"Can I reach the tissue box?": A literature synthesis on the role of location and interior built environment in independent grocery shopping by older adults

by

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Abstract

The design of community and built environments is integrally linked to independence, participation, and mobility for older adults. This capstone project reviews literature that explores the accessibility of grocery stores based on their location within the community and their interior built environments. The results indicate a trend towards fewer grocery stores in areas of low SES and population density, and they identify barriers and facilitators related to shelving, signage, labels, way finding, aisles, lighting, noise level, flooring, shopping carts, in store seating, lighting, and check outs. The evidence highlights issues such as income, availability of transportation, the utility of universal design features, to promote independence in grocery shopping for older adults who wish to age in place. This paper builds upon Lawton and Nahemow's Ecological model of Aging and proposes a conceptual model that shows how location and interior-built environments are linked to independent grocery shopping.

Keywords: accessibility; independence; grocery stores; location; interior built environment

Dedication

I have been immeasurably fortunate in my life to have had the friendship of Colin and Ruth Hempsall. I had the opportunity to walk alongside them as they finessed the process of aging, observing the many ways the environment could be challenging, and witnessing how their perseverance and ingenuity overcame adversity. I have immense love and admiration for them. They were the inspiration for this capstone project.

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To my husband for so graciously encouraging me when I expressed a desire to return to university. Your belief in the value of education is admirable, and your confidence in my abilities far outreaches my own. I truly appreciate the sacrifices you have made so I could be in school. To my three children for learning along with me; you enhance my life immeasurably, and, thank you for thinking it is 'cool' to have a mom in university. To my own mother who is an exceptional example of aging well, I thank you for your encouragement, wisdom, and instrumental support. And, finally to my extended family who has shown interest in this capstone project, and encouraged me throughout this process-thank you!

Table of Contents

List of Tables

List of Figures

Glossary

Activities of Daily Living (ADL) Tasks of personal care such as eating, dressing, bathing or showering, transferring from bed and chair (Christensen, Doblhammer, Rau, & Vaupel, 2009).

Aging in Place (AIP) Ability to live in one's own home and community safely independently, and comfortably regardless of age, income, or ability level (CDC, 2013). It includes active participation in occupations in the home and the community (Siebert, 2003, p. CE-1).

Built environment Everything humanly made, arranged, or maintained, and offering settings in which human activities are shaped (Bartuska and Young, 1994). In this study the focus is on the interior built environment of grocery stores. The term interior design will be used interchangeably with interior built environment.

Food deserts Areas with limited access to grocery stores and nutritional food (Cummins & Macintyre, 2002; Wrigley, 2002). Alternatively, they are urban and rural areas that have a high need for healthy and affordable food but low access (US Department of Agriculture, 2009).

Grocery stores Stores that offer a variety of nutritional foods at fair prices (Apparicio, Cloutier, & Shearmur, 2007).

Accessible distance Generally based on physical distance and travel time to food stores (Apparicio, Cloutier, & Shearmur, 2007; Moore, Diez Roux, Nettleton, & Jacobs, 2008).

Interior design	Design in which creative and technical solutions used within a structure to achieve an interior built environment. (www.ncidqexam.org/about-interior-design/definition-of-interior-design/)
Instrumental Activities of Daily Living (IADL)	Tasks including telephone use, grocery shopping, housekeeping, preparation of food, doing laundry, using various types of transport, handling of drugs, and management of finances (Christensen, Doblhammer, Rau, & Vaupel, 2009).
Universal Design (UD)	Design of environments and products that are more easily accessed and used by everyone without requiring specialized adaptations (Story,1998), and considers human diversity with a goal of eliminating barriers (Steinfeld & Maisel, 2012).

1.   Introduction

Both developed and developing economies are experiencing significant aging of their populations, and the World Health Organization forecasts that there will be approximately 1.5 billion adults over the age of 65 by 2050 (WHO, 2011). In Canada, the first wave of baby boomers—those individuals born between 1946 and 1964—will turn 70 years old this year. The proportion of older adults will continue to increase, eventually make up approximately one quarter of the Canadian population over the next 20 years (CIHI, 2011), and, at present, adults 85 years and older compromise the fastest growing group in this demographic (HCIC, 2011). According to statistics from the American Association of Retired Persons (AARP), 88% of older adults want to remain in their homes and communities (AARP, 2014). This highlights the need to examine how services within communities are structured to support the needs of older adults who wish to remain independent and active for as long as possible.

Most older adults prefer to shop for and prepare their own food; therefore, grocery stores are an integral part of their lives. (Thompson, Bentley, Davis, Coulson, Stathi, & Fox, 2011). Studies have shown that grocery shopping has benefits beyond just the procurement of food and the provision a nutritious diet (Quandt, Arcury, & Bell, 1998; Thompson et al., 2011); indeed, it also provides opportunities for social engagement (Lane et al., 2014), physical exercise (Kohijoki, 2011; Sidenvall, Nydahl, & Fjellstrom, 2001), mental stimulation (Kohijoki, 2011; Sidenvall et al., 2001), and it creates a sense of independence (Thompson, Bentley, Davis, Coulson, Stathi, & Fox, 2011). On one hand, research has found that relying on meal-based programs such as "Meals on Wheels" cannot fully provide all the nutritional requirements of older adults (Keller, 2007). Other formal supports such as grocery delivery services can be costly, and older adults may not feel comfortable letting strangers into their homes (Turrini et al., 2010). On the other hand, informal assistance with grocery shopping from family and friends is not always available. For instance, only 35% of older adults have children living within sixteen kilometers of them (National Academy on an Aging Society, 1999), and women, who are more likely to provide assistance, are increasingly participating in the work force which places high demands on their time, leaving less available for support (Szinovacz & Davey, 2008).   Furthermore, older adults see independent grocery shopping as one of the most important, and meaningful activities in their day-to-day

1

lives, as it significantly influences their quality of life (Dickerson, Reistetter, & Gaudy, 2013; Lowen, Davern, Mavoa, & Brasher, 2015; Meneely, Strugnell, & Burns, 2009; Pettigrew, Mizerski, & Donovan, 2005).

Despite the importance and necessity of independent grocery shopping for older adults, the role of the location and design of the interior built environment of grocery stores remains an understudied area, particularly from the perspective of Gerontological literature. Much of the existing research related to grocery stores environment has been in the area of marketing and consumer behaviour. Research has mainly focused user satisfaction as an outcome measure, and less on the person –environment fit of older adults within the grocery store environment (see Kohijoki, 2011; Meneely, Burns, & Strugnell, 2008; Moschis, Curasi, & Bellenger, 2004; Pettigrew et al., 2005). Using a person-environment lens can provide a perspective that allows for added understanding of how different environmental layouts can be helpful so older adults can effectively continue to age in place. Research on where people want to grow old consistently demonstrates that they want to live in their homes in the community as long as possible, which is a phenomenon known as 'aging in place.' The link between aging in place and independent grocery shopping is discussed in the following section.

1.1   Organization of capstone project

This capstone project is organized as follows: chapter one introduces the topic, and the background context, including aging in place, independence and social engagement. It covers the evolution and role of grocery stores, the community location, the interior built environmental context of grocery stores, the theoretical underpinnings guiding this review, the purpose of this capstone project, and the research objectives and questions. Chapter two outlines the methods. Chapter three focuses on the location of grocery stores, highlights the results from the literature review and synthesis, and provides a critical synthesis and discussion based on the review. Chapter four presents the results based on literature reviewed on interior design of grocery stores and discusses the influence of design on older adults' independent grocery shopping experience, and new technology in retail. The concluding chapter highlights the strengths and gaps in the literature, and presents limitations and recommendations of this literature review and synthesis. It proposes a conceptual model that associates

2

independence in grocery shopping by way of an interaction between older adults and the grocery store environment, and presents concluding comments.

Research on where people want to grow old consistently demonstrates that they want to live in their homes in the community as long as possible, and this phenomenon is known as 'aging in place.' The link between aging in place and independent grocery shopping is discussed in the following section.

1.2   Aging in place (AIP)

Aging in place has been defined as the 'ability to live in one's own home and community safely independently and comfortably regardless of age, income, or ability level' (CDC, 2013). Aging in place includes 'active participation in occupations in the home and the community' (Siebert, 2003, p. CE-1). A key aspect of aging is place is for older adults to maintain a reasonable balance between their abilities and the demands of the environment (Lawton & Nahemow, 1973). However, older adults are often impacted by the sensory and physical changes of aging that put them at risk of losing independence in daily activities (Guralnik, Fried, & Salive, 1996). These changes lead them to be affected by a greater number of factors within the built environment (Umstattd, Janke, & Beaujean, 2014). Even so, it is well known that older adults prefer to age in place for as long as possible and that this desire increases substantially with age (American Association for Retired Persons, 2005).

Older adults wish to live in their own homes for a number of reasons: (1) They derive a sense of belonging from living in their own homes amongst the treasured objects they have gathered over a lifetime (Oswald & Wahl, 2005); (2) They develop routines (Rowles, 2008), and often make necessary alterations to their homes to accommodate their changing needs so as to maintain their routines (Maloney, 2010); and, (3) The community, which provides ongoing proximity to family, social ties, services and activities (Peace, Holland, & Keller, 2007), serves as a 'tangible resource for aging in place' (Wiles, Liebing, Guberman, Reeve & Allen, 2011, p. 364). Thus, older adults develop deep attachments to both their homes and to their communities as they age within these contexts (Rowles, 1983; Wiles et al., 2011). Two factors that are central to aging in place are the maintenance of independence, and social engagement in older

3

age. These are discussed below and are linked to the discussion of independent grocery shopping.

1.2.1 Independence

Independence is a feature that influences the ability of older adults to age in place, and it has been regarded as a foundation for quality of life, autonomy, and personal identity (MetLife Report on Aging in Place 2.0, 2010; Wiles et al., 2012). Indeed, the WHO considers maintaining autonomy and independence key to active aging – the ongoing participation in social, economic, cultural, spiritual and civic affairs in later life (World Health Organization, 2002).

The idea of independence can have different meanings. In the western world, the notion of independence is based on being physically self-sufficient in carrying out day-to-day activities. Research indicates that maintaining independence is a priority for older adults. As discussed by Sixsmith (1986), older adults want to be able to look after themselves, have the self-direction and freedom to make their own choices, and want to avoid feeling indebted to others. Unfortunately, this perspective, has the potential to create social isolation by limiting contact from support networks that can provide assistance (Bell & Menec, 2015; Plath, 2009; Sixsmith & Sixsmith, 2008), because older adults tend to characterize the need for support as an indication of dependency, growing old, and becoming burdensome (Bell & Menec, 2015). However, in non-western cultures the understanding of independence can include dependence on others (Beall & Goldstein, 1982). For instance, the support and respect younger cohorts provide to older generations continues to help older adults remain active in society (Takagi & Silverstein, 2006).

Independence is often measured by the ability to manage a variety of activities of daily living (ADLs), and instrumental activities of daily living (IADLs), and older adults who lose their ability to perform these activities are least likely to continue to successfully age in place (Feldman, Hollander, & Oberlink, 2003). As such the link between independence and older adults' ability to carry out activities such as grocery shopping has been shown to be related to their ability to maintain their own mobility for instance being able to drive themselves to the grocery store or walk with assistive devices (Schwanen, Banister & Bowling, 2012). And, while grocery shopping is an IADL that is

4

especially important to older adults' maintenance of independence (Lawton & Brody, 1969), it also provides older adults' with the opportunity of social engagement in the community. Like maintaining independence, the link between social engagement and grocery shopping is also influential in older adults maintaining their ability to age in place.

1.2.2 Social engagement

Social engagement, a real life activity that stems from socializing with others, is important to supporting good health (Breheny & Stephens, 2009; Campbell, 2015; Glass, Mendes De Leon, Bassuk, & Berkman, 2006), and is identified as a fundamental aspect of successful aging (Rowe & Kahn, 1997). Social engagement involves maintaining activities and social roles that have a social element (Glass, Mendes de Leon, Marottoli, & Berkham, 1999). However, opportunities for social engagement can become limited in older adults due to their environment becoming more demanding (Rosso, Taylor, Phillip Tabb, & Michael, 2013; Thomas, 2011).

The grocery store is a strong social environment where non-obligatory social interactions occur (Cheang, 2002). Although men tend to engage in leisure activities and women in instrumental activities reflective of roles they have occupied throughout their lives (Davidson, 2004), both use grocery shopping as an opportunity for engaging in social relationships (Devine, 2003). However, factors such as the location of grocery stores and the design of their interior built environment can undermine the ability of older adults to socially engage and maintain social relationships.

The following section covers the evolution of current grocery stores, as well as the background context of their locations and interior built environment and how they are linked to older adults' independence and living within the community context.

1.3 Grocery stores

1.3.1 A brief history

Food preparation and consumption is a foundational component of Maslow's hierarchy of human needs (Huitt, 2004), and, in today's society, convenient access to

5

food is considered a basic human right. Today's grocery stores are defined as stores that offer nutritional food at relatively inexpensive prices (Apparicio et al., 2007); they have grown from trading posts set up in the early colonial era, and have spread across the country with westward expansion (Mayo, 1993). Full sized 'supermarkets' emerged in the 1920's and 1930's, though by the late 1930's even the largest stores were still quite small, measuring approximately 560 square metres to 750 square metres (Gottlieb & Joshi, 2010). In the 1960's new trends in food retail were introduced to accommodate the addition of other merchandise in grocery stores, transforming them into large stores where one could purchase both food and other household items. Today, grocery stores that sell groceries are on average 3,960 square metres in size whereas stores selling groceries plus merchandise ranges from 10,800- 20,700 square metres (Dunkley, Helling & Sawicki, 2004). The large size and scale of these grocery stores can negatively influence older adults' ability to independently grocery shop as they easily fatigue (Kohijoki, 2012).

This growth in the size of grocery stores has necessitated a geographic shift away from urban core neighbourhoods to suburban areas where large parcels of land are cheaper, and stores can take advantage of highways that afford convenient vehicle access (Gottlieb & Joshi, 2010). Furthermore, the construction of increasingly large stores has meant that the overall number of grocery stores has fallen, with the decrease primarily being in smaller stores formerly located core urban areas. In Canada, for example, the number of grocery stores has decreased from 33,000 in 1990 to 23,000 in 2003 (Zafirou, 2005, as cited in Peters & McCreary, 2008).

1.3.2 Older adults as important consumers

These large grocery stores (mainly located in suburbs) have targeted young families with children as their principle consumer group. However, with changing demographics and the aging of the baby boomer generation, older adults will soon be the most important group in terms of retail spending (Meyers & Lumbers, 2008; Rao, Warburton, & Bartlett, 2006) and are, therefore critically important to the grocery industry. Thus, their perspectives and experiences within grocery store environment are important (Meneely et al., 2008; Pettigrew et al., 2005), and they need to be recognized as important collaborators in the process of where stores are located and how they are designed. Yet, grocery store design and policy have failed to keep pace with this

changing demographic which has resulted in environments that are not supportive of an aging consumer base.

1.4   The location of grocery stores

The location of grocery stores has been looked at in the context of regional sprawl and the presence and absence of grocery stores, convenience stores, and fast food outlets (Lathey, Guhathakurta & Aggarwal, 2009; Raja et al., 2010). It also refers to the physical distance from residences and travel time to reach a store (Apparicio et al., 2007; Moore, Diez Roux, Nettleton & Jacobs, 2008). Among methods of determining the accessibility of grocery stores, physical distance to the consumer base is a commonly used measurement method (Zenk et al., 2005), while other studies have used grocery store density within a defined area to study access (Moore & Diez Roux, 2006). Both types of measurements deliver similar outcomes in relation to older adults' physical access to these types of food environments, with the definition of 'accessible distance' between a grocery store and a dwelling being a walkable distance of 1 km or less from a dwelling (Apparicio et al., 2007).

The location of grocery stores is an important consideration because older adults may be more disadvantaged than other age groups regarding how they get to grocery stores. Older adults may have transportation issues including whether they have access to a car. At present, a large majority of adults in the young category of 65 years to 75 can drive. However, this number decreases once one starts looking at people over the age of 75, especially older women in that age group who may never have driven a car (Statistics Canada, 2012). Access to grocery stores is also related to whether they have the physical ability walk and carry groceries (Burns & Inglis, 2007). Advancing age may bring about physical changes that can limit their ability to get to grocery stores. Therefore, the issue of available and appropriate transportation highlights the association between store location and the absence of options for accessing healthy, fresh and affordable food. The link between the availability of transportation and presence of physical limitations that influence older adults' ability to walk, and access to food for older adults is an important consideration. Locational aspects of grocery stores have given rise to another concept known as food deserts, that is closely linked to health and well-being of vulnerable populations, including older adults.

1.4.1 Food deserts

As noted above, areas with limited access to grocery stores and nutritional food have been termed 'food deserts' (Cummins & Macintyre, 1999; Wrigley, 2002). Alternatively, food deserts have been described as urban and rural areas that have a high need for healthy and affordable food but have low access (US Department of Agriculture, 2009). Need refers to levels of deprivation where present living conditions are below that of the majority in a given population (Apparicio et al., 2007). High need areas are identified based on factors such as household income, or SES, (Larsen & Gilliland, 2008), high percentages of older adults and low vehicle ownership rates (Smoyer-Tomic et al., 2006), single parent families, and the unemployment rate (Apparicio et al., 2007).

The concept of food deserts has been studied from several perspectives, including the availability of fresh foods and vegetables (Bodor, Rose, Farley, Swalm, & Scott, 2008), closure of grocery stores in inner city areas due to affluent households moving to suburban areas causing the median income of inner city areas to shrink and forcing grocery stores to close (Alwitt and Donley, 1997), or the presence of high cost food outlets (Lu & Qui, 2015). However, food deserts are most commonly identified in relation to the absence of full service grocery stores that offer nutritional food at relatively inexpensive prices (Apparicio et al., 2007; Larsen & Gilliland, 2008; Smoyer-Tomic et al., 2006). The association between older adults and food deserts is an important consideration because of the link between access to grocery stores and food insecurity in older adults.

1.4.2 Food insecurity

The concept of food deserts is closely linked to food insecurity in older adults (Chung et al., 2012; Kaufman, 2000). Food insecurity refers to the lack of food due to factors that include food affordability, accessibility and availability (Lee, & Frongillo, Jr, 2001). Older adults are at risk for being food insecure due to reasons including limited economic resources, physical limitations, poor vision, and poor hearing (Lee, Shannon, & Brown, 2014), and lack of transportation (Lee & Frongillo Jr, 2001) that influence their ability to access grocery stores. Neighbourhood characteristics including perceived safety, social cohesion, and neighbourhood walkability have also been identified as

8

factors that influence food insecurity in older adults. (Chung et al., 2012). All these factors together show that food insecurity is a multifaceted issue, where the presence of food deserts is one aspect that influences older adults' access to nutritious food at affordable prices.

One can see from this overview, that location as an environmental factor plays an integral role in older adults' independent grocery shopping and well-being. Another crucial environmental factor that affects the grocery shopping experience is the actual interior design and layout of the grocery stores.

1.5   The interior built environment of grocery stores

Older adults' preference to age in their own homes in the community creates a demand for built environments that are accessible. The built environment---that is, everything humanly made, arranged, or maintained (Bartuska & Young, 1994), that comprise the settings in which human activities are shaped (Lawrence & Low, 1990) --- has a profound impact on the health, quality of life, and well-being of older adults, and is critical to supporting their independence (Menec, Means, Keating, Parkhurst & Eales, 2011). While supportive interior built environments can increase well-being, quality of life and participation in activities, they also have the potential to negatively impact older adults by creating barriers to participation in activities if their needs are not considered (Demirkan, 2007). As a greater number of sensory and physical changes occur in older adults, they become more susceptible to the conditions of the built environment (Menec et al., 2011). This makes the design of the built environment of grocery stores particularly important in relation to the continued independence of older adults.

Most interiors of grocery stores are designed similarly for the purpose of promoting customer spending. This is achieved mainly through product placement that encourages shoppers to travel down a number of aisles where often high impulse items are placed (Figueroa, 2014), and where maximum product exposure from both sides of the aisle is achieved (Juel-Jacobsen, 2015). Furthermore, grocery stores have tended to target a young population with a median age of around 30 years (Yin, Qiu, & Ranchhod, 2016). This has resulted in the design of grocery store environments focused on needs and wants of this younger population so as to influence their loyalty customers (Petermans & Van Cleempoel, 2012). The design of the interior of the grocery store has

9

focused on customer spending and a younger demography, which has been detrimental to customers of other age groups and abilities. However, older adults with different health and mobility capacities comprise a large part of the population and they will continue to grow and over the next twenty years will make up 25 percent of the population CIHI, 2011). Therefore, the interior built environment aspects of grocery stores should be designed to support people of all levels of ability and mobility participation. Altering the design of grocery stores to make the environment useable to older adults would also make it useful to all shoppers. The following overview of Universal Design Principles highlights how this can be achieved.

1.5.1 Universal design factors

The interior built environment of grocery stores can be evaluated using the lens of Universal Design (Mace, 1998). Universal Design (UD) refers to the design of environments and products that are more easily accessible through the reduction of physical barriers, and can be used by everyone without requiring specialized adaptations that result in stigmatization (Story, 1998). It considers human diversity with a goal of eliminating barriers and enhancing well-being and quality of life (Crews & Zavotka, 2006; Steinfeld & Maisel, 2012). Design that accommodates aging is frequently a major consideration for universal design due to the strong relationship between aging and reduced independence (Steinfeld & Maisel, 2012).

Proponents of universal design (UD) argue that implementation of universal design features in the built environment will facilitate the independence of older adults in their everyday activities, including grocery shopping (Crews & Zavotka, 2006). The implementation and evaluation of UD strategies is guided by seven interrelated principles outlined in Table 1 (Story, 1998), (Steinfeld & Maisel, 2012).

Table 1:   Seven principles of universal design (adapted from Story, 1998).

Universal design principle	Description
Equitable use	Useful and marketable to people with diverse abilities
Flexibility of use	Accommodates a wide range of individual preferences and abilities
Simple and intuitive use	Easy to understand, regardless of user's experience, knowledge, language skills, or current concentration level
Perceptible information	Communicates necessary information effectively to the user, regardless of contextual factors or the user's sensory abilities
Tolerance for error	Minimizes hazards and the adverse consequences of accidental or unintended actions
Low physical effort	Can be used efficiently and comfortably with a minimum of fatigue
Size/space for approach/use	Appropriate size and space is provided for approach, reach, manipulation, and use regardless of the user's body size, posture, or mobility

Often the term universal design is used interchangeably with 'inclusive design' and 'design for all' (Clarkson & Coleman, 2015; Steinfeld & Maisel, 2012). There are several other similar (though not identical) design principles and strategies that address the changing needs of an aging population and promote independence. These include 'accessible design', 'adaptable design', and 'transgenerational design'. Although accessible and adaptable design features provide accommodations that are helpful for older adults, these features often look like specialized design and do not blend well with the overall surroundings (Deardorff & Birdsong, 2003). Moreover, they pose a risk of labelling the users, in this case, older adults, as being "disabled" (Story, 1998), which often results in stigmatization (Audirac, 2008). Since these features require specialized adaptations or equipment, they may also be financially expensive, especially if they are added after the building has been constructed (Demirkan, 2007; Story, 1998; Verbrugge & Jette, 1994). Transgenerational design strives to create products and environments that are compatible with the physical and sensory impairments associated with aging, and are often included in the initial planning stages (Pirkl, 1995). Principles of transgenerational design are similar to UD, however, it can still be stigmatizing as it is focused on accommodating the aging process (Keates, Clarkson, Harrison, & Robinson, 2000). For these reasons, universal design guidelines are more suitable for the evaluation and design of the interior built environment of grocery stores.

There is also a business case for UD. Though UD serves all demographics, older adults are a growing, influential population with considerable spending power. Capturing this consumer market through better designed products and services can lead to a considerable market share advantage (Kohijoki, 2011; Moschis, Curasi, & Bellenger, 2004; Pettigrew, Mizerski, & Donovan, 2005; Steinfeld & Maisel, 2012). Universally designed environments can reduce the influence of environmental features on older adults who are impacted by sensory and physical changes related to aging. The ecological theory of aging in the following section will explain how adapting the environment can increase older adults' independence, allowing for a better person-environment fit between older adults and their grocery store environments.

1.6   Theoretical framework guiding this capstone paper

1.6.1 The ecological model of aging (ETA)

Environmental gerontology suggests that the environment we occupy can influence how we age and our ability to age in place (Lawton, 1990). Lawton and Nahemow (1973) introduced the ecological theory of aging (ETA); a pivotal theory within environmental gerontology that focuses on the behaviour and well-being of individuals. This theory established the concept of press- competence, which is defined as the dynamic between a person's functional competence (their abilities) and the press from the surrounding environment (stress). The theory is expressed as, B= f (P, E, PxE) where behaviour (B) is a function of the person (P), the environment (E), and the interaction between them (PxE). According to the person-environment fit model, an individual with a given competence level interacts with an environment that has a given demand. This interaction results in either adaptive or maladaptive behaviour. Person-environment fit happens when the behaviour remains in the adaptive zone that includes the zone of maximum comfort or maximum performance potential. An individual with a given competence level interacts with an environment that has a given "press" or environmental "demand" as illustrated in Figure 1.
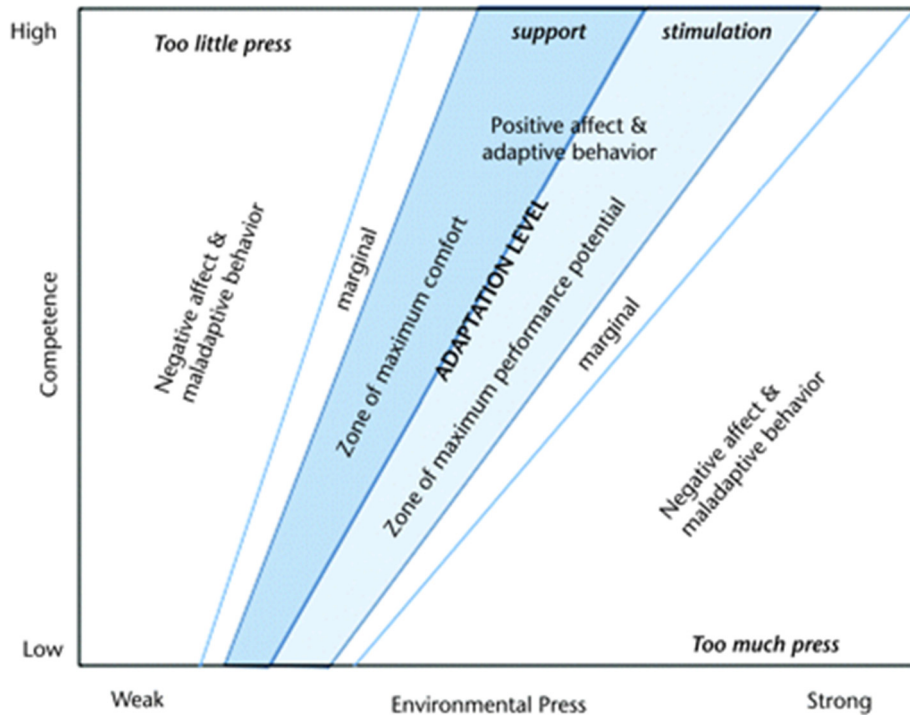
Figure 1: **Ecological model of aging (reproduced courtesy of the American Psychological Association)**

The central line in Figure 1, labeled "adaptation level", represents the theoretical level where personal competence matches the demand of the environment. A decline in functional abilities, ---manifested in later life by declining physical and cognitive functioning, or an increase in environmental demands --- will negatively impact the person – environment fit. Similarly, when competence is high and the environment fails to offer adequate challenge, the person-environment fit is negatively impacted. Unaccommodating environments can transform an impairment into a disability by restricting activities. Over accommodating environments might encourage early dependence by providing more support than is required, resulting in premature dependence. These environments place the ability to carry out activities at risk (Danford & Steinfeld, 1999). The ETA asserts that a supportive environment for older adults translates into greater competence, improved abilities to carry out everyday tasks, and more control over the environment resulting in enhanced quality of life (Lawton, 1974). Therefore, living independently is a result of older adults' ability to perform tasks associated with daily living within a supportive environment (Iwarsson, 2005).

Critics of the competence- press model argue that it focuses too much on the person being a passive receiver of the environment. However, this model implicitly

views aging as a dynamic process where the competencies of older adults and the press from the environment change throughout the process of aging (Satariano, 2006). Thus, older adults are active contributors in their environments.

Lawton (1980) proposed that environments should be designed so that they are conducive to supporting the ongoing independence and self-reliance of older adults. According to the ETA, the environment controls behaviour and does not account for how older adults manipulate aspects of their environment to reduce its demands (Iwarsson, 2005). However, since declines in the functional abilities of older adults are often biological, psychological, and social (WHO, 1999), it is more advantageous to maximize competence by enhancing the environment to support greater independence (Pynoos, Nishita and Perelman, 2003). This means that adapting the environments of grocery stores to accommodate the changing competencies of older adults will support greater independence. Some examples of environmental press in the grocery shopping experience include the distance an older adult must walk in order to get to a grocery store and the height at which desired or necessary products are placed on shelves within the grocery store. Working to mitigate these factors will accommodate the changing competencies of older adults resulting in greater independence and a better person-environment fit.

1.7   Purpose of capstone project

The purpose of this capstone project is to review literature on grocery store location and interior design to understand the person – environment interaction process that enables or deters independent grocery shopping behaviour of older adults. The rationale for considering the locational and design aspects of grocery stores is that out of all the places older adults go outside their homes, grocery stores are by far the most frequently visited place (Valdemarsson, Jernryd, & Iwarsson, 2005). Furthermore, these environmental aspects of grocery stores influence where older adults shop for food, affecting their dietary choices and behaviours (Shannon, Lee, Holloway, Brown, & Bell, 2015; Yen, Michael, & Perdue, 2009). Better access to healthy food might influence older adults' ability to maintain a nutritious diet, and enhance their independence and quality of life (Keller, Dwyer, Senson, Edwards, & Edwards, 2007).

14

1.8   Research objective and questions

The following literature review and synthesis of the location and built environment of grocery stores has two main objectives:

1. To identify the key factors that either facilitate or serve as barriers to older adults' independently accessing grocery stores.

2. To identify how environmental barriers and facilitators in the interior built environment of grocery stores are perceived.

The research questions pertaining to these objectives are:

1. What are the factors that influence the accessibility of grocery stores for older adults in relation to grocery store locations?

2. What are the environmental barriers and facilitators in the interior built environment of grocery stores?

This understanding will assist gerontologists and social scientists to understand the person-environment interactions that are key to older adults remaining independent in the community as long as possible. It will help designers, architects and store managers to develop an awareness of the influence of the built environment on older adults' (a growing consumer group with significant buying power) ability to shop and use retail environments more effectively. Chapter two outlines the methods used to identify articles to assist answering these research questions.

2.   Methods

2.1   Methodological approach

The purpose of doing a literature review and synthesis is to "promote a thesis position by building a case from credible evidence based on previous research" (Machi & McEvoy, 2012, p. 5). In addition, a literature review is intended to enhance the reader's level of knowledge of a new topic through the appraisal of existing research, identify gaps in the existing research, offer a novel perspective (Abrams, 2012), and draw sound conclusions related to the research topic (Rozas & Klein, 2010). It uses specified literature selection and synthesis methods to critically evaluate the research articles. These methods are discussed below.

2.2   Literature search selection criteria

One goal of a literature review is to present a logical argument based on a thorough understanding of the current subject matter (Machi and McEvoy, 2012). Conducting comprehensive and accurate research is imperative (Moher, Liberati, Tetzaff, Altman, and the PRISMA group, 2009). Abrams (2012) cautions, in attaining a better understanding of the subject matter, care must be taken in how the research is processed and presented. Adding value to the research process depends on "what was done, what was found and the clarity of the reporting" (Moher, Liberati, Tetzaff, Altman, and the PRISMA group, 2009). Using the following format that includes an adapted PRISMA model (Moher, Liberati, Tetzaff, Altman, and the PRISMA group, 2009) and STROBE article evaluation (von Elm, Altman, Egger, Pocok, Gotzsche, & Vandenbroucke, 2007) will assist with a high quality review of the literature on the association between independence in older adults and the location and the interior built environment of grocery stores.

2.2.1 Search process for articles related to the location of grocery stores

The primary purpose of this literature search was to find articles that examined the association between the location of grocery stores and older adults living in the community who independently grocery shop. Key search terms to identify articles related

to locational aspects of grocery stores were *seniors or older adults*, *food deserts or food access or grocery store location, transportation or distance or proximity*. The databases searched were: Ageline, Social Sciences Citation Index (SSCI), Business Source Complete, the Simon Fraser University Library database, and CINAHL Complete. Only the Simon Fraser Library database and CINAHL Complete were useful in this search. The remaining databases did not yield any articles on older adults' access to grocery stores as is relates to location of grocery stores. To be included in this review, primary sources had to meet all of the following criteria: (1) written in English; (2) published between 1999- 2016 (the 17 year window was designed to align with the contemporary literature on food accessibility); (3) studies that included original empirical research, that is, studies based on experimentation or observation; (4), studies that considered facilitators or barriers to accessing grocery stores, specifically in relation to key issues that influence access for older adults such as the presence of functional limitations, availability of transportation, availability of social supports, and socioeconomic factors; (5) studies that address the older population. The following section outlines the search strategy used in identifying articles for the review of the location and the interior built environment of grocery stores.

Initially 5572 articles were identified. Articles were first removed if there was a lack of relevance to grocery shopping. Articles were next excluded if the titles indicated a focus on neighbourhood food environments and obesity; grocery store loyalty; race/ethnicity as deprivation factors for accessing food; and, home delivery of meals. This process eliminated a majority of the articles. The remaining 82 articles were reviewed and a further 27 articles were removed because they were duplicates. An additional 46 articles were eliminated upon reading the article abstracts and contents because they did not address older adults. Table 2 includes a list of databases and search terms used in this review of the location of grocery stores.

Table 2: **Databases and search terms used to identify literature for review of location of grocery stores**

Database	Search terms	No. articles
SFU Database	Seniors OR older adults	43
AND	food deserts OR food access OR grocery store location OR	
AND	transportation OR SES	
Limiters:	1999-2015; full text, English, scholarly (peer-reviewed) journals; 65 + years	
CINAHL	Seniors OR older adults	39
AND	Proximity OR distance OR transportation	
AND	Food access OR grocery stores	
Limiters:	1999-2015; full text, English, scholarly (peer-reviewed) journals	
	Older adults OR older consumers OR seniors OR aging	
Total records identified after database searching	82	

Ultimately, nine articles were found that met the inclusion criteria for this review. Reference lists of articles identified in the database search were also examined for additional articles. This method identified two additional articles. In total, eleven articles on the locational aspects of grocery stores were included in this review. Because aging is a global phenomenon and food access is important to the health and well-being of all older adults, the literature search was not limited to specific countries. Research on the association between older adults and the location of grocery stores was available from Australia, Canada, Japan, the United Kingdom, and the United States. These articles on the location of grocery stores include key findings and research on distance, SES, travel time and transportation. The findings and research are summarized in Table 3.

Table 3: **Key study design features of the 11 studies in literature review and synthesis**

First author (year of publication) Country of study	Focus of study	Study design and method	Sample information	Key findings relating to food deserts	Outcome in relation to older adults
Cummins (1999) Scotland	To explore whether food deserts were more likely to be found in deprived areas	Quantitative Survey Spacial variations in the price and availability of food	246 food stores of varying types	No evidence of food deserts; small independent and discount grocers were more numerous in deprived areas.	Older adults living in deprived areas have good access to food stores. May not have access to high quality nutritious food.
Smoyer-Tomic (2006) Canada	To determine grocery store accessibility within the city of Edmonton, Canada	Quantitative Geographic information system (GIS) data, minimum distance and coverage methods to determine grocery store accessibility	Full range grocery stores and minimum of ten employees	Poorer urban areas generally had accessible grocery stores; six 'high need' urban areas had decreased accessibility	Older adults generally have good access to healthy food, despite living in poorer areas, although some areas have poor accessibility
Apparicio (2007) Canada	To identify food deserts in Montreal	Quantitative Geographic information system (GIS) data, measures of proximity, type, average distance to three closest different chain name grocery stores	Island of Montreal- popultion 1.8 million	Suburban and highly motorized areas had fewer grocery stores than central, denser and less motorized areas	Population aging and loss of mobility, may impact accessibility in suburban areas with fewer grocery stores
Burns (2007) Australia	To explore the geographical access to major grocery stores in a large municipality in Melbourne	Quantitative, Geographic information system (GIS) data, to measure the location grocery stores within in the city of Casey in Melbourne	Three major grocery store chains	Areas with greater SES had closer access to grocery stores and areas of less SES had closer access to fast food outlets. Grocery stores were an 8-10 min. car ride away	Access to healthy food is largely car dependent for older adults. Food security may be an issue. Access to fast food outlets may have poor nutrition implications.
Larsen (2008) Canada	To explore the evolution of food deserts in London, Ontario	Quantitative, Geographic information system (GIS) data of	Urban and suburban grocery stores in London Ontario that	Inner city neighbourhoods with low SES had the	Older adults living in poorer areas may have difficulty accessing food

			grocery stores from 1961-2005.	could be reached on foot or public transit	poorest access to grocery stores.	emphasizing the need for transportation
Hanibuchi (2011) Japan	To examine the association of local food environment to body mass index of older Japanese individuals	Quantitative, Geographic information system (GIS) data, to measure the location grocery stores and fast food outlets within 500m of older adults' home.	12,595 responses from cross-sectional data of the Aichi Gerontological Evaluation Study (AGES).	Better access to grocery stores was related to higher BMI, better access to fast food outlets was not related to higher BMI, only for those living alone	Improved access to fast food outlets may be an issue for olde Japanese who are living alone a the Japanese society is rapidly aging
Mercille (2012) Canada	To examine the associations between the availability of residential area food sources and dietary patterns among older adults in Montreal	Individual level data from NuAge study were merged with Geographic information system (GIS) data	Urban dwelling older adults age 68-84 years n=751	Fast food outlets were inversely associated with healthy diets. The presence of heathy food stores was associated with a healthier diet although these relationships were not significant	Other influences than presence fast food outlets and grocery stores need to be investigated i relation to older adults consumin a healthy diet
Huang (2012) USA	To examine the experience of older adults with a mobility disability accessing food	Qualitative, interviews, Participant worn GPS data	Thirty five adults 50 years and older with a mobility disability (using an assistive device)	Distance to grocery stores, proximity to other goods and services, and cost of grocery items were factors impacting accessibility of grocery stores	These results emphasize the importance of distance to grocer stores and cost of food for older adults. Highlights the need for transportation
Jiao (2012) USA	To explore new ways to find food deserts in King Count, Washington	Quantitative, Geographic Information Systems (GIS) data to measure physical access, related to ability to walk, bicycle, ride transit or drive within 10 minutes	Five low income groups	Almost all of the vulnerable populations lived within a 10-minute drive or bus ride of a low- or medium-cost grocery store.	The results highlight the importance of transportation for older adults for healthy food access
Yamashita (2012) USA	To explore access to healthy and unhealthy food outlets in one county in relation to	Quantitative, Geographic Information Systems (GIS) data to measure food access to	Healthy and unhealthy food outlets in census	Access to healthy food outlets was poorer than access to unhealthy food outlets. Less densely	The results highlight the importance of transportation for older adults for access to health food.

		sociodemographic factors (age), in one county in Ohio	healthy and unhealthy food outlets, measured in terms of travel distance and number of older adults in census block.	block in county in Ohio	populated areas had poorer food access. There was significant inequality in food access among older adults.
Lu (2015) Canada	To explore the accessibility of grocery stores and farmers' markets in the City of Calgary, Canada	Quantitative, Geographic Information Systems (GIS) data to measure food access to grocery stores and farmers' markets.	Accessibility of grocery stores and farmers' markets	Two communities with large populations of children and older adults and low income were classified as food deserts. The presence of Farmers' markets did not alleviate poor access to healthy food.	The presence of Farmers' markets increases the availability of of fresh food and also potentially reduce grocery prices in the area, influencing food access for lower SES older adults

2.2.2 Search process for articles related to the interior built environment of grocery stores

Searches for literature relating to the design of the interior built environment of grocery stores were conducted using internet-based databases that included the Simon Fraser University library database, CINAHL Complete, SSCI, Ageline, Avery Index to Architectural Periodicals (A) [AIAP (A)], Design and Applied Arts Index (DAAI), and Business Source Complete. Key search terms for empirical articles included *older adults or seniors or older consumer or aging*, *grocery stores or supermarkets*, *accessibility*, *built environment or physical environment or interior design.* Terms such as *universal design* and *inclusive design* were also included in the search process but produced no results when associated with grocery stores, grocery shopping, or supermarkets.

Similar to the search for articles on locational aspects of grocery stores, the literature search for this group of articles was limited to full text articles published between January 1999 and March 2016. To be included, primary sources had to be (1) written in English; (2) published since 1999 (the seventeen-year window was designed to align with the contemporary literature on aging demographics as well as to capture the recent states of grocery store environments); (3) studies that include original empirical research; and (4) studies that contain research on the environmental barriers within grocery stores; (5) studies that address the older population. Additionally, key words of either *older adults, or seniors, or older population, or elderly,* needed to appear in the research article. Table 4 shows the search strategy, including a list of databases and search terms used for this literature review and synthesis, and the number of articles identified. While certainly not a complete database source record, these articles were chosen to capture a discipline-comprehensive perspective on the phenomenon being researched.

Table 4.   **Databases and search terms used to identify literature for the interior built environment of grocery stores**

Database	Search terms	No. articles
SFU Database	Seniors OR older adults OR aging	87
AND	food shopping OR grocery stores OR supermarkets	
AND	accessibility	
Limiters:	1999-2015; full text, English, scholarly (peer-reviewed) journals	
Cinahl	Seniors OR older adults OR older consumers	14
AND	grocery shopping OR shopping OR grocery stores OR supermarkets	
Limiters:	1999-2015; full text, English, scholarly (peer-reviewed) journals	
SSCI	Older adults OR older consumers OR seniors OR aging	107
AND	food shopping OR grocery shopping OR supermarkets OR grocery stores	
AND	accessibility	
Limiters:	1999-2015; full text, English, scholarly (peer-reviewed) journals	1
Ageline	Older adults OR seniors OR aging	
AND	grocery shopping OR grocery stores OR supermarkets	
AND	accessibility	
Limiters:	1999-2015; full text, English, scholarly (peer-reviewed) journals	1
AIAP(A)	Seniors OR older adults	
AND	grocery stores OR supermarkets	
AND	interior design OR physical environment OR built environment	
Limiters:	1999-2015; full text, English, scholarly (peer-reviewed) journals	
Business Source Complete	Seniors OR older adults	21
AND	grocery stores OR supermarkets	
AND	interior design OR physical environment OR built environment	
Limiters:	1999-2015; full text, English, scholarly (peer-reviewed) journals	
Total records identified after database searching	231	

The initial search yielded 12,628 articles before any article filtering took place. Articles were first removed if there was a lack of relevance to grocery shopping. This

process removed a majority of the articles. Next, articles were excluded if the titles indicated a focus on financial incentives for the purchase of groceries, compliance of dietary guidelines in grocery purchasing, use of assistive technology to grocery shop, grocery purchasing related to ability to chew, home delivery of groceries, and nutrition status. After elimination, 231 articles remained. From this list of 231 articles, 90 duplicates were removed. A further 125 articles were excluded upon reading the article abstracts and contents because they did not meet the inclusion criteria of having older adults as study participants. Not all of the databases searched yielded articles. When the search terms *senior*, *older adult, older consumer* or *aging* were added in the search field as key words, the number of articles generated decreased dramatically. Sixteen articles were identified through this process and one further article was found by examining the reference lists of identified articles. The results of the literature search on the interior design of grocery stores yielded seventeen articles. To address the fact that aging is a global issue, this literature search included countries from outside the western world. The countries represented in this review were determined by available research on the association between older adults and the design of the interior built environment of grocery stores. These included Australia, Belgium, China, Finland, New Zealand, Scotland, Sweden, the United Kingdom, and the United States. These articles on the interior built environment of grocery stores include findings and research on wayfinding, shelving, aisles, flooring, noise, lighting, signage, shopping carts, labels, instore seating, and checkouts. Their design features are summarized in Table 5.

Table 5:   Key study design features of the 17 studies in literature review and synthesis
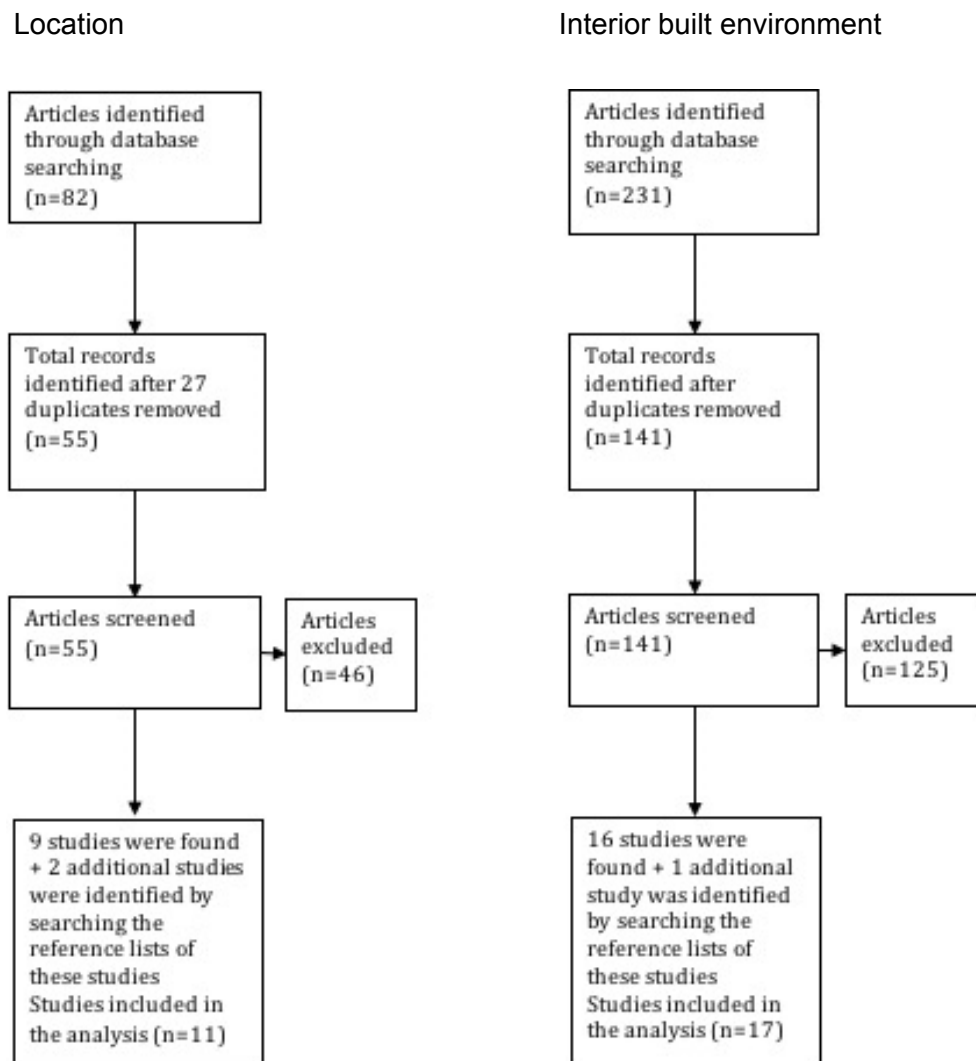
First author (year of publication) Country of study	Focus of study	Study design and method	Sample information	Key findings relating to the built environment of the grocery store	Outcome in relation to older adults
Goodwin (1999) New Zealand	To examine whether age impacts certain grocery shopping attributes.	Quantitative- mailed out questionaire	n=393 older adults in three age groups (55-64), (65-74), (75-84)	Older adults wanted to avoid long line-ups at checkouts, age discrimination in accessibility occurred in the oldest age group.	Increasing age affects older adults' ability to independently grocery shop.
Hare (1999) UK	Identifies problem areas related to food shopping, and examines the resulting feeling of lack of power within the marketplace.	Qualitative-semi structured interviews and non participatory observations	248 incidents 198 respondents	No rest area, poor access, poor signage, socialization, more assistance from staff, pack bags, interest in OA, accessible shelves, wide aisles, better lighting, smaller baskets, larger labels.	Promoting independent grocery shopping in older adults can be viewed as health promotion.
Hare (2001) Scotland	Identify the food shopping experience of older adults in relation to positive and negative factors.	Qualitative-semi structured interviews and non participatory observations	120 interviews 248 incidents	In relation to the internal store environment, there were more negative factors (57%) than positive factors (47%). Negative factors included lack of seating, while wheelchair access, store layout and clear price labelling contributed to both negative and positive experiences within the built environment of the grocery store.	To accommodate aging, grocery stores need to consider factors that can be barriers to independent grocery shopping.
Sidenvall (2001) Sweden	To investigate older Swedish women's experience of food shopping and cooking as part of independent living.	Qualitative-informal ethnographic interviews and thematic analysis	n=41 females aged 64-87 years	Factors that supported independent grocery shopping were ease of way finding, store not too large and wide aisles	Women in the Western world are culturally socialized to take on the majority of grocery shopping therefore it is a gendered role. For these women, independent grocery shopping is related to socialization, physical activity and a sense of independence.
Hare (2003) Scotland	To identify whether grocery stores contribute to older consumers being disadvantaged in grocery stores.	Quantitative-5 point scale	n=168 adults 60-74 years and 75+ years 87 females, 13 males	Older adults had issues with quantities being too large and with way finding in the store.	Dissatisfaction remains for older adult grocery shoppers, impacting their independence.

Moschis (2004) USA	Determine food shopping preferences of older adults compared to younger adults.	Qualitative-questionaire by mail	n=645 responses from adults 55+ years n=1268 responses from adults under 55 years	Recommendations include using directional signs to help locate items and reducing line-ups at cash registers.	Recognize that older adults are a diverse population resulting in differing requirements of the built environment.
Pettigrew (2005) Australia	To identify major issues for older adult shoppers.	Qualitative- focus groups Quantitative- telephone survey	Qualitative phase-6 focus groups with average of 7 participants- 2 all male and 4 all female aged 50-64 and 65+ years Quantitative phase-telephone survey n=505 respondents 50+ years	Older adults found there were issues within the grocery store including poor signage and product labelling, access to products on shelves and poorly maintained shopping baskets.	Older adults are an important market and as such need to be considered in the grocery store environment. Access issues were found to be more relevant to older women than to older men.
Bromley (2007) UK	To identify the food shopping experiences of wheelchair users.	Qualitative-interview survey followed up with in depth interviews, two focus group discussions, nine escorted shopping trips and 12 interviews with retail managers	n=120 male and female wheelchair users living independently in the community where 72 percent were 50+ years	Many wheelchair users feel they are at a disadvantage when grocery shopping, particularly in older traditional shopping locations. Newer grocery stores were advantageous due to features such as spacious aisles and special facilities.	Recently built superstores have the advantage of implementing design in the built environment to facilitate access for older adults in wheelchairs.
Meneely (2008) Ireland	To examine the extent to which retailers meet older adults needs within the food-retailing sector.	Qualitative-face to face interviews with retail managers	5 food retailers	Retailers identified the need for in store seating, smaller shopping carts and ease of way finding within their stores. However, few attempts were made to ease issues.	Food retailers are aware that barriers exist in grocery stores for older adults and these make it difficult for older adults to shop independently.
Omar (2008) Scotland	To identify the current expectation of Scottish older consumers in relation to the products and services available in the grocery store.	Quantitative-questionaire	n=142 respondents aged 55- 85+ years	Expectations identified were appropriate portion size, shorter line-ups at checkouts and assistance reading product labels and accessing products on shelves.	Grocery stores have to be prepared for the aging population

Meneely (2009) Ireland	Determine the behaviour and experience of older consumers in Northern Ireland during grocery shopping.	Qualitative - focus groups Quantitative- questionaire	4 focus groups consisting of 8-10 adults aged 60+ years n=791 questionaire	Issues experienced were lack of assistance in packing bags, inaccessible shelves, labels too small, lack of seating, over crowding, confusing store layout, product size too large.	While barriers exist that can impact older adults' independence, retailers have still to addressed them.
Petermans (2010) Belgium	To examine elderly consumers physical and social need and wants in the market place.	Qualitative-2 case studies	2 grocery store chains that serve adults 50+ years	Elderly consumers preferred wider aisles, non-skid floors, brighter lighting, lower shelf heights and clearly displayed, readable product labels and price tags.	Understanding the needs of older shoppers and implementing changes can promote independent grocery shopping for older adults.
Kohijoki (2011) Finland	To identify the role of aging on grocery shopping behaviour and the creation of consumer disadvantage.	Qualitative- 2001-2006 panel data analysis	2001- n=263 females (60-64 years n=32,65-74 years n=53, 75= n=15) 2006- n=263 females (60-64 n=0, 65-74 n=62, 75+ n=38	Issues identified included poor way finding, noisy background, high shelf height and long line-ups.	Grocery shopping becomes more difficult with age, greatest difficulty with older women 75+. This research suggests it promotes physical activity, socialization, sense of independence and mental stimulation.
Angell (2012) UK	To identify factors that influence grocery store patronage decisions in older adults.	Qualitative-semi structured interviews and non-participatory observations	n=36, 6 males, 30 females, age groups 60-69, 70-80, and 80+	Difficulties experienced within the grocery store included gaining access to products on shelves, narrow aisle width, locating merchandise, appropriate signage, poor lighting, noise level, overcrowding.	The grocery store environment influences older adults differently. Factors such as lower SES, older age, and being female impacts grocery shopping performance the most.
Huang (2012) USA	To examine facilitators and barriers to food access for older adults with a mobility disability living independently in the community.	Qualitative- semi-structured interviews	n=35 older adults aged 50-86 years 9 male, 26 female 20 used a cane or walker, 9 used and electric wheelchair, 4 used a manual wheelchair	Barriers experienced were lack of available seating, seat height, space to put assistive device while sitting. Facilitators were being able to access items on shelves.	Older adults with a mobility challenges can experience increased difficulties within the built environment of the grocery store.

Yin (2013) UK	To identify challenges faced by older adults in grocery stores.	Qualitative-ethnographic and semi-structured interviews, use of video and photographs	14 interviews based on 24 grocery stores	Issues within the grocery store included using shopping baskets, aisles too cluttered if store is small, aisles too long if store is large, products on floor blocking way, poor signage, shelving – items placed too high or too low, product size too large, labels too small to read, signage- mounted too high for impaired vision and posture. Positive factors included opportunity for socialization and shopping baskets can be used for balance and support.	Older adults face key difficulties within the built environment of the grocery store that can impact their independence in grocery shopping.
Yin (2016) China	To identify challenges older adults face in a grocery store environment in China	Qualitative-ethnographic and video based direct observations and in-depth interviews	12 participants, 9 women and 3 men over the age of 60	Design issues within the grocery store environment included using shopping carts and baskets, store layouts, aisles, shelving, and check outs	Older Chinese adults face key difficulties related to the interior design of grocery stores that can impact their independence in grocery shopping

An adapted PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) was chosen to convey the article selection process in this review (Moher et al., 2009). It combines the research process for both the location and interior built environment of grocery stores as shown in Figure 2. It illustrates the flow of information through the different phases of article selection, the number of articles identified, included and excluded. It is used in conjunction with the following appraisal of the quality of reporting of study designs known as STROBE to improve the rigour of the literature review process.

Location   Interior built environment

| Articles identified through database searching (n=82) | | Articles identified through database searching (n=231) |

| Total records identified after 27 duplicates removed (n=55) | | Total records identified after duplicates removed (n=141) |

| Articles screened (n=55) | Articles excluded (n=46) | Articles screened (n=141) | Articles excluded (n=125) |

| 9 studies were found + 2 additional studies were identified by searching the reference lists of these studies Studies included in the analysis (n=11) | | 16 studies were found + 1 additional study was identified by searching the reference lists of these studies Studies included in the analysis (n=17) |

Figure 2.   Adapted PRISMA flow diagram of article screening and selection.

2.3 Appraisal of quality of reporting of study designs

This literature review and synthesis used the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist to evaluate the quality and utility of the research articles (von Elm, Altman, Egger, Pocok, Gotzsche, & Vandenbroucke, 2007) used to consider the location and the interior built environment of grocery stores. The checklist was designed to portray key design features that should be included in an accurate and complete report of observational studies (Von Elm et al., 2007), and it was chosen for its usefulness in "critically appraising published articles" (von Elm et al., 2007, p. 250). Even though the STROBE checklist is designed for evaluating observational studies in epidemiology, it also functions as a useful lens to appraise the studies included in this review. Its purpose was not elimination of unsuitable articles, but rather to increase the rigour of this literature review and synthesis. As Appendix A and Appendix B show, the studies selected for this literature review and synthesis generally satisfied the STROBE checklist of items that should be included in reports of observational studies.

This chapter has outlined the methods used in finding and selecting research articles that examine the association between the location and the interior built environment of grocery stores and older adults living in the community who independently grocery shop. The following chapter will provide the key findings and discuss these in relation to older adults' ability to grocery shop.

3. Location of grocery Stores: Results and discussion

This chapter analyzes the results of the articles that focus on the location of grocery stores. It discusses how these results contribute to our understanding of how the location of grocery stores influence older adults' ability to independently access them. Next, it considers the implications for older adults when grocery stores are located in areas of low SES, low-density areas; specifically, when older adults do not drive. Finally, this section looks at some initiatives that have been designed to address older adults' access to nutritious food when grocery stores are not within a reasonably accessible distance from where they live in urban areas.

3.1 Key findings

This literature review and synthesis explored the association between older adults and the locations of grocery stores in urban settings. The identified studies found that some older adults have challenges in accessing grocery stores as a result of the distance between their residences and the grocery stores, and the travel time to grocery stores (Apparicio et al., 2007). All eleven studies in this review and synthesis used a Geographic Information System (GIS) to determine distance to food stores---except for Cummins and Macintyre (1999) who used the number of stores per post code as a measure of accessibility, and Huang et al., (2012) considered store access based on participant worn GPS to track participants' movements.

With regards to the association between older adults and access to stores that sell healthy food and those that sell fast food, Mercille, Richards, Gauvin, Shatenstein, Daniel et al. (2011) found that older adults living in Montreal, Canada tended to have better diets if they lived closer to grocery stores than if they lived closer to fast food restaurants. Interestingly, even when there were healthy food options available, the availability of fast food outlets contributed to a less healthy diet (Mercille et al., 2011). A study in Japan, that included 12,595 older adults, found that closer access to grocery stores was associated with increased body mass index (BMI) in older adults. In this same study, closer access to fast foods was related to higher BMI only in older adults who lived alone (Hanibuchi, Kondo, Nakaya, Nakade, Ojima et al. (2011).

Even as access to adequate nutrition is important in the maintenance of health and independence, some research has found that variations in urban area SES impacts accessibility to healthy food. Seven out of the eleven identified articles focused on urban area SES. For instance, Lu and Qui (2015) found that areas of low SES in Calgary, Canada, had fewer grocery stores. These areas remained food deserts, even with the addition of farmers' markets that offer fresh produce and have the potential to encourage lower prices through marketplace competition (Lu & Qiu, 2015). These results are similar to Yamashita and Kunkel (2012), who found that older adults living in areas of low SES in the US had poorer access to healthy food outlets and better access to unhealthy fast food outlets. Similarly, Burns and Inglis (2007) found in Australia that areas with higher SES had closer access to grocery stores, and areas of lower SES had closer access to fast food outlets. In Canada, Larsen and Gilliland (2008) also found that older adults living in urban areas of low SES had better access to fast food outlets.

Not all older adults living in low SES urban areas had to travel far to get to grocery stores, however. For example, small independent discount grocers were more numerous in low SES areas in Scotland which improved access to grocery stores (Cummins & Macintyre, 1999). More recent research from Edmonton, Canada also found that poorer urban areas generally had accessible grocery stores within walking distance (on average 1.4km) (Smoyer-Tomic et al., 2006). This same study also noted that there were six 'high need' urban areas that had poor access to grocery stores. Characteristics of these areas were lower income, lower car ownership rates, and slightly higher rates of older adults compared to the rest of the city.

Two articles that considered density of urban areas demonstrated that the density of urban areas influenced the location of grocery stores. For instance, less densely populated urban areas were found to have fewer grocery stores (Apparicio et al., 2007; Yamashita & Kunkel, 2012). These areas were highly motorized areas where residents relied on cars to access grocery stores. Similarly, Yamashita and Kunkel (2012), found that less densely populated urban areas that had high populations of older adults had fewer grocery stores, significantly impacting older adults' access to healthy food at fair prices. At the same time, denser areas that were less motorized had more grocery stores (Apparicio et al., 2007).

3.2 Discussion

3.2.1 Understanding the location of grocery stores

In light of these results, it is important to understand both the macro and micro level factors that influence where grocery stores are located. For instance, the restructuring of the grocery store industry, where 'super' stores have replaced smaller, independent grocery stores, has caused an overall reduction in the number of locations (Zafirou, 2005, as cited in Peters & McCreary, 2008). Added to this, is the perceived or actual lower purchasing power of residents in low income and less densely populated areas, which further discourages the growth of grocery stores in those neighbourhoods (Black, Carpiano, Fleming, & Lauster, 2011; Zenk et al., 2005). Furthermore, zoning regulations in less densely populated areas tend to favour residential land use over commercial land use (which includes grocery stores), and this influences the locational aspects of grocery stores (Black et al., 2011; Sewell, 1994). At the same time, exclusionary zoning policies may play a key role in influencing the location of grocery stores through SES (Black et al., 2011). Finally, other factors such as crime rates, agglomeration, and major highway access also have an influence on the location of grocery stores (Diao, 2015). One needs to study all these aspects to understand the phenomenon of food deserts as they relate older adults and grocery store locations.

3.2.2 Implications for older adults

One purpose of this literature review and synthesis was to identify factors that influence accessibility of grocery stores for older adults in relation to location. It considered accessibility based on the distance to grocery stores and fast food outlets in terms of SES and population density of urban areas. There are other elements such as affordability, quantity, quality, or the cultural appropriateness of food sold in different stores that also factor into food accessibility, however, these factors were not the focus of this review. This review was interested in the person-environment perspective as it relates to the physical location of grocery stores and older adults independently accessing food.

Research has shown that older adults have improved diets when they have better access to grocery stores that carry a variety of healthy foods at fair prices (Mercille

33

et al., 2012). This is in line with research on the food consumption and behaviour of the general population, which shows that people will have a healthier diet and consume more fruits and vegetables if healthy foods are accessible (Glanz, Sallis, Saelens, & Frank, 2007; Hersey, Anliker, Miller, Mullis, Daugherty, Das, Bray, Dennee, Sigman & Thomas, 2001; Moore, Diez Roux, Nettleton, & Jacobs, 2008; Morland, Wing, Diez Roux, 2002). Interestingly, the one study from Japan indicated that Japanese older adults who lived close to grocery stores actually had higher BMI. An explanation for this may be that there is a greater availability of confectionery and bread in Japanese grocery stores, since the availability of breads and confectionery in Japanese stores was also associated with greater intake of these foods (Muraki, Sasaki, Takahashi, & Uenishi, 2009).

Surprisingly, Mercille et al., (2012), found that when older adults had approximately equal access to both accessible healthy food outlets and fast food outlets, their diets were less healthy. This behaviour is similar to the eating behaviours of high school students in cafeterias, where when given the choice, they will select fast food over healthy foods (Briefel, Crepinsek, Cabili, Wilson & Gleason, 2009). More research needs to be done into this area to determine other underlying factors that could include limited energy or the presence of functional limitations that may influence older adults' decisions to got to fast food outlets when both are within a reasonable distance from their residences.

The research found that there was a trend toward fewer grocery stores in lower SES areas and less densely populated areas. The impact of farmers' markets as a factor for increasing the accessibility of healthy food for older adults in these areas was tested in Calgary, Canada (Lu & Qiu, 2015). However, these areas were still considered food deserts with respect to older adults being able to access healthy food at affordable prices. A possible explanation for this may be a convenience issue; when older adults become easily fatigued, they prefer to shop at familiar grocery stores that also carry a variety of everyday non-food items such as light bulbs, toilet paper, and tissues (Koijoki, 2011).

Fewer grocery stores in lower SES and less densely populated urban areas can impact older adults who are living on a limited income. In Canada, low income is not uncommon among older adults. Here, older women who live alone are particularly at risk

of living on a very limited budget and falling in the lower income category (Statistics Canada, 2013). Therefore, it is not improbable that some older adults may live in urban areas where access to grocery stores is limited due to the SES of the area.

The absence of grocery stores in some urban areas of low SES and less populated urban areas indicates that older adults will shop at small local convenience stores or fast food outlets, that often sell a limited variety of less nutritious foods at higher prices (Wrigley, 2002). This can impact older adults nutritionally, resulting in poorer health since a nutritious diet is related to reduced risk of heart disease, high blood pressure, and diabetes (Bernstein & Munoz, 2012). Higher food prices may also influence the amount of food older adults consume. Research has shown that when income is limited, older adults will sacrifice the quality and quantity of food in order to pay for other needs such as housing (Green-LaPierre, Williams, Glanville, Norris, Hunter, & Watt, 2012). Furthermore, the lack of accessible grocery stores influences their dietary choices. Their selection may be limited to less healthy food in the absence of healthier choices including fresh fruit and vegetables, resulting in poorer nutritional health (Burns & Inglis, 2007; Chung & Meyers, 1999). The accessibility of grocery stores plays a crucial role in the maintenance of health of older adults.

The situation of older adults living in areas where there are fewer grocery stores emphasizes how the lack of transportation can become a barrier to accessing healthy food at affordable prices. At present, the majority of adults in the young category of 65 years to 75 years can drive (Statistics Canada, 2015). However, this number decreases among people over the age of 75, especially among women who may never have driven a car (Statistics Canada, 2015). Older adults of that generation often prefer to either drive themselves or to be a passenger in a car rather than take public transit (Statistics Canada, 2012). This is due in part to particular barriers that public transit presents to older adults, such as limited transit service in residential areas where a large proportion of older adults live, the cost of transit passes (Statistics Canada, 2012), or difficulty transporting their groceries especially if they have health problems (Kohijoki, 2012).

Furthermore, older adults prefer to get to grocery stores independently (Kohijoki, 2012). When grocery stores are located too far to walk, drive, or take public transit, older adults may have to rely on formal or informal supports to grocery shop, however, this conflicts with their desire to remain independent (Turrini et al., 2010). Even though older

adults may enjoy the company, relying on others for transportation may make them dependent on the schedule of others, affecting their freedom to choose when they prefer to grocery shop. These factors contribute to their preference to shop at grocery stores within walking distance so they have the freedom to go on their own and not burden others or be subject to the schedules of others (Kohijoki, 2011; Mason and Beardon, 1979).

All these issues need to be considered as factors that influence independent grocery shopping in older adults and highlight the multiplicity of factors involved in grocery store location. Isolating SES and urban density will not provide a true picture of why food deserts exist in certain neighbourhoods. For example, researchers need to explore the implications of low SES in older adults, along with transit and transportation issues and the introduction of other food sources such as farmers' markets, to understand the food desert phenomenon for older adults in urban neighbourhoods.

3.2.3 Local initiatives to address options to influence food security

The findings from this review are not unique to one particular urban area in one particular country. In some areas, initiatives are arising from the non-profit and governmental levels to address the issue of having access to a variety of nutritious foods at affordable prices. Locally, the city of Vancouver is in the process of working towards creating a just and sustainable food system that makes food available for all (vancouver.ca/foodpolicy). This system recognizes the vulnerability of older adults within the current food system, and they are associated with household food insecurity. One strategy to improve food security for older adults is to invite them to participate in community food policy activities and other food based organizations. Older adults, thus, have the opportunity to participate in how the food system in Vancouver takes shape by becoming active participants in strategies that advocate for an equitable food system (vancouver.ca/foodpolicy). In the future, the success of this initiative may serve as a model to be followed by other urban areas facing similar locational challenges for grocery stores.

Additionally, there has been an effort to increase the number of outlets that offer healthy foods at fair prices through the introduction of farmers' markets (BCfarmers'market.org). To make them more affordable, some farmers' markets offer a

coupon program to offset the price of produce. These initiatives have the potential to improve accessibility to healthy and affordable foods for older adults who wish to remain living independently in the community.

This section has discussed how the location of grocery stores influences older adults' ability to independently grocery shop. It has shown that factors such as SES in urban areas and population density, influence where grocery stores are located in terms of walking distance from home for older adults who do not drive cars and do not have transit as options. Some local initiatives have been presented as examples of ways to increase food security when grocery stores are not located within walking distance for older adults. The following chapter discusses the design of the interior built environment of grocery stores and how it influences older adults to independently grocery shop.

4. Design of the interior built environment of grocery stores: Results and discussion

Following the format of chapter three, this chapter identifies the results and discuss them as they relate to older adults' ability to independently shop within the built environment of grocery stores. It considers how implementing universal design guidelines in the design of the interior built environment of grocery stores can influence older adults' ability to shop independently. Finally, it discusses ways in which the design of grocery stores can be influenced by stakeholders and by older adults themselves, and looks at examples of design strategies and the use of technology in retail.

4.1 Key findings related to the interior built environment of grocery stores

The findings of these studies demonstrated that older adults had particular challenges that impeded their ability to independently grocery shop. Shelving design, signage, way finding, layout and organization, width/length and number of aisles, lighting and noise, checkout lines, and available resting places all played a role as either facilitators or barriers to independent grocery shopping. Multiple factors often exist within one grocery store environment and compound the issue of ability to shop independently. Figure 3 shows the frequencies the various barriers in the interior built environment of grocery stores and the frequency they appeared in the studies. The data for this histogram was compiled by tabulating the number of times older adults reported each type of barrier in the research articles.
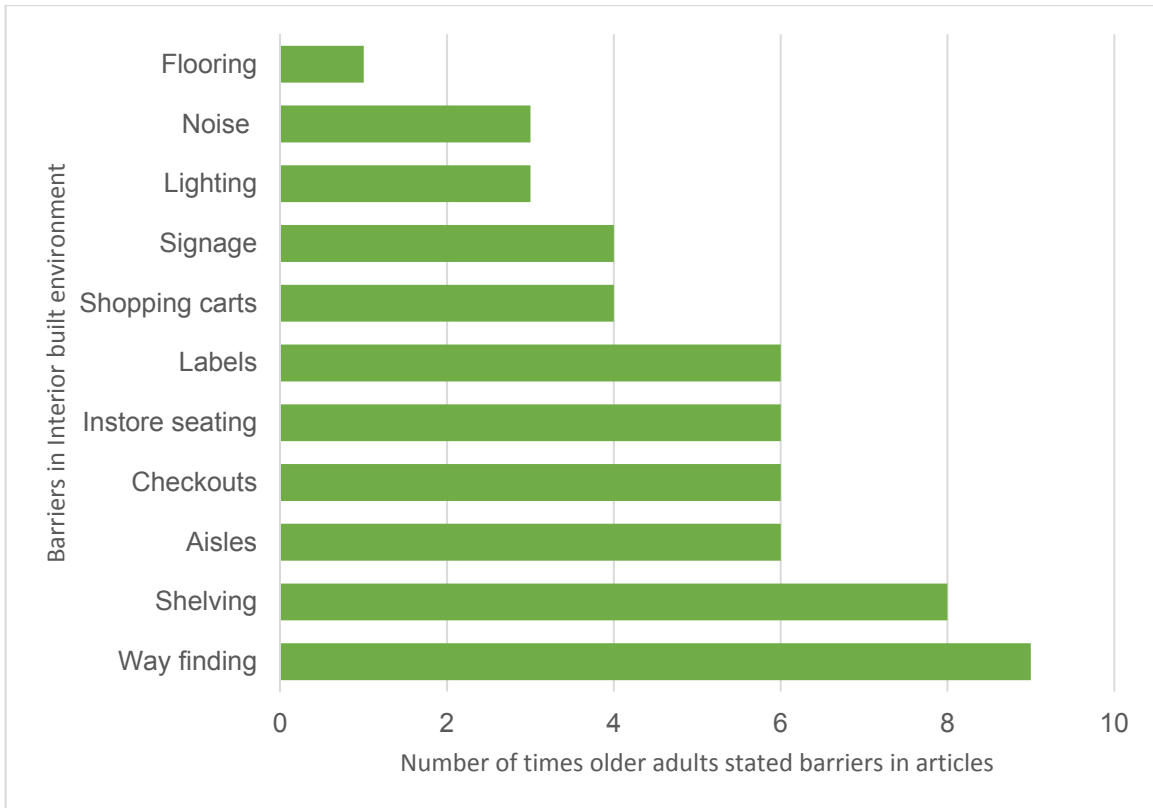
Figure 3:   Number of times older adults stated barriers in articles

In terms of shelving, older adults had difficulty reaching items on shelves due to items being placed too high or too low (Angell, Megicks, Memery, Hefferman & Howell, et al., 2012; Hare, Kirk & Lang,1999; Kohijoki, 2011; Meneely et al., 2009; Petermans and Van Cleempoel 2010; Pettigrew et al., 2005; Yin, Pei, & Ranchhod, 2013; Yin, Qiu, & Ranchhod, 2016). While having assistance in accessing products on the shelves was perceived by older adults to enhance their shopping experience (Omar, Tjandra, & Ensor, 2014), some older adults felt as if they were a burden to others if they needed to ask for assistance in obtaining products from shelves (Meneely et al., 2009). Older adults viewed being able to access products from shelves as a factor that promoted independent grocery shopping (Huang et al., 2012).

The presence, size, placement, and location of signage (Angell et al., 2012; Huang et al., 2012; Pettigrew et al., 2005; Yin et al., 2013), and label size on products and shelving (Hare et al., 1999; Hare, Kirk, &Lang, 2001; Omar et al., 2014; Petermans & Van Cleempoel, 2010; Pettigrew et al., 2005; Yin et al., 2013) were also found to influence older adults' ability to independently grocery shop. For instance, the adequate presence of signage within the grocery store to help with product location (Moschis et al.,

2004; Pettigrew et al., 2005; Yin et al., 2013) influenced whether older adults shopped at a particular store (Angell et al., 2012). Signage that was mounted too high was difficult for older adults to read due to existing vision impairment and posture limitations (Yin et al., 2013).

The size of labels and font on product labels and shelving influenced older adults' ability to decipher product contents and pricing (Hare et al., 1999; Hare, Kirk, & Lang, 2001; Meneely et al., 2009; Petermans & Van Cleempoel, 2010; Pettigrew et al., 2005; Yin et al., 2013). The majority of older adults (60.4%) found the labels and the font size on the labels too small to permit them to be easily read without assistance (Omar et al., 2014). Older adults felt that having assistance with reading product labels in the grocery store was a necessity (Omar et al., 2014).

The extent to which older adults could navigate in the grocery store (way finding) and locate products emerged as important determinants of their grocery shopping experience (Angell et al., 2012; Hare, 2003; Kohijoki, 2011; Meneely et al., 2008; Meneely et al., 2009; Moschis et al., 2004; Sidenvall et al., 2001; Yin et al., 2013, Yin et al., 2016). For example, older adults prefer to shop in grocery stores where they know their way around and can find the products they are looking for (Sidenvall et al., 2001); in contrast, they avoid stores they consider confusing, and where they experience difficulty in locating products (Angel et al., 2012). In addition, cluttered product displays in the aisles impacted wayfinding ability, especially in smaller sized grocery stores (Yin et al., 2013). Also cited as relevant issues was the need to retrace steps or walk long distances unnecessarily as a result of store lay out or products having been moved to a different area of the store (Angell et al., 2012; Hare et al., 2001). This was particularly the case for shoppers 75 years and older, owing to increased health issues (Kohijoki, 2011). Conversely, older adults found a familiar grocery store environment to be labour saving (Sidenvall et al., 2001).

Features related to aisles including aisle width (Angell et al., 2012; Bromley & Matthews, 2007; Hare et al., 1999; Huang et al., 2012; Sidenvall et al., 2001, aisle length (Huang et al., 2012), number of aisles (Huang et al., 2012), and crowding (Bromley & Matthews, 2007; Huang et al., 2012), influenced older adults' grocery shopping experience. Wide aisles were perceived as a facilitator of independent grocery shopping (Huang et al., 2012) because they accommodate maneuvering with shopping carts,

walkers, wheelchairs, and being able to avoid other shoppers with their shopping carts (Angell et al., 2012; Bromley & Matthews, 2007; Huang et al., 2012). Additionally, having enough room in the aisle to easily move required less energy (Sidenvall et al., 2001). Long aisles and a large number of aisles contributed to fatigue in older adult grocery shoppers (Huang et al., 2012) and, thus, a split length aisle was preferred (Petermans & Van Cleempoel, 2010). Aisles crowded with displays restricted movement and had the potential to make the aisles inaccessible to older adults when using a shopping cart, walker, or wheelchair (Bromley & Matthews, 2007).

Appropriate lighting within grocery stores was a concern for older adults who had vision impairments with poor lighting being seen as a barrier to independent grocery shopping (Angell et al., 2012; Huang et al., 2012; Petermans & Van Cleempoel, 2010). The prevention of loud noise from background music and paging systems was important (Angell et al., 2012), as noisy backgrounds were viewed as disruptive to the grocery shopping experience (Kohijoki, 2011). Having non-skid flooring was perceived as a safety factor in the prevention of falls while grocery shopping (Huang et al., 2012; Petermans & Van Cleempoel, 2010).

Long lineups at check-out counters also contributed to the overall grocery shopping experience of older adults (Angell et al., 2012; Goodwin & McElwee, 1999; Kohijoki, 2011; Moschis et al., 2004; Omar et al., 2014, Yin et al., 2016). That is to say, older adults preferred fast checkouts to limit the time they spent standing (Angell et al., 2012; Moschis et al., 2004). Some older adults felt there was an inadequate number of checkouts (Kohijoki, 2011), and that a dedicated 'seniors' checkout would be a benefit (Goodwin & McElwee, 1999).

The maintenance (Pettigrew et al., 2005; Yin et al., 2016), and size (Hare et al., 1999; Yin et al., 2016) of shopping carts also influenced older adults' shopping experience. For instance, 62% of older adults considered well-maintained shopping carts to be very important, with women rating this feature to be more important than men did (Pettigrew et al., 2005). Further, the research of Hare et al (1999) found that smaller shopping carts and baskets, and not having to pay for their use, influenced the grocery shopping experience of older adults. Additionally, shopping carts were viewed as a device for providing balance, support, and mobility (Huang et al., 2012; Yin et al., 2013).

The availability of in store seating was also viewed as influencing the grocery shopping experience of older adults. Grocery stores with available in-store seating were perceived to support independent grocery shopping whereas a lack of seating to rest on was seen as a barrier (Hare et al., 1999; Hare et al., 2001; Huang et al., 2012; Meneely et al., 2008; Meneely et al., 2009). The placement of seating near the check-out stations was important for older adults because it allowed them to rest while waiting in the line to purchase their groceries (Kohijoki, 2011).

Interesting non-built environment findings extracted from this literature review and synthesis pertain to older adults' perceptions of independent grocery shopping as it relates to social engagement, physical activity, mental stimulation, a sense of independence, and nutrition. While these were not the focus of this review, they were considered valuable in understanding what motivates older adults to want to independently grocery shop even when they face challenges in grocery shopping. Figure 4 shows a histogram depicting older adults' perceptions of the benefits of independent grocery shopping. In order to compile the data for this histogram, the number of times older adults stated social engagement, physical activity, nutrition, sense of independence, and mental stimulation as benefits of independent grocery shopping grocery was tabulated, and shown as a percentage of the total number of articles reviewed.
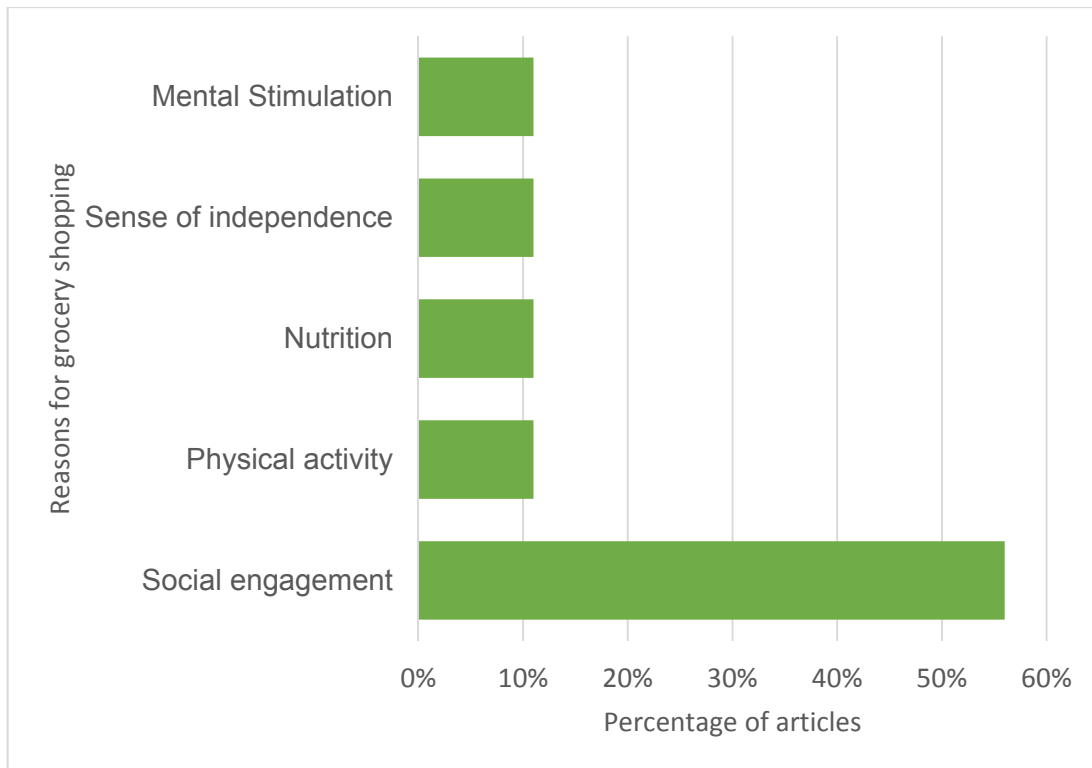
Figure 4: **Older adults' perceptions of the benefits of independent grocery shopping**

Several studies showed that older adults found grocery shopping to be an opportunity for socialization (Angell et al., 2012; Hare, 2003; Hare et al., 1999; Moschis et al., 2004; Kohijoki, 2011; Meneely et al., 2009; Moschis et al., 2004; Sidenvall et al., 2001; Yin et al., 2013). As such, grocery stores that offered seating areas or café settings, promoted opportunities for older adults to socialize (Moschis et al., 2004), as they consider grocery stores to be a place to meet friends (Angell et al., 2012). Moreover, the task of grocery shopping was considered necessary in supporting physical activity (Kohijoki, 2011; Sidenvall et al., 2001) and mental stimulation (Kohijoki, 2011) in addition to providing a sense of independence--- especially among women---as it is viewed as a continuation of their domestic lives (Sidenvall et al., 2001).

4.2 Discussion

The results of this literature review and synthesis indicate design features of the interior built environment of grocery stores that are considered barriers and facilitators for older adults who wish to grocery shop independently. The barriers noted by older adults in this review are in line with previous research by Mason and Beardon in 1979.

They studied older US adults and found that signage and product labelling were too small, resulting in the risk of incorrect interpretation of product related information. Similarly, previous research in the UK stated that older adults found it either difficult or very difficult to reach the highest and lowest shelves and to read price displays in grocery stores (Leighton and Seaman, 1997). As it can be seen from this review of the literature, difficulties in relation to independent grocery shopping due to the design of the interior built environment continue to persist for older adults. However, it is important to address issues relating to the usability of the interior built environment. Older adults are a rapidly growing population who wish to remain independent and active within their homes and communities. Being able to independently shop for their own groceries is an activity that can be enhanced by a supportive environment.

Therefore, as an environment utilized by older adults, grocery stores need to accommodate the changing needs of older adults to support their ongoing independence. The competence –press model, which explains the balance between person and environment, supports this position. As adults age, they experience decreases in sensory and physical abilities such as vision, hearing and mobility (Farange, et al., 2012; Ferrini & Ferrini, 2008; Hughes et al., 2001). The results of this research suggest that the areas of the interior built environment that appear to be of greatest concern for older adults are related to aging factors such as decreased vision, mobility and stamina. In the presence of aging factors, the environment can compensate for reduced or lost competencies and can enhance the grocery shopping experience (Wahl and Weisman, 2003).

A supportive environment also has benefits beyond maintaining independence in grocery shopping as a factor that can support independent living. Older adults are also a significant market demographic for the grocery store industry. As the population of older adults continues to grow, with the aging of the large cohort of baby boomers, they will continue to need to access food. Therefore, it is in the interest of the grocery store industry to consider how the design of the built environment of grocery stores influences older adults' grocery shopping behaviour in relation to how they are able to use the store environment to meet their grocery shopping requirements. One key element in addressing this is redesigning the interior built environment of grocery stores to reduce barriers and be and usable by all populations.

4.2.1 Universal design guidelines to promote independence in grocery shopping

As discussed in an earlier chapter, universal design guidelines are helpful for addressing some of the interior design issues highlighted in the review. Universal design principles can be used as a guide and their implementation can reduce the difficulty and effort required by people with reduced sensory and physical capacities in completing standard tasks (Danford, 2003). For example, the interior built environment of grocery stores can compensate for decreased strength and mobility and improve orientation by implementing design features that assist in wayfinding. Wayfinding was highlighted as the most frequently cited barrier for older adults in the literature review and synthesis, suggesting that walking long distances in order to locate items in grocery stores pose a significant problem for older adults who may have mobility challenges and reduced stamina. Design features such lighting sources and adequate signage can act as cues and serve as methods of improving wayfinding (Steinfeld & Maisel, 2012). Additionally, the arrangement of aisles further contributes to way finding: aisles that are arranged in a regular, parallel pattern increase speed and efficiency in grocery shopping by using straight lines that do not slow down movement and allow for clear sight lines (Juel-Jacobsen, 2015;). Adequate width and minimized aisle length also contribute to energy conservation and improved visual pathways by permitting a smoother flow of traffic that enables the ease of passage of shopping carts, and deters the feeling of exhausting and endless aisles (Juel-Jacobsen, 2015).

In creating an interior built environment that reflects human diversity, consideration for the size and maintenance of shopping carts is important to all shoppers. In this review, this was of particular concern for older women. Understandably, due to their stature and strength, they found using large and poorly maintained shopping carts to be exhausting. Similarly, designing store environments that included in-store seating would benefit any shoppers who became uncomfortable standing or walking for long periods of time. In this review, older adults suggested that seating near checkouts would provide respite while waiting to pay for their groceries. Lighting, signage and labelling, and noise levels that take into consideration decreased vision, postural changes, and decreased hearing, as well as flooring that prevents glare and the risk of slipping, all work together to promote independence in grocery shopping.

45

While features of the interior built environment of grocery stores presented as barriers for older adults, they could also be viewed as facilitators. For example, this review found some good examples of design features that benefitted older adults by promoting energy conservation. Adequate signage, wide, split length aisles that could accommodate easy shopping cart maneuvering and allow for ease in avoiding other shoppers all helped to minimize required energy. Additionally, grocery stores that offered smaller shopping carts were considered energy saving (Hare et al., 1999), particularly when they could be used as balance and mobility devices. These examples illustrate that there is an understanding of the needs of older adults in relation to the design of the interior built environment of grocery stores.

Finally, this review found a number of further reasons why older adults prefer to grocery shop independently. For example, the reviewed studies concluded that grocery shopping is an activity that promotes social engagement, physical activity, good nutrition, mental stimulation, and maintaining a sense of independence. Indeed, in more than half of the articles that were reviewed (see figure 4 above), older adults stated that getting out and talking to people is an integral reason for doing their own grocery shopping. As was noted earlier, social engagement is beneficial for older adults in maintaining their health, which foregrounds the importance of grocery shopping as a health-promoting activity that influences independence.

4.2.2 Effecting change in the design of the interior built environment of grocery stores

The review and synthesis has demonstrated how the design of the interior built environment of grocery stores influences older adults' independence in grocery shopping, and it suggests that limitations persist in implementing design features that support this independence. One reason for this gap is that engineers, architects, and environmental planners are provided with limited education regarding the utilization of universal design aspects in creating environments that promote independence (Steinfeld & Maisel, 2012). A second reason is that, with respect to aging, engineers, architects and store managers may still not be aware of the barriers within the interior built environment of grocery stores, and they may not fully recognize how older adults would benefit from environmental adaptations that would improve access. Finally, older adults themselves may not realize that there are environmental alternatives that would make

grocery shopping easier for them. One approach to overcoming these challenges is to improve the information on this topic, which could be achieved by ensuring educational curricula have foci including the utilization of universal design, as well as, information on how the aging process impacts sensory and physical abilities. Furthermore, dissemination can be achieved through the forms of conferences, exhibits, publications, media, educational programs, and consumer information (Steinfeld & Maisel, 2012). Similar to how older adults can be community collaborators in addressing the presence of food deserts in urban areas, they also can influence designs for improving how they are able to use this environment by sharing their experiences with store managers in dealing with the barriers they encounter when they are grocery shopping. While, as this review and synthesis found, design issues are apparent in the interior built environment of grocery stores that influence older adults' independence, there are good examples of where universal design is used in retail and of new up and coming technology in grocery stores to assist older adults in carrying out independent shopping as is demonstrated in the following section.

4.2.3 Design and technology in retail

There is a need to consider the design of the interior built environment of retail outlets to address the diversity, not only in different age groups, but also diversity with the older adult population. The following are examples that include design and technology features in retail that seek to promote ease, comfort, and independence in shopping.

IKEA is an example of how universal design guidelines have been incorporated into the planning of retail outlets (Steinfeld & Rogers,2012). IKEA is internationally known for its affordable, attractive and useful products, and their store design is a good example of universal design in practice. The intentional design of the layout of the store to promote access to products through ease of wayfinding is noticeable. The most salient feature is the clear, wide, linear pathway through the store from its entrance to its check outs. The aisles are wide, well lighted, with posted signage, and graphics on the floor to simplify navigation throughout the store. During the shopping process smaller items can be collected and put into a variety of receptacle options including a reusable shopping bag, small cart, or larger cart to suit the needs of the user. Larger items are located in the warehouse area and their exact location is recorded on a tag attached to

the showroom goods. The simplicity of the store layout and ease of wayfinding creates a comfortable shopping experience for users that could be incorporated into grocery store environments. However, while improved wayfinding can reduce energy expenditure (Kohijoki, 2012; Sidenvall et al., 2001), the large size and scale of IKEA stores may offset this positive attribute for older adults who have reduced stamina.

Along similar lines of refining wayfinding capacity in retail outlets, the use of public computerized kiosks in shopping malls is being tested as an alternate system to finding one's route from beginning to end. These kiosks include menus that contain both text and icons to identify locations. When a location is found and chosen on the screen, a panoramic visual of the location is provided on the screen. Interestingly, tests using this technology found that it was preferred by a younger population of users who are accustomed to using touch screens and mobile phones. Satisfaction surveys from older participants reflected a preference for modes of wayfinding, such as building floor maps, they were familiar with using (Tuzin, Telli, & Alir, 2016).

Turning to new technology within grocery store environments, a recent trial was conducted with older adults using a person following shopping cart robot that is based on a combination of radio and ultrasound signals that between the cart and a tag placed on the user's leg. This technology is aimed at older populations to improve the ease of grocery shopping. Results from testing this technology have shown that it is well accepted by older adults as they see it as a technological advancement that will improve their lives, instead of something that replaces their physical abilities (Sales, Marti, Marin, Cervera, & Sanz, 2016).

Finally, technology is paving the way for reducing the necessity of person-grocery store interaction with the advent of 'Click and Collect' grocery services (Creasey, 2012; Strauss, 2016). This service allows people to pick up groceries previously ordered online, which have been selected and packed by instore employees. While this service has been found to be useful for busy families who tend to have large grocery needs, there is little research on how older adults find this service. Results of this literature review and synthesis found that today's older adults prefer to grocery shop for reasons that include social engagement, physical activity, nutrition, mental stimulation, and a sense of independence. As well, this service relies on the ability of the user to have transportation, which can be a barrier to older adults who do not drive. However, future

older adults' may have different shopping preferences that align with reduced grocery store interface.

This chapter covered the results and discussion of the interior built environment of grocery stores. The ecological theory of aging was the lens used to consider this person-environment fit issue. Ways to effect change to the design of the interior built environment of grocery stores were also discussed, along with examples of how universal design has been implemented in retail outlets and in the changing landscape of grocery shopping. The final chapter in this capstone project is the conclusion. It will consider the strengths and limitations, of the review and synthesis of the location and the interior built environment of grocery stores, as well as, offer some recommendations that will help advance the understanding of the the person-environment interaction within the grocery shopping environment. It will present a conceptual model that hypothesizes that the interaction between older adults and the locational and the interior built environment of grocery stores influences independence in grocery shopping. It will end with concluding comments regarding the

5. Conclusion

5.1 Strengths and limitations

A key strength of this literature review and synthesis is that it draws attention to a largely understudied area, utilizing gerontology theory to understand grocery shopping in relation to older adults' independence and aging in place. In the absence of a gerontology perspective, this literature review and synthesis draws on research from design and marketing disciplines. Considering these perspectives together, adds to the robustness of this work by demonstrating that other disciplines are also concerned with how older adults manage within the location and interior built environment of grocery stores.

The findings of the literature review and synthesis considered the interaction between older adults with varying competencies and the location and interior built environment of grocery stores. The results must be considered within the context of the following limitations. One limitation of this literature review and synthesis is the number of articles reviewed for both the location and the built environment of grocery stores. This can be attributed to the selection criteria, which included having articles that only pertained to older adults. This limited the overall number of articles included in the review even though some articles that were removed because of this criterion, may have been generalizable to the older population. For instance, articles considering the location of grocery stores may have contained information that was relevant to all populations (for example, Black et al., 2011). However, this limitation also illustrates the need for added research related to the accessibility of grocery stores for older adults. Indeed, the lack of attention to this area of research is surprising since the older population is increasing in size, and has the potential to exert market influence. Older adults wish to remain living in their homes and communities for as long as possible, and independent grocery shopping is an important activity that contributes to their ability to remain in their homes.

An additional limitation of this capstone paper was the lack of the definition of a grocery store across the articles. Throughout the reviewed studies, grocery stores, supermarkets, shops, and retail outlets were used to describe food outlets accessed by older adults. In this capstone paper, all these terms were included under the umbrella term of 'grocery store' to define grocery outlets that offered a variety of nutritional foods

at fair prices. However, individual studies may have had alternative definitions with regards to size, pricing, and available foods.

A gap in this topic area is the fact that no research on the interior built environment of grocery stores originated in Canada. Much of the research was conducted in Europe. Rebuilding Europe after WWII may have generated greater attention to design considerations to accommodate the post war baby boom (Steinfeld & Maisel, 2012), which may have generated a foundation for considering built environments. While this may be a possible explanation for a European focus, the lack of Canadian perspectives may affect the generalizability of this literature review and synthesis. The built environment of grocery stores in other countries may differ from those in Canada in relation to such factors as store size, aisle width, shelving heights, and store locations. These differences may be accounted for by specific building policies, or land use and zoning polices (Black et al., 2011).

5.2   Recommendations for further study

There are a number of recommendations of studies that could be conducted to assist in understanding the person-environment fit between older adults and grocery store environments. Conducting a study in Canadian urban areas using the results of this literature review and synthesis, as its basis, would have the potential to add to the body of knowledge on this topic and improve the awareness of stakeholders involved in the grocery industry. Furthermore, the strategies used by older adults to maintain their independence in response to barriers in the location and interior built environment of grocery stores merits further study helping to further understand the person-environment interaction within the grocery shopping environment.

Taking into account that grocery shopping is a gendered social role (Sidenvall et al., 2001), a study exploring how gender influences older adults' experience in grocery store environment would help understand the person-environment fit between older adults and grocery stores. Along similar lines, another area of study would be to explore the differences in Caucasian and immigrant older adults and the person-environment fit in grocery stores. This is of interest in Canada since it is a multicultural country with an aging population. As well, a study exploring the differences between the perspectives of baby boomers and adults in the 85 and older age group regarding on line shopping and
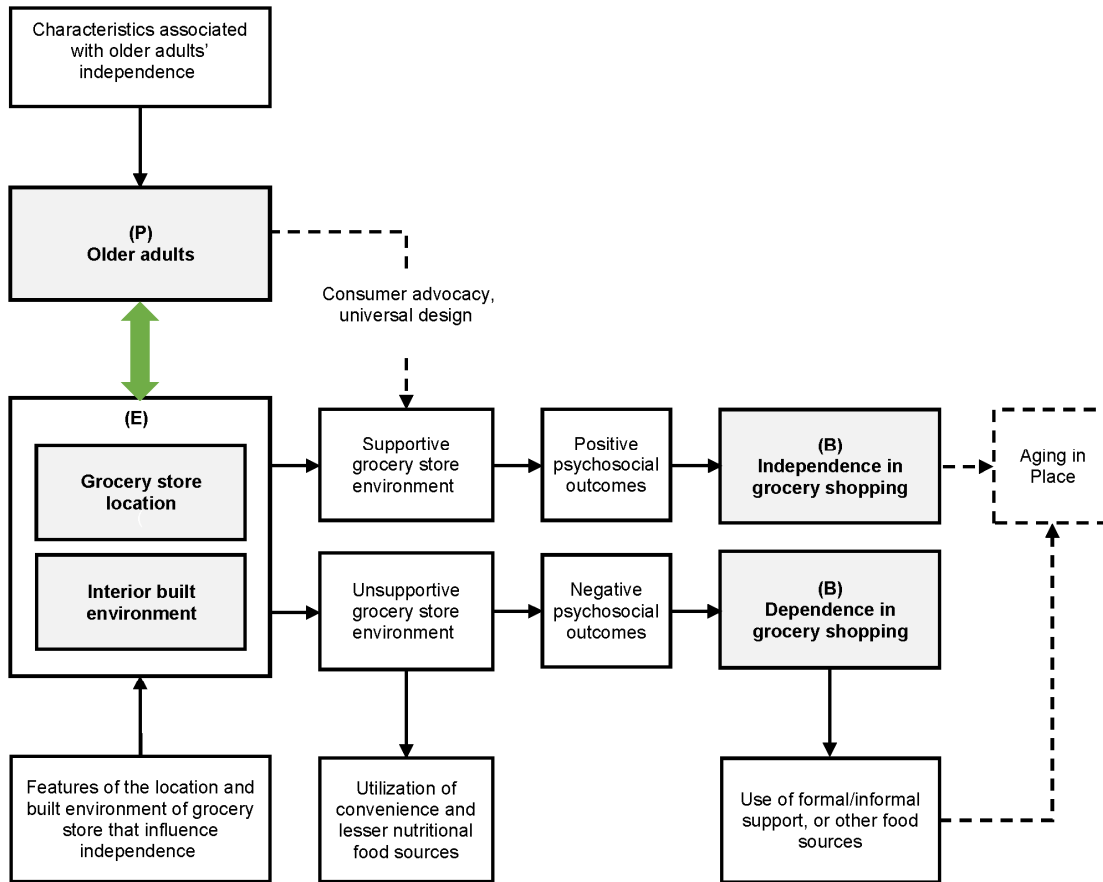
use of delivery services would be beneficial. This would help the grocery store industry know how to prepare for the aging of the large baby boomer population.

Taking into account the various sizes, types, and locations of grocery stores in urban areas, a study that considers older adults' preferences in shopping in large versus small store environments would be useful to understand the person-environment fit between older adults and grocery stores. A similar study could include older adults' perspectives on using farmers' markets as an alternative to shopping in large scale grocery stores to explore the person-environment fit. These areas of prospective studies show that the interaction between older adults and the grocery store environment is multi-faceted. In order to understand the complexity of grocery shopping for this population, more research is recommended.

Conducting this research would entail using outside observer methods and self-report data to provide a subjective perspective of older adults. However, measuring the person-environment fit in grocery stores has unique challenges. One particular challenge is the absence of scales for measuring accessibility in the interior built environment of grocery stores (Steinfeld & Smith, 2012). While some work has been done in the development of such scales by Steinfeld and Danford (1999), and more recently, a scale developed for end users in the restaurant environment has been tested (Park, Smith, & Leigl, 2011), considerably more work is needed to develop effective scales.

5.3   Conceptual model

The vast majority of older adults wish to be as independent as possible and to age in place. However, they are more likely than other populations to be influenced by their environments, which impacts their ability to be independent. The results of this review are presented in a conceptual model that is based on a person-environment fit perspective, and hypothesizes that the interaction between older adults and the location and the interior built environment of grocery stores influences independence in grocery shopping.

Characteristics associated with older adults' independence

(P)
Older adults

Consumer advocacy, universal design

(E)

Grocery store location

Interior built environment

Supportive grocery store environment

Positive psychosocial outcomes

(B)
Independence in grocery shopping

Aging in Place

Unsupportive grocery store environment

Negative psychosocial outcomes

(B)
Dependence in grocery shopping

Features of the location and built environment of grocery store that influence independence

Utilization of convenience and lesser nutritional food sources

Use of formal/informal support, or other food sources

Figure 5: **Conceptual Model depicting the association between the location and the interior built environment of grocery stores and independent grocery shopping in older adults.**

The conceptual model is informed by the ecological model of aging (Lawton & Nahemow, 1973). As the conceptual model indicates by the double headed arrow, the association between older adults and the location and interior built environment of grocery stores is a dynamic and interactive system. Both older adults' competence levels and the demands imposed by the environment of grocery stores need to be considered together since the behaviour of older adults is a function of both factors. The characteristics of older adults take into account the process of aging, such as reduced vision, hearing and physical abilities, which can manifest as reduced competencies in relation to the environment. Features associated with the location of grocery stores are urban area SES and density which influences the distance older adults need to travel to buy groceries. This review also identified features of the interior built environment of grocery stores that affected the ability of older adults to shop independently. These features include: wayfinding, shelving height, size of labels, presence of in store seating,

aisle width and length, efficiency of check outs, size and location of signage, lighting, noise levels and size and maintenance of shopping carts. The interaction between these person (P) factors and the environment (E) factors determine the shopping behaviour, (B), of older adults. Namely, whether older adults are independent or dependent is a result of this interaction.

Since declines in functional abilities of older adults are often progressive biologically, psychologically, and socially (WHO, 1999), it is better to maximize their competence in grocery shopping by adapting the environments of grocery stores to accommodate the changing abilities of older adults. Features that mitigate barriers associated with the location and built environment of grocery stores can be implemented with the adoption of universal design features during store construction. Older adults can also influence the environment of grocery stores. They can voice their concerns to store managers specifying where barriers exist for them. They also can 'vote with their feet' by patronizing stores that are accessible, resulting in reduced patronage for stores that do not accommodate their needs. This process is indicated by a dashed arrow linking older adults to the grocery supportive store environments, by way of collaboration with store managers.

As the ecological theory of aging hypothesizes, an unsupportive environment (one where the environmental demands are high in relation to the competence of older adults) will elicit decreased performance. For example, this conceptual model indicates, when barriers are present, the ability for older adults to independently grocery shop is likely to be reduced. This initiates the use of convenience and lesser nutritional food sources. This will have an impact on the health and well-being of older adults since good nutrition is linked to reduced risk of certain diseases such as heart disease, high blood pressure, and diabetes (Bernstein, Munoz, 2012). Conversely, as this conceptual model indicates, a supportive environment positively influences older adults and leads to independence in grocery shopping.

This conceptual model incorporates psychosocial outcomes as an aspect of the person-environment fit interaction. A supportive or unsupportive grocery store environment can influence older adults' psychosocial outcomes. For instance, a supportive grocery store environment is one that is barrier free for older adults and allows them to successfully complete their grocery shopping. This in turn, aids in

creating positive psychosocial outcomes such as control, autonomy, and independence (Martikainen, Bartley & Lahelma, 2002). An unsupportive environment reduces the opportunities for these outcomes. For instance, an unsupportive environment can reduce opportunities for social engagement. Grocery shopping is known to be a social activity that includes benefits of improved mental health and well-being.

The association between independent grocery shopping and aging in place is represented by a dashed line indicating that independent grocery shopping in a supportive environment has the potential to contribute to older adults' ability to age in place. This conceptual model also indicates that under specific conditions, dependence in grocery shopping can still support aging in place. This special circumstance of dependence includes support from family and friends, and the use of other food sources. Research has shown that having formal and informal grocery shopping support can enable older adults to remain in their homes (Chappell & Funk, 2011; HCIC, 2011). However, there are a number of reasons why older adults prefer not to use formal and informal support. For example, formal support is not always available, there can be a cost involved in accessing formal services, older adults are uncomfortable with strangers in their homes, and older adults may feel like a burden to family and friends (Turrini et al., 2010). Thus, it is more advantageous to maximize older adults' competence by enhancing the environment to support greater independence (Pynoos, Nishita, & Perelman, 2003). This would mean grocery store environments should be designed so that they are conducive to supporting the ongoing independence and self-reliance of older adults (Lawton, 1980).

5.4   Concluding comments

As in the rest of the world, the population in Canada is aging. It has been estimated that in twenty years' time the older adults will constitute over one quarter of the population of Canada (CIHI, 2011). The majority of older adults wish to age in place, which means being able to participate in activities within the home and community. One of the most important activities is independent grocery shopping.

Therefore, it is important to recognize needs of older adults in order to offer accessible services in a way that supports independent living. Research conducted nearly four decades ago by Mason and Bearden (1979) found that more than 30 per

cent of older adults in their study, indicated that grocery shopping was a problem due to the interior built environment. This situation still appears to be present but there has been little additional progress or research in this area. As indicated by this review of recent literature, older adults continue to be challenged by the location and design of the interior built environment of grocery stores. Recalling that older adults are a diverse group, special attention should be allocated to those older adults in the community over the age of 75 who often live alone, are women, do not have access to a car or drive, and often have multiple challenges that restrict their movement, keeping them close to home. They are the fastest growing population of older adults and have the most health challenges (HCIC, 2011). To enable this group to grocery shop in their communities, one has to pay special attention to the location and interior design of grocery stores in urban neighbourhoods that have proportionately larger groups of older adult residents.

It is predicted that older adults are soon going to be the most important group in terms of retail spending (Meyers & Lumbers, 2008). The aging of the large cohort of baby boomers, and their potential to spend based on their unique affluence (Rao, Warburton, & Bartlett, 2006), make them critically important to the grocery industry. The results of this capstone project can be used by the marketing industry to enhance service to this growing, influential population. With the collaboration of this older population, designing grocery store environments that support independence is attainable.

This review of the literature on grocery store environment is challenging the current paradigm of grocery store locations and interior design, by highlighting the significant impact these factors have on older adults. It poses possible areas to investigate further to not only gain enhanced understanding of the person-environment fit between older adults and the grocery store environment, but also to consider new understandings of factors that influence older adults' ability to remain independent in their homes and their communities.

References

Abrams, S.E. (2012). Purpose, insight, and the review of literature. *Public Health Nursing,* 29, 3, 189-190.

Alwitt, L.F., & Donley, T.D. (1997). Retail stores in poor urban neighbourhoods. The Journal of Consumer Affairs, 31, 1, 139-164.

Angell, R., Megicks, J.M., Hefferman, T., & Howell, K. (2012). Understanding the older shopper: A behavioural typology. *Journal of Retailing and Consumer Services,* 19, 2, 259-269.

Apparicio, P., Cloutier, M.S., & Shearmur, R. (2007). The case of Montreal's missing food deserts: evaluation of accessibility to food supermarkets. *International Journal of Health Geographics,* 6,4.

AARP. (2014). Home and community preferences of the 45+ population

Audirac, I. (2008). Accessing transit as universal design. *Journal of Planning Literature*, 23,1, 4–16.

Bartuska, T.J., & young, G.L. (Eds.). (1994). The built environment: Creative inquiry into design and planning. Menlo Park, CA: Crisp Publications.

Beall, M.C. & Goldstein, M.C. (1982). Work, ageing and dependency in a Sherpa population in Nepal, Social Sciences and Medicine, 16, 135-140.

Bell, S., & Menec, V. (2015). You don't want to ask for the help- The imperative of Independence: Is it related to social exclusion? *Journal of Applied Gerontology,* 34,3, NP1-NP21.

Bernstein, M., & Munoz, N. (2012). Position of the academy of nutrition and dietetics: Food and nutrition for older adults: Promoting health and wellness. Journal of the Academy of Nutrition and Dietetics, 112, 8, 1255-1277.

Black, J., Carpiano, R.M., Fleming, S., & Lauster, N. (2011). Exploring the distribution of food stores in British Columbia: Associations with neighbourhood socio-demographic factors and urban form. *Health & Place,* 17, 961-970.

Bodor, J.N., Rose, D., Farley, T.A., Swalm, C., & Scott, S.K. (2008). Neighbourhood fruit and vegetable availability and consumption: The role of small food stores in an urban environment. *Public Health Nutrition*, 11,4, 413-420.

Breheny, M., & Stephens, C. (2009). I sort of pay back in my own little way: Managing independence and social connectedness through reciprocity. *Ageing & Society,* 29, 1295–1313.

Briefel, R.R., Crepinsek, M.K., Cabili,C., Wilson, A., & Gleason, P.M. (2009). School food environments and practices affect dietary behaviours of U.S. public school children. Journal of the American Dietetic Association, 109, 2, S91-S107.

Burns, C.M., & Inglis, A.D.   (2007). Access to healthy and fast foods by car, bus and foot in an urban municipality in Melbourne. *Health and Place,* 13, 877-885.

Canadian Institute for Health Information, *Health Care in Canada, 2011: A Focus on Seniors and Aging,* Ottawa, Ont.: CIHI, 2011.

Cheang, M. (2000). Older adults' frequent visits to a fast-food restaurant: Nonobligatory social interaction and the significance of play in a "third place." *Journal of Aging Studies,* 16,3, 303-321.

Chung, W.T., Gallo, W.T., Giunta, N., Canavan, N.S., Parikh, N.S., & Fahs, M.C. (2012). Linking neighbourhood characteristics to food insecurity in older adults: The role of perceived safety, social cohesion, and walkability. Journal of Urban Health, 89,3, 407-418.

Chung, C., & Myers, S.L. (1999). Do the poor pay more for food? An analysis of grocery store availability and food price disparities. The Journal of Consumer Affairs, 33,2, 276- 296.

Clarkson, J., & Coleman, R. (2010). Inclusive design. *Journal of Engineering Design,* 21, 2-3, 127-129.

Clarkson, J., & Coleman, R. (2015). History of inclusive design in the UK. *Applied Ergonomics*, 46B, 235-247.

Conference Board of Canada. (2016). Elderly Poverty. Retrieved from Conference Board of Canada website at http://www.conferenceboard.ca.

Cotterill, R.W., & Franklin, A.W. (1995). The urban grocery store gap: Food marketing policy issue paper (No. 8). Retrieved from http://www.fmpc.uconn.edu/publications/ip/ip8.pdf.

Creasey, S. (2012). Welcome to the click & collect revolution: supermarkets have been ramping up click & collect and some are now looking at grocery as well as non-food ... heralding the dawn of the grocery drive thru. Grocer, 235, 8062, 36.

Crews, D. E. & Zavotka, S. (2006). Aging, disability, and frailty: Implications for universal design. *Journal of Physiological Anthropology*, 25, 1, 113–118, 2006.

Cummins, S., & Macintyre, S. (1999). The location of food stores in urban areas: A case study in Glasgow. *British Food Journal*, 101, 7, 545-553.

Cummins S, & Macintyre S. (2002). "Food deserts" — evidence and assumption in health policy making. *British Medical Journal,* 325,7361, 436–438.

Danford, G.S. (2003). Universal design people with vision, hearing, and mobility impairments evaluate a model building. *Generations,* 27,1,91-94.

Danford, G. S., & Steinfeld, E. (1999). Measuring the influences of physical environments on the behaviors of people with impairments. In E. Steinfeld & G. S. Danford (Eds.), *Enabling environments: Measuring the impact of environment on disability and rehabilitation* (pp. 111-137). New York: Kluwer Academic/Plenum Publishers

Davidson, K. (2004). "Why can't a man be more like a woman?": Marital status and social networking of older men. *The Journal of Men's Studies, 13*,1, 25-43.

Davies, R. L. and Champion, A. G. (1980) Social Inequality in Shopping Opportunities: How The Private Sector Can Respond (Cheshunt: Tesco Stores Ltd).

Deardorff, C.J., & Birdsong, C. (2003). Universal design: Clarifying a common vocabulary. *Housing and Society*, 30.2,119-138.

Demirkan, H. (2007). Housing for the aging population. *European Review of Aging and Physical Activity*, 4, 1, 33–38.

Devine, C.M. (2003). A life course perspective: Understanding food choices in time, social location and history. *Journal of Nutrition Education and Behaviour*, 37,3, 121-128.

Diao, M. (2015). Are inner-city neighborhoods underserved? An empirical analysis of food markets in a U.S. metropolitan area. Journal f Planning Education and Research, 35,1, 19-34.

Dickerson, A.E., Reistetter, T., & Gaudy, J.R. (2013). The perception of meaningfulness and performance of instrumental activities of daily living from the perspective of the medically at risk older adults and their caregivers. *Journal of Applied Gerontology*, 32,6,749-764.

Donovan, R.J., Rossiter, J.R., Marcoolyn, G. & Nesdale, A. (1994). Store atmosphere and purchasing behavior. *Journal of Retailing*, 70,3, 283–94.

Drewnowski, A., & Evans, W.J. (2001). Nutrition, physical activity, and quality of life in older adults: Summary. *Journals of Gerontology, Series A,* 56A, 89–94.

Dunkley, B., Helling, A., & Sawicke, D.S. (2004). Accessibility versus scale: Examining the trade-offs in grocery stores. *Journal of Planning Education and Research*, 23, p. 387-401.

Feldman, P., Hollander, H. & Oberlink, M.R. (2003). The advantage initiative: Developing community indicators to promote the health and well-being of older people. *Family & Community Health,* 26,4, 268-274.

Ferrini, A.F. & Ferrini, R.L. (2008). *Health in the later years* (4th ed.). New York: McGraw-Hill.

Figueroa, H. (2014). Grocery Store Design. In P. B. Thompson, & D.M. Kaplan (Eds.), Encyclopedia *of Food and Agricultural Ethics* (pp. 1141–1147). Dordrecht, Netherlands: Springer Science and Business Media. 1141-1141.

Fuller-Thomson, E., Yu, B., Nuru-Jeter, A., Guralnik, J. M., & Minkler, M. (2009). Basic ADL disability and functional limitations rates among older Americans from 2000–2005: The end of decline? *Journal of Gerontology: Biological Sciences and Medical Sciences*, *64*, 1333–1336.

Glass, T. A., Mendes De Leon, C. F., Bassuk, S. S., & Berkman, L. F. (2006). Social engagement and depressive symptoms in late life: Longitudinal findings. *Journal of Aging and Health*, 18, 604–628.

Glass, T. A., Mendes De Leon, C. F., Marottoli, R.A. & Berkman, L. F. (1999). Population based study of social and productive activities as predictors of survival among elderly Americans. *British Medical Journal,* 319, 478-483.

Glanz, K., Sallis, J.F., Saelens, B.E., Frank, L.D. (2007). Nutrition environment measures survey in stores (NEMS-S): Development and evaluation. *American Journal of Preventive Medicine,* 32,4, 273-281.

Gottlieb, R., & Joshi, A. (2010). *Food Justice.* Retrieved from http://sfu.serialsolutions.com

Gray Donald, K. (1995). The frail elderly: Meeting the nutritional challenges. *Journal of American Dieticians Association,* 95,5, 538-540.

Greene-LaPierre, R.J., Williams, P.L., Glanville, N.T., Norros, D., Hunter, H.C.M & Watt, C.G. (2012). Learning from "Knocks in Life": Food Insecurity among Low-Income Lone Senior Women. *Journal of Aging Research,* 2012, 1-11, doi: 10.1155/2012/450630.

Guralnik, J.M., Fried, L.P., & Salive, M.E. (1996). Disability as a public health outcome in the aging population. *Annual Review of Public Health*, 17, 25–46.

Hare, C. (2003). The food-shopping experience: a satisfaction survey of older Scottish consumers. *International Journal of Retail & Distribution Management,* 31,5, 244-255.

Health Canada & the Division of Aging and Seniors. (2006). *Healthy aging in Canada: A new vision, a vital investment, from evidence to action - a background paper*. Retrieved October 29, 2015, from http://www.phac-aspc.gc.ca/seniors-aines/pubs/haging_newvision/pdf/vision-rpt_e.pdf.

Health Care in Canada (2011). *A focus on Seniors and Aging.* Retrieved from
www.cihi.ca.

Health Council of Canada. (2012). Seniors in need, caregivers in distress: What are the
home care priorities for seniors in Canada? Retrieved 24 August 2015 from
http://www.healthcouncilcanada.ca/homecare/.

Hersey, J., Anliker, J., Miller, C., Mullis, R. M., Daughery, s., Das, S., Bray, C.R.,
Dennee, P., Sigman-Grant, M., & Thomas, o. (2001). Food shopping practices
are associated with dietary quality in low-income households. *Journal of Nutrition
Education,* 33,1, S16-S26.

Huang, D.L., Rosenburg, D.E., Simonovich, S. D., & Belza, B. (2012). Food access
patterns and barriers among midlife and older adults with mobility disabilities.
Journal of Aging Research, 2012, Article ID231489.

Hughes, V.A., Frontera, W.R., Wood, M., Evans, W.J., Dallal, G.E., Roubenoff, R.,
Fiatrioni Singh M.A. (2001). Longitudinal muscle strength changes in older adults:
influence of muscle mass, physical activity, and health. *Journals of Gerontology
Series A: Biological Sciences and Medical Sciences*, 55, 5 B209-217.

Huitt, W. (2004). Maslow's hierarchy of needs. Educational Psychology Interactive.
Valdosta, GA: Valdosta State University. Retrieved March 13, 2016 from
http://chiron.valdosta.edu/whuitt/col/regsys/maslow.html

Jiao, J., Moudon, A.V., Ulmer, J., Hurvitz, P.M., & Drewnowski, A. (2012). How to
identify food deserts: Measuring physical and economic access to supermarkets
in King County, Washington. *Research and Practice,* 102,10, e32-e39.

Juel-Jacobsen, L.G. (2015). The world for a crooked street: towards a supermarket
morphology of shopping aisles and retail layout. *Interiors,* 6,1, 59-90.

Kamphuis CB, Giskes K, de Bruijn GJ, Wendel-Vos W, Brug J, van Lenthe FJ.
Environmental determinants of fruit and vegetable consumption among adults: a
systematic re- view. *British Journal of Nutrition*, 2006; 96: 620-35. doi:
10.1079/BJN2006 1896

Kaufman, P.R. (2000). Consolidation of food retailing: Prospects for consumers &
grocery suppliers. *Agricultural Outlook, Economic Research Service/USDA,* 18-
22.

Keates, S., Clarkson, P. J., Harrison, L. A., & Robinson, P. (November 1, 2000).
Towards a practical inclusive design approach. Paper presented at the
Proceedings of the Conference on Universal Usability, New York, NY, USA.

Keller, H.H. (2007). Promoting food intake in older adults living in the community: A
review. *Applied Physiology, Nutrition, and Metabolism,* 32, 991-1000.

Keller, H.H., Dwyer, J.J.M., Edwards, v., Senson, C., & Edward, H.G. (2007). Food security in older adults: Community service provider perceptions of their roles. *Canadian Journal on Aging,* 26,4,317-328.

Kohijoki, A-M. (2011). The effect of aging on consumer disadvantage in grocery retail services among the Finnish elderly. *Journal of Retailing and Consumer Services*, 18, 370-377.

Larsen, K., & Gilliland, J. (2008). Mapping the evolution of 'food deserts' in a Canadian city: Supermarket accessibility in London, Ontario, 1961-2005. International Journal of Health Geographics, 7,10, doi:10.1186/1476-072X-7-16

Lathey, V., Guhathakurta, S., & Aggarwal, R. (2009). The impact of subregional variations in urban sprawl on the prevalence of obesity and related morbidity. *Journal of Planning Education and Research,* 29, 127.

Lawrence, D.L., & Low, S.M. (1990). The built environment and spacial form. *Annual Review of Anthropology* 19, 453-505.

Lawton, M. P., & Nahemow, L. (1973). Ecology and the aging process. In C. Eisdorfer & M.P. Lawton (Eds.), *The psychology of adult development and aging* (pp. 619-674). Washington, DC: American Psychological Association.

Lawton, M. P. (1974). Social ecology and the health of older people. *American Journal of Public Health, 64*(3), 257-260.

Lawton, M. (1980). *Environment and Aging*. Belmont, CA: Brooks/Cole.

Lee, S.J., & Frongillo, A. (2001). Factors associated with food insecurity among U.S. elderly persons: Importance of functional impairments. *Journal of Gerontology: Social Sciences,* 56B,2, S94-S99.

Lee, J.S., Shannon, J., & Brown, A. (2014). Living in food deserts was associate with food insecurity in a statewide sample of older adults in need of aging and food assistance programs in Georgia*. Journal of the Academy of Nutrition and Dietetics,* 114,9.

Leighton, C., & Seaman, C. E. A. (1997). The elderly food consumer: disadvantaged? *Journal of Consumer Studies and Home Economics,* 21, 363-370.

Levasseur, M., Desrosiers, J., & Noreau, L. (2004). Is social participation associated with quality of life of older adults with physical disabilities? *Disability & Rehabilitation,* 20, 1206-1213.

Lowen, T., Davern, M.T., Mavoa, S., & Brasher, K. (2015). Age-friendly communities: Access to services for older people. Australian Planner, 52,4, 255-265.

Mace, R.M. (1998). Universal design in housing. Assistive Technology, 10, 21-28.

62

Machi, L.A., McEvoy, B.T. (2012). *The literature review: Six steps to success* (2nd ed,). London, UK: Sage Publications Ltd.

Martikainen, P., Bartley, M., & Lahelma, E. (2002). Psychosocial determinants of health in social epidemiology. *International Journal of Epidemiology*, 31, 1091-1093.

Mason, J. B., & Beardon, W. O. (1979). Satisfaction/dissatisfaction with food shopping among elderly consumers. *The Journal of Consumer Affairs*, 13,2, 359-370.

Mayo, J. M. (1993*). The American grocery store: The business evolution of an architectural space*. Westport, Connecticut: Greenwood Press.

Mendes de Leon, C.F. (2005). Social engagement and successful aging. European Journal on Aging, 2, 64-66, DOI: 10.1007/s10433-055-0020-y.

Menec, V.H., Means, R., Keating, N., Parkhurst, G. and Eales, J. (2011). Conceptualizing age-friendly communities. *Canadian Journal on Aging,* 30, 3, 479-93.

Meneely, L., Burns, s., & Strugnell, C. (2008). Food retailers' perceptions of older consumers in Northern Ireland. *International Journal of Consumer Studies*, 32, 341-348.

Meneely, L., Strugnell, C., & Burns, A. (2009). Elderly consumers and their food store experiences. *Journal of Retailing and Consumer Services*, 16, 458-465.

Mercille, G., Richard, L., Gauvin, L., Kestens, Y., Shatenstein, B., Dniel, M., & Payette, H. (2012). Associations between residential food environments and dietary patterns in urban-dwelling older adults: results from the VoisiNuAge study. *Public Health Nutrition*, 15,11, 2026-2039.

MetLife Mature Market Institute. (2010). *The MetLife Report on Aging in Place 2.0: Rethinking solutions to the home care challenge*. Retrieved from www.metlife.com/assets/cao/mmi/ publications/studies/2010/mmi-aging-place.pdf

Meyers, H., & Lumbers, M. (2008). Understanding older shoppers: A phenomenological investigation. Journal of Consumer Marketing, 25,5,294-303.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D., & the PRISMA Group (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine,* 51,4, 264-269.

Moore, L.V., & Diez Roux, A.V. (2006). Associations of neighbourhood characteristics with the location and type of food stores. *American Journal of Public Health,* 96,2, 325-331.

Moore, L.V., Diez Roux, A.V., Nettleton, J.A., & Jacobs Jr, D.R. (2008). Associations of the local food environment with diet quality: A comparison of assessments based on surveys and geographic information systems: the multiethnic study of atherosclerosis. *American Journal of Epidemiology*, 167,917-924, doi: 10.1093/aje/ kwm394

Morland, K., Wing, S., Diez Roux, A., & Poole, C., (2002). Neighborhood characteristics associated with the location of food stores and food service places. *American Journal of Preventative Medicine*, 22, 23–29.

Moschis, G., Curasi, C., & Bellenger, D. (2004). Patronage motives of mature consumers in the selection of food and grocery stores. *Journal of Consumer Marketing,* 21, 2, 123-133.

Myers, H., & Lumbers, M. (2008). Understanding older shoppers: A phenomenological investigation. *Journal of Consumer Marketing*, 25,5, 294-301.

National Academy on an Aging Society. (1999). *Demography is not destiny.* Retrieved from www.agingsociety.org/agingsociety/pdf/destiny1.pdf.

National Advisory Council on Aging. (2006). *Seniors in Canada 2006 Report Card*.

National Center for Health Statistics, (2011). *Health, United States, 2010: With Special Feature on Death and Dying. Hyattsville, MD.* Retrieved from http://www.cdc.gov/nchs/data/hus/hus10.pdf#054.

Omar, M., Tjandra, N.C., & Ensor, J. (2014). Retailing to the "grey pound": understanding the food shopping habits and preferences of consumers over 50 in Scotland. *Journal of Retailing and Consumer Services*, 21, 753-763.

Oswald, F., & Werner-Wahl, H. (2005). Dimensions of the meaning of home in later life. In Rowles, G.D., & Chaudhury, H. (Eds.), Home and Identity in Late Life: International Perspectives (21-40). New York: Springer Publishing Company, Inc.

Park, M., Smith, R.O., & Liegl, K. (2011). The Restaurant Accessibility and Task Evaluation Tool (RATE-IT), [in Process. Festival of the International Conference of Caregiving, Disability, Aging Technology., Jun. 2011, pp. 1–4. [Online]. Available: http://web.resna. org/conference/proceedings/2011/UD/ park-69625.pdf.

Peace, S. M., Holland, C., & Kellaher, L. (2006). *Environment and identity in later life*. New York: Open University Press.

Peters, E.J., & McCreary, T.A. (2008). Poor neighbourhoods and the changing geography of food: Retailing in Saskatoon, Saskatchewan, 1984-2004. *Canadian Journal of Urban Research*, 17,1.

Pettigrew, S., Mizerski, K., & Donovan, R. (2004). Serving seniors better: Service guidelines for supermarkets. *Australasian Journal on Ageing*, 23,3.

Pirkl, J.J. (1995). Transgenerational design: prolonging the American dream. *Generations*, 19, 1, 32–36.

Plath, D. (2009). International policy perspectives on independence in old age. *Journal of Aging and Social Policy*, 21, p. 209-223.

Pynoos, J., Nishita, C., & Perelman, L. (2003). Advancements in the home modification field: A tribute to M. Powell Lawton. *Journal of Housing for the Elderly*, *17,* 105–116.

Quandt, S. A., Arcury, T.A., & Bell, R.A. (1998). Self-management of nutritional risk among older adults: A conceptual model and case studies from rural communities. *Journal of Aging Studies,* 12,4, 351-368.

Raja, S., Yin, L., Roemmich, J., Ma, C., Epstein, L., Yadav, P., & Ticoalu. A. (2010). Food environment, built environment and women's BMI: Evidence from Erie County, New York. *Journal of Planning Education and Research* 29, 4, 444-60.

Rao, A.V., Warburton, J., & Bartlett, H. (2006). Health and social needs of older Australians from culturally and linguistically diverse backgrounds: Issues of implications, Australia. *Australian Journal of Ageing*, 25,4, 174-179.

Rosso, A.L., Taylor, J.A., PhillipTabb, L., & Michael, Y.L. (2013). Mobility, disability, and social engagement in older adults. *Journal of aging and Health,* 25,4, 617-637.

Rowles, G. D. (1983). Place and personal identity in old age: Observations from Appalachia. *Journal of Environmental Psychology*, 3, 299-313.

Rowles, G.D. (2008). Place in occupational science: A life course perspective on the role of environmental context in the quest for meaning. *Journal of Occupational Science,* 15:3, 127-135, doi: 10.1080/14427591.2008.9686622

Rozas, L.W., & Klein, W.C. (2010). The value and purpose of the traditional qualitative literature review. *Journal of Evidence-Based Social Work,* 7, 387-399.

Sales, J., Marti, J.V., Marin, R., Cervera, E., & Sanz, P. (2016). CompaRob: The shopping cart assistance robot. *International Journal of Distributed Networks*, 2016, Article ID 4781280

Schwanen, T., Banister, D., & Bowling, A. (2012). Independence and mobility in later life. *Geoforum,* 43,6, 1313-1322.

Shannon, J., Lee, J.S., Holloway, S.R., Brown, A., & Bell, J. (2015). Evaluating the relationship between urban environment and food security in Georgia's older population. *Applied Geography*, 60, 224-229.

Satariano, W. (2006). *Epidemiology of aging: An ecological approach.* Portland,
        Oregon: Ringgold Inc.

Sidenvall, B., Nydahl, M., & Fjellstrom, C. (2001). Managing food shopping and
        cooking: The experience of older Swedish women. *Ageing and Society*, 21, 2,
        151-168.

Siebert, C. (2003). Aging in place: Implications for occupational therapy. *OT Practice, 8,*
        CE1-CE8.

Sixsmith, A. (1986). Independence and home in later life. In C. Philipson & B.M. Strang
        (Eds.), *Dependency and interdependency in old age*. London: Croom Helm.

Sixsmith A., & Sixsmith J. (2008). Ageing in place in the United Kingdom. Ageing
        International, 32, 219-235, DOI 10.1007/s12126-008-9019-y

Smoyer- Tomic, K.E., Spence, J.C., & Amrhein, C. (2006). Food deserts in the
        Prairies? Supermarket accessibility and neighbourhood need in Edmonton,
        Canada. *The Professional Geographer,* 58,3, 307-326.

Statistics Canada. (2013). *Canadian Income Survey,* 2013. Retrieved from Statistics
        Canada website http://www.statcan.gc.ca.

Statistics Canada. (2015). *Profile of senior's transportation habits.* (Catalogue number
        11-008-X no. 93). Retrieved from the Statistics Canada website
        http://www.statcan.gc.ca

Steinfeld, E., & Danford, G.S. (1999). Theory as a basis for research on enabling
        environments. In E. Steinfeld and G. S. Danford (Eds.), Measuring Enabling
        Environments. New York: Kluwer/Plenum, 1999.

Steinfeld, E., & Maisel, J. (2012). *Universal Design: Creating inclusive environments.*
        New Jersey: John Wiley and Sons.

Steinfeld, E., & Smith, R.O. (2012). Universal design for quality of life technologies.
        Proceedings of the IEEE, 100,8, 2539-2554.

Story, M.F. (1998). Maximizing usability: the principles of universal design. *Assistive
        Technology*, 10, 1, 4–12.

Strauss, M. (2016, April 22). In e-commerce battle, grocery stores perfect 'click and
        collect'. The Globe and Mail. Retrieved from
        http://www.theglobeandmail.com/report-on-business/on-the-frontlines-of-the-
        online-grocery-shopping-battle/article29726909/

Takagi, E., Silverstein, M. (2006). Intergenerational coresidence of the Japanese
        elderly: Are cultural norms proactive or reactive? Research on Aging, 28, 4, 473-
        492.

Thomas, P.A. (2011). Trajectories of social engagement and limitations in late life. *Journal of Health and Social Behaviour*, 52,4, 430-443.

Thompson, J.L., Bentley, G., Davis, M., Coulson, J., Stathi, A., & Fox, K.R. (2011). Food shopping habits, physical activity and health- related indicators among adults aged> 70 years. *Public health and Nutrition,* 14,9, 1640-1649.

Turrini, A., D'addezio, L., Maccati, F., Davy, B.M., Arber, S., Davidson, D., Grunert, K., Schuhmacher, B., et al….Lumbers, M. (2010). The informal networks in food procurement by older people-A cross European perspective. *Ageing International*, 35, 253-275, doi: 10.1007/s12126-010-9060-5

Tuzin, H., Telli, E., & Alir, A. (2016). Usability testing of a 3D touch screen kiosk system for wayfinding. *Computers in Human Behaviour*, 61, 73-79.

Umstattd Meyer, M. R., Janke, M.C., & Beaujean, A.A. (2013). Predictors of older adults' personal and community mobility: Using a comprehensive theoretical mobility framework. The Gerontologist, 54,3, 398-408.

Valdemarsson, M., Jernryd, E., & Iwarsson, S. (2005). Preferences and frequencies of visits to public facilities in old age—a pilot study in a Swedish town center. *Archives of Gerontology and Geriatrics*, 40, 15-28.

Veall, M.R. (2006). Canadian seniors and the low income measure. Canadian Public Policy, 34, 47-58.

Verbrugge LM, Jette AM (1994). The disablement process. *Social Science and Medicine,* 38, 1–14.

von Elm, E., Altman, D.G., Egger, M., Pocock, S.J., Gotzsche, P.C., & Vandenborucke, J.P. (2007). The strengthening the reporting of observational studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. *Preventive Medicine,* 45, 247-251.

Wahl, H-W., & Weisman, G.D. (2003). Environmental Gerontology at the beginning of the new millennium: Reflections on it historical, empirical, and theoretical development. *The Gerontologist*, 43,5, 616-627.

Wiles, J.L., Leibling, A., Guberman, N., Reeve, J., & Allen, R.E.S. (2011). The meaning of "aging in place" to older people. The gerontologist, 52,3,357-366.

World Health Organization, 2002. Active Ageing: A Policy Framework. <http://whqlibdoc.who.int/hq/2002/WHO_NMH_NPH_02.8.pdf>.

World Health Organization. (2011). Global health and aging. Retrieved from http://www.who.int/ageing/publications/global_health/en/

Wrigley, N. (2002). Food deserts' in British cities: Policy context and research priorities."
Urban Studies, 39,11, 2029–2040.

Yamashita, T., & Kunkel, S.R. (2012). Geographic access to healthy and unhealthy
foods for the older population in a U.S. metropolitan area. *Journal of Applied
Gerontology*, 31,3, 278-313.

Yen, I.H., Michael, Y.L., & Perdue, L. (2009). Neighborhood environment studies of
health of older adults: A systematic review. *American Journal of Preventive
Medicine*, 37,5,455-463.

Yin, Y., Pei, E., & Ranchhod, A. (2013). The shopping experience of older supermarket
consumers. Journal of Enterprise Information Management, 26,4, 444-471.

Yin, Y., Qiu, S., & Ranchhod, A. (2016). An exploratory investigation into senior
customers' supermarket shopping experiences in China. *Journal of Retailing,*1-
52.

Zenk, S.N., Schultz, A.J., Israel, B. A., James, S.A., Bao, S., & Wilson, M.L. (2005).
Neighborhood racial composition, neighborhood poverty, and the spatial
accessibility of supermarkets in metropolitan Detroit. *American Journal of Public
Health,* 95, 4, 660–67.

Appendix A: STROBE Statement checklist for the 11 articles that met the inclusion criteria for the review of the location of grocery stores (first author, year of publication)

	Cummins (1999)	Smoyer-Tomic (2006)	Apparicio (2006)	Burns (2007)	Larsen (2008)	Hanabuchi (2011)	Huang (2012)	Jiao (2012)	Mercille (2012)	Yamashita (2012)	Lu (2015)
Title and Abstract	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Introduction											
Background/rationale	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Objectives		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Methods											
Study design		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Setting	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Participants	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Variables	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Data measurement	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Study size	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Quantitative variable	✔	✔	✔	✔	✔	✔	X	✔	✔	✔	✔
Statistical methods	✔	✔	✔	✔	✔	✔	X	X	✔	✔	✔
Results											
Participants	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Descriptive data	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Outcome data		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Main results	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Discussion											
Key results	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Limitations	X	X	✔	✔	X	✔	✔	✔	✔	✔	✔
Interpretation	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Generalizability	X	X	X	X	X	X	✔	X	X	✔	✔
Other information											
Funding	X	X	X	✔	X	X	✔	X	✔	✔	X

yes, ✔ no, X Partly, ≠

Appendix B: STROBE Statement checklist for the 17 articles that met the inclusion criteria for the review of the interior built environment of grocery stores (first author, year of publication)

	Goodwin (1999)	Hare (1999)	Hare (2001)	Sidenvall (2001)	Hare (2003)	Moschis (2004)	Pettigrew (2005)	Bromley (2007)	Meneely (2008)	Meneely (2009)	Petermans (2010)	Kohijoji (2011)	Angell (2012)	Huang (2012)	Yin (2013)	Omar (2008)	Yin (2016)
Title and Abstract	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Introduction																	
Background and rationale	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Objectives	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Methods																	
Study design	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Setting	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Participants	≠	✔	✔	✔	✔	✔	≠	≠	≠	✔	✔	✔	✔	✔	✔	✔	✔
Variables	✔	✔	✔	✔	✔	≠	≠	✔	✔	✔	✔	✔	✔	✔	✔	✔	
Data measurement	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Study size	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Quantitative variable	✔	X	X	X	✔	X	X	X	X	X	X	X	X	X	X	✔	X
Statistical methods	X	X	X	✔	✔	X	✔	X	X	X	X	✔	X	X	X	X	X
Results																	
Participants	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Descriptive data	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔
Outcome data	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔
Main results	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔
Discussion																	
Key results	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔
Limitations	X	X	X	X	X	X	X	X	X	X	X	X	✔	✔	✔	X	✔
Interpretation	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Generalizability	X	✔	✔	≠	✔	≠	≠	≠	✔	X	✔	✔	✔	X	✔	✔	✔
Other Information																	
Funding	X	X	X	✔	X	✔	X	X	X	X	X	X	X	X	✔	✔	✔

yes, ✔ no, X Partly, ≠

Appendix C: Evidence for barriers and facilitators in the interior built environment of grocery stores

Obstacles obstructing pathway in aisle
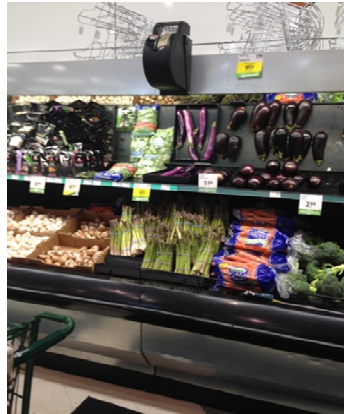
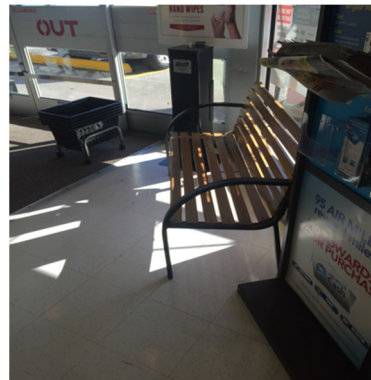Plastic bag dispenser inaccessible for all users

Items on top and bottom shelves not accessible to all users

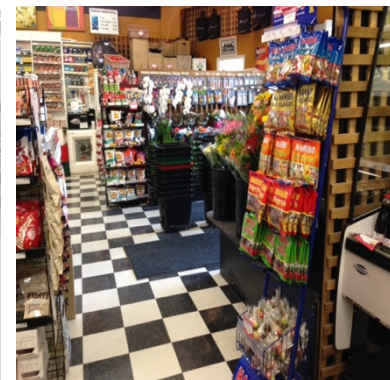Items on higher shelves in freezer are inaccessible to all users

Spacious walkway and good sight lines

Presence of in-store seating

Wide aisles with few obstacles

Cluttered entrance impacting way finding