the study, the subjective nature of the responses on the questionnaire leaves many unanswered questions. Future research could further explore older adults' ratings of importance of different attributes of ATS services using focus group methodology. This would enable researchers to tease out and obtain a more comprehensive understanding of the importance of different elements of ATS services.

Additionally, more focused research is needed to fully comprehend the importance of different attributes of ATS services to transportation disadvantaged sub-groups of older adults. It would allow for a better understanding of why specific attributes of ATS services were rated as more or less important or essential than others by different groups of the older adult population. Obtaining in-depth responses from transportation disadvantaged sub-groups about the needs and the expectations that they have of ATS services could aid in the development of more responsive alternate transportation services.

5.3 Conclusions

Given the increase in the proportion of older adults with chronic medical conditions impairing functioning in developed nations worldwide, it is expected that an increasingly larger proportion of older adults will face reductions in mobility as 'giving up the car keys' becomes a greater probability. As such, for many older adults a shift from reliance on the private vehicle to reliance and dependence on others or on alternate forms of transportation to maintain mobility will likely occur. With this, the role of ATS services and their ability to meet the out-of-home mobility needs of older adults can only be expected to gain in importance over the next few decades.

Given the paucity of research on the 5 A's of senior friendly transportation (The Beverly Foundation, 2001, 2005), the results from this research add to the existing knowledge about the attributes of transportation services that older adults deem to be necessary and important for maintaining mobility. This is important as there is a lack of understanding toward their mobility needs and the importance that different sub-sets of the older adult population, especially those transportation disadvantaged groups, place on different aspects of alternate transportation services. Knowledge of those factors that are associated with older adults' ratings of importance toward different attributes of ATS services also is important for planning transportation alternatives that will be utilized by an increasingly larger proportion of older adults in the coming decades. Having alternate transportation programs and services that are responsive and cognizant of older adults' needs and preferences will become increasingly important as Canada's and the world's population continues to age.

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Appendices

Appendix A. Survey Questions Relating to the 5 A's of Senior Friendly Transportation

Table A-1

Survey Questions Relating to Availability

Senior Friendly Feature	Survey Question
Availability	How important is it to you that alternate transportation services are available Monday to Friday in the daytime? How important is it to you that alternate transportation services are available Monday to Friday in the evening? How important is it to you that alternate transportation services are available during the weekend in the daytime? How important is it to you that alternate transportation services are available during the weekend in the evening?

Table A-2

Survey Questions Relating to Acceptability

Senior Friendly Feature	Survey Question
Acceptability	How reasonable is it to have to book a ride at least 24 hours in advance? How reasonable is it to have to book a ride at least 48 hours in advance? How reasonable is it to have to book a ride more than 48 hours in advance? How reasonable is it to expect alternate transportation service providers offer rides without having to book in advance? How important is it to you that the drivers have additional knowledge about seniors' health issues? How important is it to you that alternate transportation vehicles are clean?

Table A-3

Survey Questions Relating to Accessibility

Senior Friendly Feature	Survey Question
Accessibility	How important is it to you that the driver goes to the door to pick you up and walks you to the door of your destination? How important is it to you that the driver escorts you from the house to the inside of your destination? How important is it to you to have a transportation service that will provide rides for health related appointments? How important is it to you to have a transportation service that will provide rides for essential services? How important is it to you to have a transportation service that will provide rides for social activities? How important is it to you to have a transportation service that will provide rides to religious activities?

Table A-4

Survey Questions Relating to Adaptability

Senior Friendly Feature	Survey Question
Adaptability	How important is it to you to have a transportation service that provides an escort who can assist you with essential services? How important is it to you to have a transportation service that provides an escort who will stay with you during your doctor's visit? How important is it to you to have a transportation service that allows for multiple stops during the trip? How important is it to you to have a transportation service that provides a vehicle that can accommodate a wheelchair that is folded up? How important is it to you to have a transportation service that provides a vehicle that can accommodate a scooter?

Table A-5

Survey Questions Relating to Affordability

Senior Friendly Feature	Survey Question
Affordability	Would you be willing to pay more for a service where the driver goes to the door to pick you up and walks you to the door of where you are going? Would you be willing to pay more for a service where the driver escorts you from the house to the inside of where you are going? Would you be willing to pay more for a service that allow for multiple stops?

Appendix B. Frequency Statistics of the Ratings of Importance that Respondents Place upon Different Attributes of the 5 A's of Senior Friendly Transportation

Table B-1

Frequency Statistics for the Ratings of Importance that Respondents Place upon Availability Features of Senior Friendly Transportation Services

Senior Friendly Feature	Item	*n* (%) Not at all Important	Somewhat Important	Very Important
Availability	Importance of service during week/daytimes (*n* = 899)	76 (8.5)	154 (17.1)	669 (74.4)
	Importance of service during week/evenings (*n* = 892)	324 (36.3)	406 (45.5)	162 (18.2)
	Importance of service on weekends/daytime (*n* = 896)	154 (17.2)	389 (43.4)	353 (39.4)
	Importance of service on weekends/evenings (*n* = 892)	439 (49.2)	323 (36.2)	130 (14.6)

Note. The sample size of each item ranged from 892 to 899 with missing data accounting for less than 1.0%.

Table B-2

Frequency Statistics for the Ratings of Importance that Respondents Place upon Acceptability Features of Senior Friendly Transportation

Senior Friendly Feature	Item	*n* (%) Not at all Reasonable	Somewhat Reasonable	Very Reasonable
Acceptability	Reasonability of 24 hour advance scheduling (*n* = 887)	186 (21.0)	374 (42.2)	327 (36.8)
	Reasonability of 48 hour advance scheduling (*n* = 883)	484 (54.8)	301 (34.1)	98 (11.1)
	Reasonability of > 48 hour advance scheduling (*n* = 880)	691 (78.5)	145 (16.5)	44 (5.0)
	Reasonability of no advance scheduling required (*n* = 877)	186 (21.2)	288 (32.8)	403 (46.0)
		Not at all Important	Somewhat Important	Very Important
	Importance of drivers with knowledge about seniors' health issues (*n* = 894)	66 (7.4)	262 (29.3)	566 (63.3)
	Importance of clean vehicles (*n* = 898)	16 (1.8)	143 (15.9)	739 (82.3)

Note. The sample size of each item ranged from 880 to 898 with missing data accounting for less than 3.0%.

Table B-3

Frequency Statistics for the Ratings of Importance that Respondents Place upon Accessibility Features of Senior Friendly Transportation

Senior Friendly Feature	Item	*n* (%) Not at all Important	Somewhat Important	Very Important
Accessibility	Importance of door-to-door service (*n* = 886)	122 (13.8)	288 (32.5)	476 (53.7)
	Importance of door-through-door service (*n* = 886)	166 (18.7)	343 (38.7)	377 (42.6)
	Importance of rides to health-related appointments (*n* = 899)	23 (2.6)	102 (11.3)	774 (86.1)
	Importance of rides to essential services (*n* = 892)	75 (8.4)	342 (38.3)	475 (53.3)
	Importance of rides to social activities (*n* = 896)	303 (33.8)	476 (53.1)	117 (13.1)
	Importance of rides to religious activities (*n* = 866)	232 (26.8)	380 (43.9)	254 (29.3)

Note. The sample size of each item ranged from 866 to 899 with missing data accounting for less than 4.0%.

Table B-4

Frequency Statistics for the Ratings of Importance that Respondents Place upon Adaptability Features of Senior Friendly Transportation

Senior Friendly Feature	Item	*n* (%) Not at all Important	Somewhat Important	Very Important
Adaptability	Importance of escorts for essential services (*n* = 890)	289 (32.5)	386 (43.3)	215 (24.2)
	Importance of escorts for health-related appointments (*n* = 890)	448 (50.3)	305 (34.3)	137 (15.4)
	Importance of trip chaining (*n* = 893)	162 (18.1)	431 (48.3)	300 (33.6)
	Importance of accommodating wheelchairs (*n* = 884)	118 (13.3)	161 (18.3)	605 (68.4)
	Importance of accommodating scooters (*n* = 876)	264 (30.1)	268 (30.6)	344 (39.3)

Note. The sample size of each item ranged from 876 to 893 with missing data accounting for less than 3.0%.

Table B-5

Frequency Statistics for the Ratings of Importance that Respondents Place upon Affordability Features of Senior Friendly Transportation

Senior Friendly Feature	Item	*n* (%) Yes	No
Affordability	Will pay more for door-to-door service (*n* = 875)	520 (59.4)	355 (40.6)
	Will pay more for door-through-door service (*n* = 878)	431 (49.1)	447 (50.9)
	Will pay more for trip chaining (*n* = 882)	597 (67.7)	285 (32.3)

Note. The sample size of each item ranged from 875 to 882 with missing data accounting for less than 3.0%.

Appendix C. Factor Solutions with Rotated Factor Structures

Table C-1

Rotated Factor Matrix and Unsuppressed Factor Loadings for the Four-Factor Solution

Senior Friendly Feature	Item	Factor 1	2	3	4
Availability	Importance of service during week/daytimes	.16	**.75**	.01	.13
	Importance of service during week/evenings	.16	**.77**	-.02	-.06
	Importance of service on weekends/daytime	.16	**.76**	.00	.09
	Importance of service on weekends/evenings	.14	**.74**	-.10	-.07
Acceptability	Reasonability of 24 hour advance scheduling	-.01	-.12	**.69**	-.18
	Reasonability of 48 hour advance scheduling	-.03	.02	**.95**	.02
	Reasonability of > 48 hour advance scheduling	-.10	.01	**.83**	.10
	Reasonability of no advance scheduling required[+]	-.15	-.21	-.15	.03
Accessibility	Importance of drivers with knowledge about seniors' health issues	**.52**	.15	.04	.04
	Importance of clean vehicles	**.37**	.21	.08	.11
	Importance of door-to-door service	**.72**	.01	-.03	.10
	Importance of door-through-door service	**.78**	.03	-.02	.19
	Importance of rides to health-related appointments	**.51**	**.50**	-.14	.25
	Importance of rides to essential services	**.39**	**.48**	-.06	.11
	Importance of rides to social activities	**.36**	**.51**	-.04	-.04
	Importance of rides to religious activities	**.39**	**.36**	.00	.03
Adaptability	Importance of escorts for essential services	**.68**	.24	-.09	.03
	Importance of escorts for health-related appointments	**.63**	.17	-.04	.04
	Importance of trip chaining	**.39**	**.36**	.03	.05
	Importance of accommodating wheelchairs	**.64**	.24	-.07	.20
	Importance of accommodating scooters	**.55**	.27	-.05	.12
Affordability	Will pay more for door-to-door service	.20	-.04	-.04	**.84**
	Will pay more for door-through-door service	**.30**	.00	-.04	**.80**
	Will pay more for trip chaining	.03	**.33**	.00	**.34**

Note. Factor loadings greater than .30 are shown in boldface.

* Accounted for 84.9% of the variance.

[+] Item did not significantly load on to any factor.

Table C-2

Rotated Factor Matrix and Unsuppressed Factor Loadings for the Three-Factor Solution

Senior Friendly Feature	Item	Factor 1	Factor 2	Factor 3
Availability	Importance of service during week/daytimes	**.73**	.12	.01
	Importance of service during week/evenings	**.79**	.01	-.03
	Importance of service on weekends/daytime	**.75**	.10	-.01
	Importance of service on weekends/evenings	**.75**	-.01	-.10
Acceptability	Reasonability of 24 hour advance scheduling	-.08	-.10	**.69**
	Reasonability of 48 hour advance scheduling	.02	-.02	**.95**
	Reasonability of > 48 hour advance scheduling	-.02	-.03	**.84**
	Reasonability of no advance scheduling required[+]	-.24	-.08	-.15
	Importance of drivers with knowledge about seniors' health issues	.26	**.43**	.03
	Importance of clean vehicles	.27	**.35**	.07
Accessibility	Importance of door-to-door service	.17	**.65**	-.03
	Importance of door-through-door service	.18	**.74**	-.02
	Importance of rides to health-related appointments	**.56**	**.50**	-.15
	Importance of rides to essential services	**.53**	**.33**	-.06
	Importance of rides to social activities	**.58**	.21	-.05
	Importance of rides to religious activities	**.44**	.29	.00
Adaptability	Importance of escorts for essential services	**.39**	**.55**	-.10
	Importance of escorts for health-related appointments	**.31**	**.52**	-.04
	Importance of trip chaining	**.43**	**.31**	.02
	Importance of accommodating wheelchairs	**.35**	**.62**	-.07
	Importance of accommodating scooters	**.37**	**.49**	-.06
Affordability	Will pay more for door-to-door service	-.13	**.63**	-.03
	Will pay more for door-through-door service	-.06	**.69**	-.03
	Will pay more for trip chaining[+]	.27	.17	.00

Note. Factor loadings greater than .30 are shown in boldface.

* Accounted for 76.3% of the variance.

[+] Item did not significantly load on to any factor.