The Neighbourhood Food Environment and Self-Reported Food Intake and Food Selection

by

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ABSTRACT

The neighbourhood food environment, defined as the exposure to (measured as availability, density, or distance to) healthy and unhealthy food outlets around places within which individuals gravitate, including home, schools, workplaces, and beyond, plays a complex role in influencing food intake and food selection. This dissertation comprises three studies that collectively explore various dimensions of the neighbourhood food environment and its influence on food intake and selection.

Study 1 aimed to synthesize existing evidence on the changes in food intake and food selection following physical relocation in non-refugee populations. A comprehensive literature review was conducted using databases such as MEDLINE, EMBASE, CINAHL, and SCOPUS from 1946 to August 2022. Four articles met the inclusion criteria, providing both longitudinal (N = 2) and cross-sectional (N = 2) evidence. The findings suggest that relocation to an urban neighbourhood with more convenience stores, cafés, and restaurants is associated with increased unhealthy food intake among adults. Factors such as income, vehicle access, cost, availability, and perceptions of the local food environment were also influential.

Study 2 examined the changes in food intake, food selection, and the related capability, opportunity, and motivation for healthy eating behaviours (COM-B) among older adults who had relocated within the past 12 months ("movers") compared to those who had not ("non-movers"). The cross-sectional study included 155 English-speaking older adults (aged ≥ 60 years) residing in various housing types across Alberta. No significant differences were observed in food intake, food selection, or COM-B constructs by relocation status. These findings highlight the complexity of dietary behaviours and the multiple factors influencing them, suggesting a need for future longitudinal studies with larger and more diverse samples.

Study 3 investigated whether food intake and selection, perceptions of the neighbourhood food environment, and perceived food availability, accessibility, and affordability differed between winter and non-winter seasons among older adults. The cross-sectional study included 155 English-speaking older adults (aged ≥ 60 years) residing in independent units across Alberta. The results indicated no significant seasonal differences in food intake, food selection or perceptions of the neighbourhood food environment, food availability, accessibility, and affordability. This stability may be attributed to consistent food availability and established shopping habits among older adults. Future research should employ longitudinal designs and objective measures of dietary intake to better understand the interaction between seasonal variations and dietary outcomes.

In summary, this dissertation provides novel insights into the influence of relocation and seasonal variations on dietary behaviours among older adults in Canada, highlighting the need for more comprehensive research to inform policies and interventions aimed at increased fruit and vegetable consumption in this population.

PREFACE

This dissertation includes six chapters detailing the results from three studies that examine different dimensions of the neighbourhood food environment and food intake and food selection. Chapter 1 provides a general introduction to the research topic and outlines the study objectives. Chapter 2 discusses the rationale behind the studies, identifies knowledge gaps, and states the purpose of the dissertation.

Chapter 3 (Study 1) reviews current knowledge on food intake and food selection following physical relocation. I was responsible for conceptualizing the review, creating a codebook, conducting data extraction, performing data analysis and synthesis, and writing the manuscript. J. Kung, librarian at the University of Alberta, provided guidance on developing a search strategy for the different databases. J. C. Spence and K. Lee were the supervisory authors and contributed to concept formation and manuscript composition. All authors read and approved the final manuscript.

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Chapter 4 (Study 2) reports on self-reported food intake, food selection, and the capability, opportunity, and motivation for consuming fruits and vegetables (COM-B) among two groups of older adults (age ≥ 60 years): those who have relocated within the past 12 months and those who have not experienced relocation. Chapter 5 (Study 3) examines perceptions of the neighbourhood food environment perceptions, food availability, accessibility and affordability, and self-reported food intake and food selection among two groups of older adults (age ≥ 60 years): those surveyed from December 1st to March 31st ("winter") and those surveyed during other times ("non-winter").

These studies are part of the "Designing Communities to Support Healthy Aging in Residents" study, conducted by the Housing for Health team at the University of Alberta (Ethics approval from the University of Alberta: Pro00092947 and Pro00094863). I developed the food-related questions in the survey questionnaire. My role also included administering in-person paper surveys to participants with multiple research assistants, cleaning the data, conducting data analysis, and writing the manuscripts. Drs Spence and Lee were the supervisory authors and

contributed to concept formation and manuscript composition. All authors read and approved the final manuscripts.

Chapter 6 presents a general discussion and conclusion for the dissertation.

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ACRONONYMNS

ANCOVA	Analysis of Covariance
COM-B	Capability Opportunity and Motivation for Behaviour Change
FFQ	Food Frequency Questionnaire
ICC	Intraclass Correlation Coefficient
IQR	Interquartile Range
NCD	Noncommunicable Diseases
NEMS	Nutrition Environment Measures Survey
NEMS-P	Perceived Nutrition Environment Measures Survey
NHANES III	Third National Health and Nutrition Examination Survey
PANES	Physical Activity Neighbourhood Environment Scale
SEM	Social-Ecological Model
SES	Socioeconomic Status
WHO	World Health Organization

Chapter 1. Introduction

1.1 Background

A diet rich in fruits, vegetables, whole grains, nuts, seeds, and legumes helps protect against non-communicable diseases (NCDs) such as diabetes, heart disease, stroke, and cancer(World Health Organization, 2024). Key drivers of unhealthy eating include a complex interplay of individual-level factors, such as increased consumption of processed foods high in calories, salt, sugar, and saturated fat, and broader sociocultural and environmental determinants. These broader determinants include factors such as socioeconomic status, cultural norms, marketing and advertising practices, food availability and accessibility, and the neighbourhood food environment (Fuhrman, 2018; Skerrett & Willett, 2010).

Canada's Food Guide recommends 7-10 servings of fruit and vegetables per day (Health Canada, 2024). The World Health Organization (WHO) and the World Cancer Research Fund recommend 5 servings of fruit and vegetables per day (World Cancer Research Fund, 2018b; World Health Organization, 2019b). The Dietary Guidelines for Americans recommends 2½ servings of vegetables and 2 servings of fruit per day (U.S. Department of Health and Human Services, 2021). Various reviews have associated low intake of fruits and vegetables with NCDs including, but not limited to, cardiovascular diseases, hypertension, hypercholesterolemia, osteoporosis, many cancers, chronic obstructive pulmonary diseases, respiratory problems and poor mental health (Celik & Topcu, 2006; Park, Heo, & Park, 2011; Payne, Steck, George, & Steffens, 2012; Williamson, 1996a). A meta-analysis of 16 cohort studies following 469,551 participants provides further evidence that a higher consumption of fruit and vegetables is associated with a lower risk of all-cause mortality, particularly cardiovascular mortality (Wang et al., 2014). Thus, fruits and vegetables are universally promoted as healthy and are a quantifiable indicator of healthy eating.

Available data globally suggests insufficient fruit and vegetable consumption. For instance, 28.6% of Canadians aged 12 and older reported consuming the recommended servings of fruits and vegetables (Statistics Canada, 2019). As for the US, 12.3% and 10.0% of adults met fruit and vegetable intake recommendations, respectively (Lee, Moore, Park, Harris, & Blanck, 2019). In the UK, various demographic groups met the recommended fruit and vegetable consumption guidelines in differing proportions: 33% of adults, 40% of older adults aged 65 to

74 years, 27% of older adults aged 75 years and older, and 12% of adolescents aged 11 to 18 years (Public Health England, 2020). Sub-Saharan Africa exhibits lower-than-recommended fruit and vegetable intake levels, with an average daily consumption of 268g compared to the WHO's guideline of 400 g (Mensah, Nunes, Bockarie, Lillywhite, & Oyebode, 2021). Finally, in Australia, 44.1% of adults met fruit intake recommendations, while 6.5% met vegetable intake recommendations (Australian Bureau of Statistics, 2022).

Costs associated with unhealthy diets are high. For example, the direct and indirect health care costs associated with Canadians not meeting Canada Food Guide recommendations were estimated at CAD$13.8 billion in 2014 (Lieffers, Ekwaru, Ohinmaa, & Veugelers, 2018). Estimated annual diet-related health care costs were USD$50.4 billion in the US in 2018 (Jardim et al., 2019). In the UK, the cost of poor diet-related health care was estimated to be £5.8 billion in 2006-2007(Scarborough et al., 2011). Similarly, in Australia, the total health expenditure attributable to low consumption of vegetables was estimated at AUD$1.4 billion in 2015-2016 (Deloitte Access Economics Australia, 2016). According to the Global Medical Trends Survey, healthcare costs attributable to poor dietary habits are projected to rise steadily in Sub-Saharan Africa (Watson, 2022). The high prevalence of unhealthy eating habits and the economic burden of not meeting dietary recommendations for health suggests that investments in promoting healthy eating have the potential of substantial health impacts as well as savings in direct and indirect health care costs in developed and developing countries.

By 2050, the number of adults aged 65 or over will be twice the number of children under the age of five and also surpass the number of adolescents aged between 15 and 24 years (United Nations, 2019). Older adults may be more vulnerable to poor nutrition due to age-related changes, such as loss of muscle mass and strength, an elevated risk of chronic diseases, and alterations in appetite regulation and postprandial metabolism (Norman, Haß, & Pirlich, 2021). Emerging research indicates that incorporating fruits and vegetables into the diet, alongside sufficient calorie intake, during older adulthood, can help prevent or alleviate malnutrition, cognitive decline, falls, walking disability, and other geriatric-related conditions. (Nicklett & Kadell, 2013). Despite ample evidence detailing the personal and clinical consequences of poor nutrition and its economic impact on the healthcare system, poor nutrition among older adults remains a significant problem with reported high prevalence rates (Crichton et al., 2019). A systematic review and meta-analysis using 22 screening tools reported pooled prevalence rates of

inadequate fruit and vegetable intake among older adults, ranging from 15.2% in Spain to 37.7% in Switzerland (Leij-Halfwerk et al., 2019). In Canada, 23.3% of men and 36.7% of women aged 65 and older achieve the recommended servings of fruits and vegetables per day (Statistics Canada, 2019). Major US studies, such as the US Department of Agriculture's Continuing Surveys of Food Intakes by Individuals, Behavioural Risk Factor Surveillance System, and Third National Health and Nutrition Examination Survey (NHANES III) have estimated that 21 to 37% of men and 29 to 45% of women aged 65 years and older achieve the recommended servings of fruits and vegetables per day (depending on the methodology) (Sahyoun, Zhang, & Serdula, 2005; Serdula et al., 1995). In summary, the projected demographic shift toward an aging population underscores the importance of addressing inadequate nutrition and emphasizing the significance of augmenting fruit and vegetable consumption.

Some relevant frameworks for identifying and understanding the factors that influence health behaviours such as dietary intake and food choices include the socio-ecological model (SEM) (McLeroy, Bibeau, Steckler, & Glanz, 1988) and the behaviour change wheel (Michie, van Stralen, & West, 2011). SEM delineates the multifaceted influences on food choices, extending beyond individual factors to encompass social, cultural, economic, and environmental determinants. Meanwhile, the behaviour change wheel integrates the capability, opportunity, motivation, and behaviour (COM-B) model to delve into the specific elements shaping behaviours like food choices (Timlin, McCormack, & Simpson, 2021). The COM-B model offers a nuanced perspective on the factors that can influence food intake and selection. This model recognizes the dynamic interplay of capability (individual's psychological and physical capacity), opportunity (external factors providing cues or support), and motivation (brain processes driving decision-making) in shaping behaviours related to food selection and food intake. In the COM-B model, capability is said to be associated with behaviour directly and indirectly via the mediating effect of motivation. Incorporating the COM-B model within the behaviour change wheel not only enhances comprehension of behaviour but also offers a structured approach for intervention development and evaluation (Michie, Van Stralen, & West, 2011). Effectively modifying behaviour within the COM-B necessitates adjustments in one or more components, addressing the behaviour itself or behaviours that either support or compete with it (Michie, Atkins, & West, 2014). The integration of SEM and the COM-B model within the behaviour change wheel presents a robust framework for understanding and addressing the

myriad influences on health behaviours, particularly in dietary choices. In connecting environmental factors to COM-B, it's crucial to specify how these factors influence the capability, opportunity, and motivation components of the COM-B model. The conceptual model in Figure 1.1 illustrates the relationships explored in this dissertation. It integrates elements of the SEM to capture individual-level factors (e.g., socio-demographics) and neighborhood-level factors (e.g., neighborhood socio-demographics), along with the COM-B framework to examine how relocation status, neighborhood food environment perceptions, and seasonal variations interact to influence fruit and vegetable intake and selection among older adults.

The neighbourhood and built environment are acknowledged as important social determinants of health, including their influences on food intake and food selection (Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008). The built environment encompasses all aspects of an individual's surroundings, whether human-made or modified (Frank, Iroz-Elardo, MacLeod, & Hong, 2019), while the neighbourhood environment refers to the immediate physical, social, and economic surroundings of a residential area, including housing conditions, proximity to amenities, safety, social cohesion, and community resource (Raine, 2005). Both environments exhibit features that can either facilitate or hinder healthy behaviours (Myers, Denstel, & Broyles, 2016). For the purposes of this thesis, the focus will be on the neighbourhood food environment. Broadly defined, the neighbourhood food environment encompasses the distribution of food sources, such as number, type, location, and accessibility, within a designated area, such as a neighbourhood, where food can be obtained from outlets, such as restaurants, convenience stores, and grocery stores that are generally open to the public (Glanz, Sallis, Saelens, & Frank, 2005b). Recent reviews suggest that the neighbourhood food environment, particularly the distribution of sources such as grocery stores, supermarkets, and fast-food outlets, plays a complex role in influencing dietary intake (Myers, 2023a). The current evidence recognizes that no single feature of the neighbourhood acts in isolation to influence health behaviours and future research should consider integrating multiple aspects of the neighbourhood food environment, including social context, to better understand their collective influence on dietary behaviours and health outcomes.

The complexity of establishing causal relationships between environmental factors and health outcomes stems from the presence of confounding variables, such as genetics and lifestyle, the time lag in observing health effects, ethical constraints limiting experimental

manipulations, the interconnected nature of environmental exposures, challenges inherent in retrospective study designs, and the potential for observer bias (Diez Roux, 2004). Given the inherent challenges associated with establishing causal relationships between environmental factors and health outcomes, investigating the consequences of physical relocation (i.e., moving to an alternative neighbourhood or community) emerges as a potentially efficient approach for comprehending the influence of the neighbourhood food environment on health. Analyzing dietary behaviours before and after physical relocation constitutes a form of natural experiment, allowing researchers to compare the influence of proximity to different neighbourhood food environments on behaviour and health. The available research, conducted in Tanzania, the USA, Greece and Australia, involved various age groups: individuals aged 15 years and above, female students aged 17-18 years, undergraduate students aged 22.3 ± 1.8 years, and adults aged 40.5 ± 11.8 years, respectively (Bivoltsis, Trapp, Knuiman, Hooper, & Ambrosini, 2020; Butler, Black, Blue, & Gretebeck, 2004; Cockx, Colen, & De Weerdt, 2018; Papadaki, Hondros, J, & Kapsokefalou, 2007). Findings from these studies indicated that moving to an urban neighbourhood with increased proximity to convenience stores, cafés, and restaurants was associated with elevated unhealthy food intake in adult populations. Moreover, factors such as income, vehicle access, cost, availability, and perceptions of the neighbourhood food environment played a role in shaping food selection and intake (Bivoltsis et al., 2020). The limited evidence base concerning changes in food intake and selection after physical relocation in non-refugee populations underscores the need for further research in this area. Notably, none of these studies were conducted in Canada or focused on older adults.

The perception of one's neighbourhood food environment can be influenced by various factors, including personal experiences, socio-cultural backgrounds, and seasonal variations (Black & Macinko, 2008). Seasonal variations can significantly influence food accessibility and choices, especially in regions with distinct seasonal changes. The existing literature suggests that food consumption patterns exhibit seasonal variations. Specifically, studies conducted in China (Cai et al., 2004), focusing on women aged 40-70 years, and in Slovakia (Smolková et al., 2004), including men and women aged ≥ 44 years, revealed a doubling in fresh vegetable and fruit intake in summer and autumn compared to winter. The disparity in rural and urban study locations, respectively, suggests that cultural practices, alongside seasonal supply and consumption patterns of vegetable intake, likely contributed to the observed variation. However,

a study in Turkey, involving men and women aged ≥ 65 years, demonstrated that fruit consumption increased only in autumn exclusively among males (Ersoy et al., 2018). The authors concluded that this discrepancy may be partially attributed to the uninterrupted availability of fresh fruits and vegetables throughout the year in Turkey, given the relatively high intake across all seasons. Notably, the average fruit intake for men and women was 167g, 140g, 192g, 296g and 222g, 241g, 209g and 236g in winter, spring, summer and autumn, respectively. Supporting this hypothesis, the average vegetable intake for men and women was 226g, 365g, 329g, 252g and 201g, 305g, 298g, and 243g in winter, spring, summer, and autumn, respectively. The increase in fruit consumption exclusively among males in autumn supports the notion that there may be gender-specific factors influencing dietary behaviour during seasonal variations. Within Canada, prior research has primarily explored seasonal variations in terms of food insecurity within Inuit communities in Nunavut (Guo et al., 2015). This Canadian study highlights the unique challenges faced by Inuit communities, where food insecurity is influenced by seasonal access to traditional and market foods, reflecting broader issues of food accessibility and cultural practices.

A recent systematic review identified six studies that investigated exposure to neighbourhood food environments (Cetateanu & Jones, 2016). The majority of these studies originated from the US (N = 4), while one study each were conducted in Canada and the UK. Among the US studies, three focused on adults (Christian, 2012; Gustafson, Christian, Lewis, Moore, & Jilcott, 2013; S. N. Zenk et al., 2011), and one specifically examined individuals aged ≥ 50 (Huang, Rosenberg, Simonovich, & Belza, 2012). The Canadian and UK studies concentrated on adolescents (Harrison, Burgoine, Corder, van Sluijs, & Jones, 2014; Shearer et al., 2015). Associations between observed mobility patterns in the neighbourhood food environment and dietary outcomes were inconclusive with large variations in the number of food outlet types assessed, sample sizes, and recording periods. Notably, none of the studies reported the season of data collection or participants' perceptions of the neighbourhood food environment.

Although nutritional consumption may vary over the year, environmental factors (e.g., changes in ambient temperature and humidity), physiological/perceptual factors (e.g., threshold changes), and psychological factors (e.g., New Year Resolutions) also contribute (Fujihira, Takahashi, Wang, & Hayashi, 2023). The potential fluctuations in food consumption across different seasons warrant further investigation to comprehend the dynamics of the

neighbourhood food environment throughout the year. In climates with pronounced seasonal variations, examining how individuals interact with their surroundings during winter and non-winter conditions can offer valuable insights into the influence of the local environment on dietary behaviours and food choices (Dixon, Ugwoaba, Brockmann, & Ross, 2021; King, Thornton, Bentley, & Kavanagh, 2015; Lebel, Krittasudthacheewa, Salamanca, & Sriyasak, 2012).

Future research should consider social, cultural, economic, and environmental determinants, such as seasonal variations and perceptions of the local neighbourhood food environment, to better understand the multifaceted influences on dietary outcomes. This comprehensive approach aims to provide a nuanced comprehension of the complexities involved in individuals' food intake and selection patterns, thereby contributing to a more detailed understanding of how the neighbourhood food environment influences dietary outcomes.

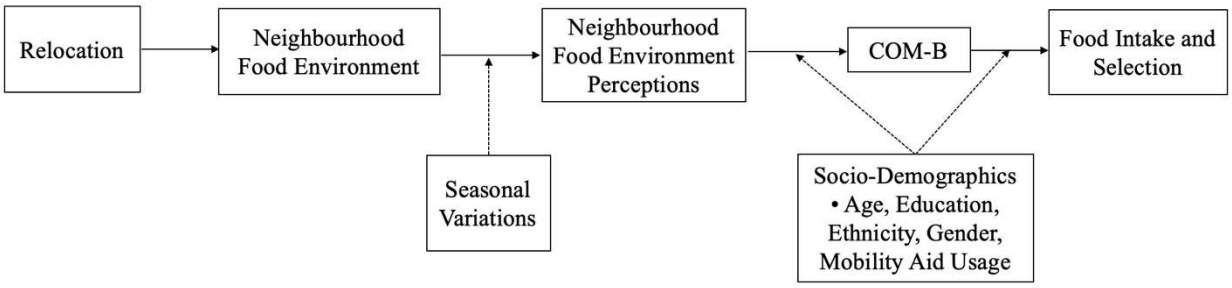
1.2 Dissertation Projects

The high economic cost of unhealthy diets, combined with a widespread pattern of insufficient fruit and vegetable consumption globally highlights the need to investigate the influence of the neighbourhood food environment on food intake and food selection, aiming to inform targeted interventions and potentially alleviate healthcare expenditures. The existing literature on neighbourhood food environments reveals gaps in knowledge that necessitate further exploration, particularly in Canada and among older adults. A scoping review has already been completed that showed moving to an urban neighbourhood with more convenience stores, cafés, and restaurants around the home was associated with an increase in unhealthy food intake, defined as increased consumption of high-calorie, low-nutrient foods such as fast food, sugary snacks, and alcoholic beverages, in adult populations (Kouritzin, Spence, & Lee, 2023). Following this, two cross-sectional studies involving older adults (age ≥ 60 years) were conducted to investigate the influence of the neighbourhood food environment on food intake and food selection (see Figure 1.1). These studies are part of the "Designing Communities to Support Healthy Aging in Residents" Study, conducted by the Housing for Health team at the University of Alberta (Ethics approval from the University of Alberta: Pro00092947, and Pro00094863). The first study compared self-reported food intake, food selection, and the capability, opportunity, and motivations for consuming fruits and vegetables (COM-B) between two groups: those who have relocated within the past 12 months and those who have not

experienced relocation. The second study investigated seasonal variation on neighbourhood food environment perceptions food availability, accessibility and affordability, and self-reported food intake and food selection.

These three studies are presented in this thesis as Chapters 3, 4, and 5 after review of the relevant literature (Chapter 2). The thesis concludes with a general discussion (Chapter 6), combining the key findings of the three studies, overarching strengths and limitations of the research, and identifying key implications for future research.

Figure 1.1 Conceptual Framework



Chapter 2. Literature Review

2.1 Healthy Eating

2.1.1 Definitions of Healthy Eating

A healthy diet is associated with physical and mental health (Eilat-Adar, Sinai, Yosefy, & Henkin, 2013; Li et al., 2017). Healthy eating involves the consumption of a balanced and varied diet that provides essential nutrients in appropriate proportions (Cena & Calder, 2020). Poor diets are a leading cause of preventable obesity-related death and NCD, including cancer, cardiovascular disease and type 2 diabetes, accounting for 11 million deaths annually (Afshin et al., 2019). As such, dietary improvements could prevent one in every five deaths (Gakidou et al., 2017). There is converging evidence that a healthy diet consists predominantly of whole, plant-based foods, including fruit, vegetables, pulses, nuts, whole grains and oily fish (English et al., 2021; Mozaffarian, Rosenberg, & Uauy, 2018). In contrast, diets high in refined grains, red and processed meat, sweets and sugar-sweetened beverages are rich in saturated fat, sodium and added sugar are associated with an increased risk of NCD (Fabiani, Naldini, & Chiavarini, 2019; Schwingshackl et al., 2017).

Food choices are influenced by social and economic determinants, encompassing factors such as access to affordable and nutritious options, cultural influences, and promotional tactics employed within the food industry (Story et al., 2008). Individual factors, including education, income, and food literacy contribute to the complexity of dietary behaviours (Giskes, van Lenthe, Avendano-Pabon, & Brug, 2011). Understanding the diverse determinants of food intake and food selection is important for promoting and sustaining healthy eating habits on a population level.

2.1.2 Public Health Guidelines for Healthy Eating

Global health organizations, including the WHO, the U.S. Department of Health and Human Services, Health Canada, and the European Union Food-Based Dietary Guidelines, advocate for a healthy diet characterized by regular consumption of fruits, vegetables, whole grains, and lean proteins, while limiting added sugars, sodium, saturated fats, and cholesterol, with varying regional nuances, such as the emphasis on plant-based proteins by Health Canada

(Health Canada, 2024; Knowledge For Policy, 2024; U.S. Department of Health and Human Services, 2021; World Health Organization, 2024).

The WHO defines a healthy diet as including regular consumption of fruits, vegetables, legumes, nuts, and whole grains, with an emphasis on at least 400g of fruits and vegetables daily (World Health Organization, 2024). This definition also involves limiting free sugar intake to less than 10% of total energy, restricting total fat intake to less than 30% of total energy, favoring unsaturated fats over saturated fats, keeping trans-fat intake below 1% of total energy, and maintaining daily salt intake below 5g.

The Dietary Guidelines for Americans 2020–2025 delineate a healthy eating plan to emphasize the inclusion of fruits, vegetables, whole grains, and fat-free or low-fat dairy. Additionally, it encourages the incorporation of diverse protein sources, while placing limits on added sugars, sodium, saturated fats, trans fats, and cholesterol. The guidelines also underscore the importance of aligning one's dietary choices with their daily calorie needs (U.S. Department of Health and Human Services, 2021).

The revised Canada's Food Guide, released on January 22, 2019, urges Canadians to adopt a healthy eating routine that involves emphasizing a variety of nutrient-rich foods such as vegetables, fruits, whole grains, and protein sources, with a preference for plant-based proteins (Health Canada, 2024).

While specific public health guidelines for healthy eating in Europe vary by country, overarching principles include a balanced diet rich in fruits, vegetables, whole grains, lean proteins, and moderation in sugar, salt, and alcohol consumption (Knowledge For Policy, 2024).

2.1.3 Healthy Eating Guidelines for Older Adults

The worldwide population of individuals aged 60 and older is expected to double to 2.1 billion by 2050 (World Health Organization, 2022). The dietary needs of older adults' merit distinct consideration due to age-related changes in metabolism, nutritional requirements, and potential health challenges. In older adults, higher diet quality is prospectively associated with better quality of life, including physical function, general health, vitality, and physical composite score, as well as a reduced risk of impaired instrumental activities of daily living (Gopinath, Russell, Flood, Burlutsky, & Mitchell, 2014). Dietary guidelines for older adults advocate for increased consumption of fruits, vegetables, whole grains, and dairy, while recommending

reductions in added sugars, saturated fat, and sodium (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2020).

For individuals aged 60 and above, the USDA MyPlate recommendations emphasize the importance of enjoying a diverse range of foods from each food group to reduce the risk of chronic diseases. Specific emphasis is placed on incorporating fruits and vegetables, choosing foods low in added sugar, saturated fats, and sodium, ensuring sufficient protein for muscle maintenance, focusing on essential nutrients, staying hydrated, maintaining a healthy weight through a balanced diet and active lifestyle, and practicing food safety measures to prevent illness (U.S. Department of Agriculture, 2024).

Canada's Food Guide recommends that seniors focus on a variety of nutrient-rich foods, including vegetables, fruits, whole grains, and protein sources, to promote and protect health, provide essential nutrients, prevent chronic diseases, and address challenges associated with aging, such as changes in appetite and lifestyle, while also offering practical tips on hydration, grocery shopping, and cooking for one or two people (Government of Canada, 2022).

In addition to the dietary guidelines provided by the USDA and Health Canada, various countries offer tailored recommendations to support the nutritional needs of older adults. The Australian Department of Health and Aged Care advises maintaining a nutrient-dense yet energy-appropriate diet, incorporating foods from all good groups such as fruits and vegetables, whole gains, lean proteins and low-fat dairy. Additionally, the guidelines highlight the importance of limiting foods and drinks high in fat, added salt, added sugars, and alcohol, with considerations for the need of increased fiber and water intake to address age-related changes like slowed bowel function (Government of Australia, Department of Health and Aged Care, 2022). Such comprehensive recommendations underscore the global recognition of the significance of promoting healthy eating habits among older adults to mitigate the risk of chronic diseases and enhance overall well-being.

2.1.4 Assessing Dietary Patterns of Older Adults

Available data globally suggest inadequate nutrition in older adults. In 2008/2009, 34% of Canadians aged 65 or older (more than 4.1 million) were at nutritional risk (Statistics Canada, 2015). In the United States, the mean consumption of total fruits and vegetables significantly

decreased from 3.90 to 2.49 in older adults aged 65 years or older, from 2001-2002 to 2017-2018 (Long, Zhang, Chen, & Wu, 2022). In 2021, 83.07% of older adults in Manta, Ecuador, were at nutritional risk due to being overweight or obese (Ricardo, Damaris, Daniel, & Marta, 2022).

The prevalence and consequences of inadequate nutrition in older adults, including its association with geriatric syndromes, frailty, sarcopenia, and micronutrient deficiencies, highlight the need to better understand barriers faced by older adults in obtaining and consuming dietary recommendations, including fruits and vegetables (Nicklett & Kadell, 2013). As populations age, the challenges in accessing and incorporating fruits and vegetables into their diets become more pronounced (Sahyoun et al., 2005).

2.2 Factors Influencing Healthy Eating

2.2.1 Conceptual Frameworks, Theories and Models

Conceptual frameworks, theories, and models provide structured approaches for exploring the diverse factors influencing individuals' food intake and selection (Chen & Antonelli, 2020). Viewed through a post-positivist lens, these tools guide the investigation of the dynamic interplay between external influences and personal dietary choices.

A conceptual framework identifies a set of variables and their presumed relationships that account for specific phenomena (Sabatier, 2007). It serves as a preliminary structure to guide research by outlining key concepts and their interconnections.

A theory, on the other hand, elucidates a more intricate and logically coherent set of relationships, encompassing direction, hypotheses, and the covariation of variables (Sabatier, 2007). Theories provide deeper explanations and predictions about how and why certain factors influence dietary behaviours.

Finally, a model is a focused and specific representation developed to make assumptions about a limited set of parameters and variables. Models systematically explore and test these assumptions on a restricted set of outcomes to depict causal linkages between constructs derived from one or more theories (Sabatier, 2007).

The application of existing frameworks, theories, and models, as well as the development of new ones, can contribute to advancing interdisciplinary knowledge and enhancing population health research (Carpiano & Daley, 2006).

2.2.2 Social-Ecological Model

The Social-Ecological Model (SEM) emphasizes the dynamic interplay between individuals and their broader environmental contexts. This model recognizes the multifaceted influences on food choices, encompassing not only personal factors but also social, cultural, economic, and environmental determinants. The relevance of ecological models lies in their ability to capture the complexity of factors shaping dietary behaviours and the recognition that individuals do not make food choices in isolation but are embedded within larger systems. SEM posits that individual dietary behaviors are influenced by factors operating at multiple levels, including the individual (personal beliefs and preferences), interpersonal relationships (family, friends, social networks), community (local environment and resources), societal (cultural norms and policies), and even policy levels (government regulations and public health initiatives) (McLeroy et al., 1988).

By considering the broader environment, these models contribute to a comprehensive understanding of the factors that contribute to both healthy and unhealthy eating patterns. For instance, research applying ecological models has explored the influence of social networks and cultural contexts on individuals' food choices (Caspi, Sorensen, Subramanian, & Kawachi, 2012; Story et al., 2008). A recent scoping review highlights the importance of ecological determinants in shaping eating behaviour among older adults, emphasizing the need for nutrition communication strategies that consider these influences comprehensively (Montez De Sousa Í, Bergheim, & Brombach, 2022). Additionally, Rugel and Carpiano (2015) found that emotional and informational social support significantly influences adequate fruit and vegetable intake among older adult Canadians, underscoring the critical role of social factors in dietary behaviours. The neighbourhood food environment, which includes availability, accessibility, affordability of healthy food options, plays a pivotal role in shaping dietary choices among older adults, further validating the utility of ecological models in this context.

2.2.3 COM-B

Perceptions of the neighbourhood food environment is a key construct in understanding mediating factors between the physical environment and health outcomes (Chandrabose et al., 2019). The Capability, Opportunity, Motivation, and Behaviour (COM-B) framework suggests that beliefs related to capability, opportunity, and motivation may mediate the relationship between external factors (e.g., policies, environment) and individual behaviour (Michie et al., 2011).

Antecedents of eating behaviour within the COM-B framework encompass perceptions of psychological factors (e.g., emotional predisposition to food) and physical capabilities (e.g., cooking and skill), social factors (e.g., cultural influences), physical opportunities (e.g., neighbourhood environment), and motivation, which involves reflective processes (e.g., conscious decisions) and automatic processes (e.g., habits, emotional reactions). The COM-B recognizes that behaviour change is induced by modifying at least one of these components. The COM-B constructs are influenced by intervention functions and policy categories via the behaviour change wheel, which presents potential public health intervention opportunities that could be useful for supporting healthy aging in communities (Michie et al., 2011).

Figure 2.1, adapted from Timlin et al. (2021), illustrates how the physical and social elements of the neighbourhood food environment may influence the components of the COM-B model. In essence, the neighbourhood food environment can either facilitate or hinder an individual's capability, opportunity, and motivation to engage in healthy eating behaviors, thereby playing a crucial role in shaping dietary outcomes.

2.2.4 Neighbourhood Food Environment

In recent years, the relationship between the built environment and its influence on health outcomes has garnered significant attention within public health research (Renalds, Smith, & Hale, 2010). For the purposes of this thesis, the focus will be on the neighbourhood food environment aspect of the built environment. The neighbourhood food environment, defined as the physical and socio-economic context in which individuals access and consume food, plays a pivotal role in shaping food intake and food selection and, consequently, health outcomes (Caspi et al., 2012).

Lytle (2009) provides a comprehensive overview of the complexities involved in measuring the neighbourhood food environment, emphasizing that it is not merely the presence or absence of food outlets that matters, but a combination of factors including accessibility, affordability, and the social and cultural context. These dimensions are crucial in understanding how food environments influence dietary behaviors, particularly among older adults who may face unique challenges in accessing healthy food options. While numerous studies have delved into the intricate relationship between the neighbourhood food environment and health outcomes, there exists a discernible gap in our understanding, particularly concerning older adult populations within Canada (Choi, Crimmins, & Ailshire, 2022; Souza et al., 2022). Previous Canadian literature has primarily focused on the relationship between neighbourhood socioeconomic disadvantage and fruit and vegetable consumption in adults aged 18-95 years (Ball et al., 2015), the neighbourhood food environment and obesity in adults aged 30-75 years (Walker et al., 2020), and the built environment influence on physical activity, food consumption, and health in individuals aged 11 years and older (Frank et al., 2022). Collectively, the evidence revealed an association between neighbourhood -level socioeconomic status (SES) and fruit consumption, indicating higher odds of greater fruit intake in neighbourhoods with a higher SES (Ball et al., 2015), the ratio of fast-food to full-service restaurants are positively associated with obesity and abdominal obesity across a diverse range of Canadian communities and cities (Walker et al., 2020), and healthy retail food environments were associated with healthy eating and lower body mass index and waist circumference (Frank et al., 2022).

The unique challenges and considerations faced by older adults, such as mobility constraints, changing dietary needs, and increased vulnerability to health risks, necessitate a more nuanced exploration. Older adults may navigate their neighbourhood food environments differently, with varying perceptions and interactions that could significantly influence their dietary choices and overall health (Kamphuis, de Bekker-Grob, & van Lenthe, 2015). Addressing this gap will help inform targeted interventions and policies tailored to this specific demographic.

2.2.5 Physical Relocation

Previous research has often examined dietary habits and neighbourhood environments separately, with limited studies exploring them concurrently (Papas et al., 2007). However,

recent studies have highlighted the importance of understanding the complex interplay between individuals' dietary behaviours and their physical environment (e.g., residential location) (Yamaguchi et al., 2022). The distinction between the physical aspects of the environment and its influence on food behaviours is not always clear, as individuals may self-select their residential locations based on various economic, social, and environmental factors. For example, activity-conscious individuals may be more likely to move to neighbourhoods with higher walkability and more recreational facilities (Lee, Ewing, & Sesso, 2009). Furthermore, the wide variability in how the environment is conceptualized poses challenges in comparing results across studies. Therefore, examining the influence of physical relocation, such as moving to another neighbourhood, can provide valuable insights into the role of the neighbourhood food environment on health outcomes, as it allows for a comparison of proximity and access to elements within neighbourhood food environments as determinants of influence.

Reviews that have examined dietary outcomes following physical relocation have generally been limited to mass migrations such as refugee crises (Guerra et al., 2019; Osei-Kwasi et al., 2016; Wang, Min, Harris, Khuri, & Anderson, 2016; Zhang, Liu, Diggs, Wang, & Ling, 2019). The limited literature that delves into the dietary patterns of non-refugees who have recently relocated, juxtaposing their self-reported food intake and food selection with those of their previous neighbourhood, calls for more research (Kouritzin et al., 2023). To date, no research has included older adults and applied appropriate research designs to account for neighbourhood self-selection and concurrent life events. For example, older adults with mobility issues may choose different neighbourhoods than their more physically active counterparts, such as congregate-living housing which often contain social supports, cafeterias/restaurants, and elevators. Such transitions not only influence their food intake and food selection, but also emphasize the importance of developing tailored interventions and support systems as they adapt to new surroundings (Park, Han, Kim, & Dunkle, 2017).

As global populations continue to age, there is increasing interest on understanding the intricate ways in which physical relocation can influence dietary behaviours (Kouritzin et al., 2023). This nuance stems from extensive research that highlights the influence of neighbourhood food environments on diet and obesity (Myers, 2023b). Older adults, often vulnerable to changes due to age-related factors, may undergo significant alterations in their daily routines and lifestyles when they relocate (Sanchini, Sala, & Gastmans, 2022). The decision to move, driven

by various factors such as health, economic circumstances, or familial reasons, can inadvertently influence an individual's food intake and food selection. This rapidly growing demographic have unique health needs and present an important opportunity for public health initiatives to address associated health care cost concerns.

2.2.6 Seasonal Variations

The perception of one's neighbourhood food environment can be influenced by various factors, including personal experiences, socio-cultural backgrounds, and seasonal variations (Black & Macinko, 2008). Seasonal variations, in particular, can significantly influence food accessibility and choices, especially in regions with distinct seasonal changes. Canadian research suggests that seniors discern differences in built environment preferences between summer and winter, with some preferences aligning with the WHO age-friendly domains (Garvin, Nykiforuk, & Johnson, 2012). The potential fluctuations in food access and mobility across different seasons warrant a deeper investigation to understand the dynamics of the neighbourhood food environment throughout the year.

2.3 Measurement Tools

2.3.1 Food Intake and Food Selection Measures

Food intake and selection can be assessed by subjective report and objective observation (Shim, Oh, & Kim, 2014). Subjective dietary assessment methods include open-ended surveys such as dietary recalls and closed-ended surveys such as food frequency questionnaires (FFQs). FFQs ask participants how often and how much food they ate over a specific period and are intended to assess overall dietary intake and/or a change in intake overtime (Willett, 2012). This method enables the assessment of long-term dietary intakes in a relatively simple, cost-effective, and time-efficient manner. FFQs are not as precise as other more open-ended methods but have the ability to identify dietary patterns within populations, such as adherence to specific dietary guidelines (Bailey, 2021).

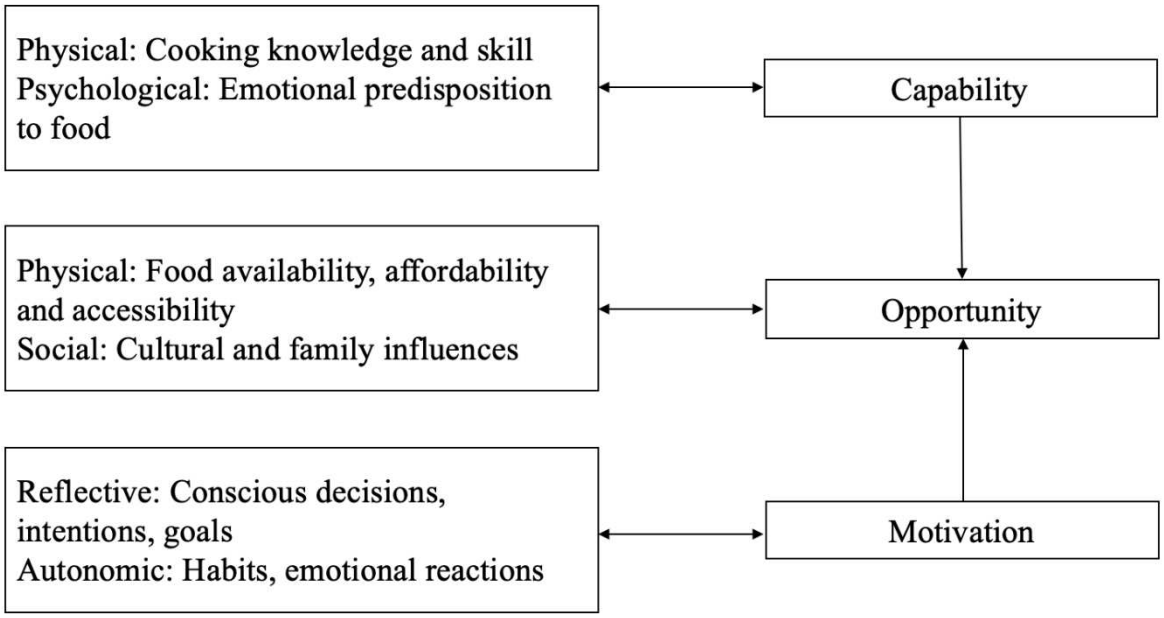
The Nutrition Environment Measures Survey (NEMS), developed by Glanz et al. (2005), is a widely disseminated and well established survey to study a range of food environments and

contexts (urban, rural, different institutional environments) for description, associations with diet and health outcomes, and to evaluate policy and environment interventions (Glanz, 2009). Stemming from this, The Perceived Nutrition Environment Measures Survey (NEMS-P) offers a more focused tool for assessing not only the types and quantities of foods consumed but also the contextual factors shaping individuals' food choices, such as availability, accessibility, and affordability of healthier options within their neighbourhood food environments (Green & Glanz, 2015). NEMS-P has been shown to be easy to understand and to have good test–retest reliability in measuring food intake and food selection, particularly fruits and vegetable, salty food, and sugar-sweetened beverages (Avelar et al., 2023).

2.3.2 Perceived Neighbourhood Food Environment Measures

The complex relationships among nutrition environments, diet, and health outcomes have been conceptualized and widely studied (Glanz, Sallis, Saelens, & Frank, 2005a). Methods to document, measure, and explain these relationships include observations, surveys, and geographic analyses. With the exception of one study that used a three-item measure of perceived food environments (Moore, Diez Roux, & Franco, 2012), NEMS-P is one of the most widely used, reliable and valid measure that comprehensively assesses key dimensions of perceived neighbourhood food environments (Green & Glanz, 2015). The survey items have been shown to be easy to understand, have good test–retest reliability, and discriminate between neighbourhood food environments in disadvantaged compared to more-affluent communities.

Figure 2.1 COM-B Beliefs and Neighbourhood Food Environment



Chapter 3. Study 1

Food Intake and Food Selection Following Physical Relocation: A Scoping Review

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3.1 Abstract

Objectives: To synthesize the current available evidence on the changes in food intake and food selection after physical relocation in non-refugee populations.

Methods: The inclusion criteria were studies with a measurement of food selection and/or food intake in non-refugee populations where physical relocation had occurred with self-reported or objective assessment of the neighbourhood physical environment before and after relocation. Databases searched included MEDLINE, EMBASE, CINAHL and SCOPUS from 1946 to August 2022.

Results*:* A total of four articles met the inclusion criteria. Overall, these studies gave longitudinal (N = 2) and cross-sectional (N = 2) evidence to suggest that moving to an urban neighbourhood with more convenience stores, cafés and restaurants around the home was associated with an increase in unhealthy food intake in adult populations. Additional factors such as income, vehicle access, cost, availability and perceptions of the local food environment played a role in shaping food selection and food intake.

Conclusion*:* Four internal migration studies were found. The limited evidence base calls for more research. Future studies should include children and apply appropriate research designs to account for neighbourhood self-selection and concurrent life events. International migration studies should include assessment of neighbourhood physical environments pre- and post-relocation.

3.2 Introduction

Unhealthy diets are a significant risk factor for chronic disease, disability and premature death (Devries et al., 2014). One of every five deaths across the globe is attributable to suboptimal diet (Afshin A, 2019). Key drivers of unhealthy eating include increased consumption of processed foods high in calories, salt, sugar and saturated fat, and a lack of whole grains, nuts, seeds, legumes, fruits and vegetables (Fuhrman, 2018). Evidence-based elements of a healthy diet include emphasizing fruits and vegetables, unsaturated fats, whole grains, plant protein sources and limiting consumption of trans and saturated fats, highly refined grains and sugary beverages (Skerrett & Willett, 2010). A key healthy dietary factor in many available guidelines is fruit and vegetable consumption. The 2015 to 2020 Dietary Guidelines for Americans recommend at least 2½ servings of vegetables and 2 servings of fruit per day (US Department of Health and Human Services and U.S. Department of Agriculture, 2015). The World Health Organization (World Health Organization, 2019a) and the World Cancer Research Fund (World Cancer Research Fund, 2018a) recommend 5 servings of fruit and vegetables per day. Various reviews have associated low intake of fruits and vegetables with cardiovascular diseases, hypertension, hypercholesterolemia, osteoporosis, many cancers, chronic obstructive pulmonary diseases, respiratory problems and poor mental health (F. Celik & F. Topcu, 2006; H.-M. Park, J. Heo, & Y. Park, 2011; M. E. Payne, S. E. Steck, R. R. George, & D. C. Steffens, 2012; Williamson, 1996b). A meta-analysis of 16 cohort studies following 469,551 participants provided evidence that a higher consumption of fruit and vegetables is associated with a lower risk of all-cause mortality, particularly cardiovascular mortality (X. Wang et al., 2014). Fruit and vegetable intake and selection are thus used as key outcome measurements of healthy eating in this scoping review.

Available data globally suggests insufficient fruit and vegetable consumption. For instance, a majority of adults in Australia, Canada, the UK, and US do not meet recommended fruit and vegetable consumption guidelines (Jardim et al., 2019; Lieffers et al., 2018; Office, 2001). In Sub-Saharan Africa, daily fruit and vegetable intake (268 g) remain below the World Health Organization's recommendation (400 g) (D. O. Mensah, Nunes, Bockarie, Lillywhite, & Oyebode, 2020). Health care costs associated with not meeting food guidelines and/or treating obesity range from USD$3.3 billion to USD$50.4 billion in developed countries (Duckett & Swerissen, 2016; Jardim et al., 2019; Lieffers et al., 2018; Office, 2001). Similarly, according to

the Global Medical Trends Survey (Willis Towers Watson, 2022), healthcare costs attributable to poor dietary habits are projected to rise steadily in Sub-Saharan Africa. The high prevalence of unhealthy eating habits and the economic burden of not meeting dietary recommendations for health suggests that investments in promoting healthy eating have the potential of substantial savings in direct and indirect health care costs.

Dietary behaviours and food consumption are shaped by interrelated personal and environmental factors, including knowledge (Shepherd et al., 2006), affordability (Andreyeva, Long, & Brownell, 2010), physical neighbourhood environments and accessibility (Cummins & Macintyre, 2006). The complex interplay of personal, cultural and environmental factors impacting dietary behaviours can be categorized and described using the five levels of influence conceptualized by the socio-ecological model (intrapersonal, interpersonal, institutional, community and public policy) (Committee on Examination of the Adequacy of Food et al., 2013; Wold & Mittelmark, 2018). Longitudinal studies linking changes in the local food environment to changes in eating behaviour and diet selection provide evidence that increased numbers of fast food outlets and convenience stores around the home may contribute to a lower diet quality, increased unhealthy food intake and higher BMI (Boone-Heinonen et al., 2011; Richardson et al., 2015; Rummo et al., 2017; Rummo et al., 2015). Cross sectional studies link availability and accessibility of healthful food sources to healthier dietary patterns, such as increased fruit and vegetable consumption (Cerin et al., 2011). Therefore, creating neighbourhoods that provide opportunities to purchase healthy food and limit exposure to unhealthy food represents a potential strategy to address some of the contributing factors to the burden of chronic diseases caused by poor dietary intake (Sallis & Glanz, 2009).

Understanding how individuals interact with their physical environment is one crucial component for public health strategies aimed at improving dietary intakes. Previous research usually examines dietary habits and/or neighbourhood environment separately, and few studies have dealt with them simultaneously (M. A. Papas et al., 2007). Residential location refers to the structures in which people live, and the grounds on which such structures are located including, but not limited to, houses, apartments, condominiums and the amenities around them (Winden, Chen, & Melton, 2016). The distinction between the physical aspects of the environment and its underlying food behaviour influences is also not always clear because people may self-select their residential locations based on multiple, and usually unmeasured,

economic and social variables. For example, activity-conscious individuals may be more likely to move to neighbourhoods with higher walkability and more recreational facilities (I.-M. Lee, R. Ewing, & H. D. Sesso, 2009). In addition, the wide range of conceptualization of the environment makes it challenging to compare results across studies. Examining the influence of physical relocation (i.e., moving to another neighbourhood) may be an efficient way to determine the role of the neighbourhood environment on health. Specifically, analyzing health outcomes following physical relocation represents a different type of natural experiment that allows researchers to compare proximity and access to elements within food environments as a measure of influence.

To date, reviews that examined dietary outcomes following physical relocation have generally been limited to mass migrations such as refugee crises (Guerra et al., 2019; H. A. Osei-Kwasi et al., 2016; Wang et al., 2016; Q. Zhang, R. Liu, L. A. Diggs, Y. Wang, & L. Ling, 2019). These reviews have found that food insecurity is a marked consequence of international migration and constitutes an emerging global public health problem. Less is understood about the influence of residential relocation on food consumption when moving from neighbourhood to neighbourhood within non-refugee populations. A scoping review aims to map the existing literature in a field of interest in terms of the volume, nature, and characteristics of the primary research (Arksey & O'Malley, 2005). This scoping review synthesized the current evidence on the association between food intake and food selection, and physical relocation in non-refugee populations, where the food environment before and after relocation are also assessed. All studies that had a measurement of food selection and/or food intake after physical relocation (either prospectively or retrospectively) with self-reported or objective assessment of neighbourhood physical environment before and after relocation were included. Non-refugee was defined as an individual who had undergone immigration, migration or relocation due to reasons besides persecution. Food selection was defined by the British Nutrition Foundation definition: the selection of foods for consumption which results from the competing, reinforcing and interacting influences of a variety of factors (British Nutrition Foundation, 2004). Food intake was defined as the daily eating patterns of an individual, including specific foods, calories consumed and relative quantities (D. Michael Denbow & Mark A. Cline, 2015). Physical relocation was defined as the action of moving to a new place and establishing one's home there (Merriam-Webster, 2022). The research questions included: What studies have been done on

food selection and food intake following physical relocation? How does physical relocation affect food selection and food intake? How does physical relocation affect healthy eating outcomes (defined by fruit and vegetable intake)? What is known about the facilitators and barriers to healthy eating (defined by fruit and vegetable intake) following physical relocation?

3.3 Methods

A scoping review provides an overview of the literature on a topic and can be most useful when there is a variety of research designs or an expected scarcity of evidence (Armstrong, Hall, Doyle, & Waters, 2011). Guided by the Arksey et al (2015) methodological framework for scoping reviews and recommendations for strengthening methodological rigor (Arksey & O'Malley, 2005), a systematic methodological approach for searching, selecting, summarizing, and synthesizing the existing literature on food intake and food selection following physical relocation in a non-refugee study population was employed.

3.3.1 Protocol and Registration

Our protocol was drafted using the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Tricco et al., 2018). The final protocol was registered prospectively with the Open Science Framework (https://osf.io/3wvfu/) (Open Science Framework, 2022).

3.3.2 Approach

Searches were conducted from the earliest database inception (1946) to August 2022 in the electronic databases MEDLINE, EMBASE, CINAHL, and SCOPUS for peer-reviewed papers. Search terms included key words related to physical relocation, food selection and food intake (see Table 3.1). The detailed search strategy for each database is available in the appendix. The listed databases were searched and resulting citations were downloaded into Covidence (Veritas Health Innovation, 2022).

3.3.3 Selection Process

The focus of this scoping review was available academic literature. Peer-reviewed studies that had any outcome measurement of food selection and/or food intake where physical relocation had occurred (either prospectively or retrospectively) with self-reported or objective assessment of neighbourhood physical environment before and after relocation were included. Non-English publications, gray literature, studies using only refugees or immigrants as the study population, and/or relocation with limited food intake self-selection were excluded. The last exclusion criterion was chosen because eating behaviours within institutional food environments with minimal dietary self-selection may not be comparable to behaviours determined by availability of choices in neighbourhood food environments.

Following a standard protocol, potential included studies were screened for eligibility based on the title, abstract and full text. Uncertainty was discussed among all authors and any disagreement was resolved by consensus. A PRISMA flow diagram presents the summary of the study selection process (Figure 3.1).

3.3.4 Methodological Quality Appraisal

We did not appraise methodological quality or risk of bias of the included articles, which is consistent with guidance on scoping review conduct (Peters et al., 2015). However, characteristics of available studies were extracted and documented to provide information on strengths and weaknesses.

3.3.5 Data Extraction and Analysis

Publication characteristics, study characteristics and participant information were extracted. Publication characteristics included author, year of publication, publication type, and country in which the study was conducted. Study characteristics included study design, aim and objectives of the study, research methods, neighbourhood environmental attributes (perceived or objectively measured), results and main conclusions. Participant information included number of participants, age and gender. Finally, results regarding sociability and perceived safety were also extracted because both these attributes have also been linked to how the neighbourhood

environment could influence residents' willingness and ability to access nearby food amenities (Jilcott, Laraia, Evenson, & Ammerman, 2009). Sociability was defined as the web of social relationships that surround an individual and the extent to which an individual is connected with others (Berkman & Syme, 1979). Safety was defined as how safe individuals feel in their neighbourhoods (Velasquez, Douglas, Guo, & Robinette, 2021).

3.4 Results

3.4.1 Article Characteristics

The literature search identified 144 potential studies after removing duplicates. A total of 129 irrelevant documents were removed during phase one screening for the wrong outcomes or incorrect study population. For example, many studies focused on displacement of natural disaster victims or cardiometabolic outcomes. Of the 15 full-text studies assessed for eligibility, four studies met the inclusion criteria and were included in the review (Bivoltsis et al., 2020; Butler et al., 2004; Cockx et al., 2018; Papadaki et al., 2007). The first published study of food intake and food selection following physical relocation in non-refugee populations appeared in 2004 (Butler et al., 2004), followed by 2007 (Papadaki et al., 2007), 2018 (Cockx et al., 2018) and 2020 (Bivoltsis et al., 2020). In the studies by Butler et al (2004) and Papadki et al (2007), participants relocated out of the family home to attend college; in the study by Cockx et al (2018) participants relocated from a rural to urban environment; and in the study by Bivoltsis et al (2020) participants relocated from an established neighbourhood to a new residential development. All studies relied on quantitative data and involved adult populations. The study by Butler et al (2004) included only female participants; the other three studies included both female and male participants. The studies by Butler et al (2004) and Papadaki et al (2007) used a cross-sectional study design; the studies by Bivoltsis et al (2020) and Cockx et al (2018) used a longitudinal study design. Sample sizes ranged from 54 (Butler et al. 2004) to 9,417 (Cockx et al. 2018) participants. Butler et al (2004) evaluated food intake and food selection 5 months post-relocation, Papadaki et al (2007) evaluated food intake and food selection 3 to 4 years post-relocation, Bivoltsis et al (2020) used a pre- and 1-2 year post- relocation measurement and Cockx et al (2018) used a pre- and 4 year post- relocation measurement. All studies assessed food frequency and included a measurement of food selection and food intake. In addition, the study by Cockx et al (2018) included a food diversity score and the study by Butler et al (2004)

included measurements of nutrient self-efficacy and macronutrient consumption. Table 3.2 summarizes the characteristics of the included studies. Table 3.3 summarizes the results of the included studies.

3.4.2 Food Selection and Food Intake

Fruit, vegetable, bread/pasta, milk, meat and refined sugar consumption were the most commonly used food intake outcomes. Grocery stores, home meals and meals consumed outside of the home at convenience stores, cafés and restaurants were the most commonly used locations of food selection. A variety of measures were employed to operationalize these concepts including self-administered questionnaires about usual food intake, lifestyle behaviours, perceptions, self-efficacy, socio-demographic variables and measurements of the neighbourhood environmental attributes.

Some studies reported small positive outcomes after relocation (e.g., decreased white bread consumption (Papadaki et al., 2007); a greater percentage of healthy food outlets around the home following relocation was found to be associated with an increase in fruit and vegetable intake (Bivoltsis et al., 2020)). However, the negative influence on food intake and food selection after physical relocation was the more prominent theme. For example, although Papadaki et al (2007) reported some positive outcomes, students who relocated within Greece when starting university modified their dietary habits in a generally undesirable direction (decreased fresh fruit, raw and cooked vegetables, pulses, seafood, olive oil consumption and increased sugar consumption). Butler et al (2004) reported a significant increase in alcohol consumed of freshman female college after relocation from home. Bivoltsis et al (2020) reported that moving to a new residential development with more convenience stores, cafés and restaurants around the home was associated with an increase in unhealthy food intake. Although researchers reported that a greater percentage of healthy food outlets around the home following relocation was significantly associated with an increase in fruit and vegetable intake, 64% of participants experienced a decline in the percentage of healthy food outlets around the home following residential relocation compared to 25% who experienced an improvement. Cockx et al (2018) reported relocating to urban areas resulted in a significant decrease in maize and cassava consumption, and a significant increase in bread, pasta, cereal products, sugar, sweet, pastries, sodas, tea, coffee and meals/snacks consumed outside the house.

As a whole, healthy food intake declined among relocated residents. However, relocation seemed to have a positive influence on sociability as shown by an increase in leisure activities and meals consumed outside the home, especially when residents relocated for university (Butler et al., 2004; Papadaki et al., 2007) or from a rural to urban environment (Cockx et al., 2018). There was no change in perceived neighbourhood safety.

3.4.3 Facilitators and Barriers to Healthy Eating

The most commonly reported facilitators of healthy eating were increased income and food selection from rural migration. Major barriers to healthy eating included lack of time and competing priorities, lack of accessible transportation, no grocery stores within walking distance (as defined by a 1.6-km road network buffer), cost and not adjusting habits to favour a healthier diet.

Papadaki et al (2007) reported that lack of experience in planning meals, a general lack of interest in food, or lack of time were also barriers for healthier dietary choices and precipitating factors for increased consumption of take-away and convenience meals. Bivoltsis et al (2020) reported that having children <18 years of age at home at baseline was associated with an increase in unhealthy food intake, access to a vehicle at baseline was associated with an increase in diet quality and fruit/vegetable intake following relocation, and higher socioeconomic status and increasing hours of work per week was associated with a decrease in unhealthy food intake. The latter is contrary to what was expected as working > 40 hours per week is associated with time-related barriers to healthful eating in previous literature in adults (Escoto, Laska, Larson, Neumark-Sztainer, & Hannan, 2012; Oostenbach, Lamb, Crawford, & Thornton, 2022) and young adults (Escoto et al., 2012). Butler et al (2004) reported that nutrition self-efficacy, defined by one's belief in his or her ability to manage a diet even in the face of obstacles such as stress or exposure to unhealthy foods (Nastaskin & Fiocco, 2015), did not change during the first semester of university after physical relocation from home. Cockx et al (2018) reported income as the main mediator through which rural-urban migration affected dietary change. If it were not for the increases in income associated with rural-urban migration, there would have be no significant change in consumption. Not surprisingly, the most significant change in consumption

was away from traditional staples (maize, cassava) which are typically consumed from one's own production in rural areas.

3.5 Discussion

This review found a scarcity of literature on residential relocation and food selection and intake in non-refugee and institutional residential populations that included assessments of food environments pre- and post-relocation, with four publications in four countries (three high-income countries and one lower-income country) meeting the inclusion criteria. The small number of studies and heterogenous designs make it difficult to draw conclusions about associations. Overall, these studies provided longitudinal (N = 2) and cross-sectional (N = 2) evidence to suggest that moving to an urban neighbourhood with more convenience stores, cafés and restaurants around the home was associated with an increase in unhealthy food intake. There is evidence that having a greater percentage of healthy food outlets around the home following relocation was significantly associated with an increase in fruit and vegetable intake; however, a majority of participants experienced a decline in the percentage of healthy food outlets around the home following residential relocation compared to a minority who experienced an improvement. Intrapersonal (individual) level characteristics of food intake included preferences/perceptions and knowledge/skills; interpersonal level characteristics of food intake included food availability, social support, time constraints and culture; community/institution level characteristics of food intake included food availability (stores), school/workplace food environment, eating out and access; and policy level characteristics of food intake included food pricing. Biological and psychological determinants of food selection were not tested in these studies. Other economic, physical and social determinants of food selection included cost, income, availability, skills (e.g. cooking), time, culture, family, peers and meal patterns. Furthermore, factors such as vehicle access and availability of public transportation played a role in shaping food selection and food intake, improving outcomes when present.

In all studies, dietary selection and intake as well as personal context changed significantly following residential relocation. In the Butler et al (2004) and Papadaki et al (2007) studies, participants moved out of the family home to a university campus. Papadaki et al (2007) reported that the majority (73%) of students living away from home lived alone during their

studies, 18% shared a flat with friends and a small proportion (8.1%) lived in shared student residences. A finding of interest in the Papadaki et al (2007) study is that there were no major differences in dietary habits at baseline when students lived in the family home, regardless of whether students came from Athens or other parts of Greece. Both Butler et al (2004) and Papadaki et al (2007) found that young adults who relocated when starting university significantly increased convenience and take-away meal consumption. The findings of Papadki et al (2007) suggest that food shopping plays a significant role in the forming dietary habits because students still living with their families, where food shopping and cooking were usually performed by a family member, did not change their diets in a major way after starting university. Cockx et al (2018) found that compared to household members who remained in their original rural villages, those relocating to urban areas experienced a pronounced shift away from traditional staples and towards more convenience meals away from home. These findings suggest that the ratio of unhealthy to healthy food outlets influences people's dietary choices, a finding consistent with the previous cross-sectional research exploring the influences of relative and absolute measures of exposure (Clary, Ramos, Shareck, & Kestens, 2015; Mason, Bentley, & Kavanagh, 2013). For example, having a higher number of convenience stores within 3 km (Boone-Heinonen et al., 2011; Rummo et al., 2015) and fast food restaurants within 1 km around the home (Rummo et al., 2017) is associated with lower dietary quality in the US. In Canada, individuals living in neighbourhoods with a moderate or high density of fast-food chain restaurants are more likely to be excessive fast-food consumers (Laxer & Janssen, 2014). In the Bivoltsis et al (2020) study, participants moved from a previously established neighbourhood to a new residential development. The new developments were typically located in suburban greenfield areas and infill locations. The majority of participants (64.0% vs 24.8%) experienced a decline in the percentage of healthy food outlets around the home following residential relocation to a new development. These findings are consistent with previous research that identified an overall lack of healthy food outlets in new developments: 2.3 times more takeaway/fast food outlets than supermarket/greengrocers in new developments compared with 1.7 times in established neighbourhoods (Bivoltsis, Trapp, Knuiman, Hooper, & Ambrosini, 2019).

Findings from these studies generally show less healthy food consumption following relocation. This is consistent with previous literature: a systematic review of 11 studies with

university students reported higher salt, fat, and added sugar consumption on campus (X. Li, Braakhuis, Li, & Roy, 2022); and empirical evidence shows rural residents tend to have lower calorie intakes and higher dietary quality than their urban counterparts (Ren, Castro Campos, Peng, & Glauben, 2021). With the exception Bivoltsis et al (2020), where the change was non-significant, all studies reported a significant decrease in fruit and vegetable consumption following physical relocation. While it is difficult to compare the magnitude of associations across studies given the variety of measurements used, previous studies that used survey measures of the food environment consistently reported small but meaningful differences in fruit and vegetable consumption within the different dimensions of "food selection" (biological, economic, physical, social, and psychological determinants) (Caitlin, Glorian, V., & Ichiro, 2012). For example, individuals who reported shopping at a supermarket consumed, on average, 1.22 more servings per day of fruits and vegetables than those who did not (Shannon N Zenk et al., 2005), and individuals who reported easy supermarket access consumed, on average, 86 more grams per day of fruit (approximately half a serving) than those who reported poorer access (Rose & Richards, 2004).

The changes observed in food intakes after relocating are likely also influenced by specific individual factors modifying the way participants respond to a changing environment. For example, having children at home and lower socioeconomic status at baseline were associated with an increase in unhealthy food intake after relocating (Bivoltsis et al., 2020). Thus, families with children and people living on low incomes may be especially vulnerable to purchasing less healthy convenience foods from accessible food outlets around the home. Previous research also suggests that low-income residents may be more susceptible to unhealthy food intake in environments where there is a high prevalence of unhealthy food outlets (Boone-Heinonen et al., 2011; Rummo et al., 2015). In Edmonton, Canada, the odds of exposure to fast food outlets are greater in areas with more Indigenous peoples, renters, lone parents, low-income households and public transportation commuters (Hemphill, Raine, Spence, & Smoyer-Tomic, 2008; Smoyer-Tomic et al., 2008). In the Bivoltsis et al (2020) study, access to a vehicle at baseline was associated with an increase in diet quality and fruit/vegetable intake following relocation. This suggests that people with vehicles may be better able to travel beyond their immediate neighbourhood to obtain healthy food, increasing their potential to access healthy

food. Urban migration may also explain some of the deterioration of fruit and vegetable consumption as individuals are purportedly further from fresh, seasonal local produce.

Residential relocation had some influence on participant behaviour and perceptions. Bvioltsis et al (2020) found that individual positive perceptions of the local food environment on average decreased from pre- to post-relocation, as indicated by 40.1 % of participants reporting a decrease in the presence of a supermarket/grocery store within 15-min walk of home. Previous research has revealed that both objective and perceived measures of increased distance to the nearest supermarket with a good variety of fresh and processed vegetables is associated with decreased daily consumption of fruit and vegetables (Sharkey, Johnson, & Dean, 2010). Only Cockx et al (2018) assessed whether physical relocation affects men and women differently. The changes in the consumption and selection of different food categories after relocation appeared to be similar, except for meals and snacks consumed away from home. The more pronounced increase in the latter food category was driven by male migrants. A potential explanation lies is that women in Africa may often migrate for marriage (Collinson, 2009). Conversely, male migrants are more likely to be unmarried and to live alone, and perhaps are less likely to cook or have someone else preparing food at home.

3.6 Limitations

Limitations inherent to scoping review methodology are that they identify available research and point to research that needs to be conducted on a topic rather than contributing essential research. This review is also limited by restricting studies to English-language publications, exclusion of gray literature, and heterogeneous measurement and outcome measures. Furthermore, no intervention studies were identified. Therefore, only observational studies were available and two of the four were cross-sectional further preventing conclusions about causality.

Daily food selection and consumption were estimated through self-reported surveys in all studies, which is subject to measurement error from incorrect recording of food intake and potential reluctance to report consumption of unhealthy foods. For instance, previous literature shows that up to 50% of participants may incorrectly self-report food consumption (Cook, Pryer, & Shetty, 2000). There are also challenges separating out what changes in dietary behaviour

might be from the move itself rather than the change in residential context. For example, some relocations are associated with negative life events (e.g., divorce, ill health, loss of unemployment). Finally, summarising across diverse environmental attributes and different outcome measurements is methodologically challenging. While categorizing these measures provides a 'big picture' of the overall evidence, it may fail to address potential biases in interpretation.

Despite these limitations, this review has multiple strengths including a comprehensive search strategy to identify available evidence on the topic and avenues for further research. The diversity of the geographical locations provides a representation of the changes in food intake and selection following physical relocation in four different continents compared to earlier reviews on the local food environment that have been limited to studies from primarily higher- or upper-middle-income countries (Caspi et al., 2012; Sawyer et al., 2021).

3.7 Conclusion

Residential relocation provides a unique opportunity for studying possible environment-induced changes in food intake and food selection, especially when the environments pre- and post-relocation are assessed. This scoping review identified four studies from three high-income countries and one low-income country: two studies with residential relocation out of the family home to a college campus, one study with residential relocation from a rural to urban environment, and one study with residential relocation from an established neighbourhood to a new residential development. Moving to a new residential development with more convenience stores and restaurants around the home was associated with an increase in unhealthy food intake. Conversely, having a greater percentage of healthy food outlets around the home following relocation was significantly associated with an increase in fruit and vegetable intake; however, a majority of participants experienced a decline in the percentage of healthy food outlets around the home following residential relocation compared to a minority who experienced an improvement. Commonly reported barriers to healthy eating also included lack of time and competing priorities, lack of accessible transportation, no grocery stores within walking distance, cost and not adjusting habits to favour a healthier diet.

The limited evidence base calls for more research examining food intake, food selection and residential relocation that include assessments of food environments pre- and post-

relocation. None of the studies looked at residential relocation to a different state/province, which may lead to greater changes in the neighbourhood food environment and more significant dietary changes than relocation within the same state/province. None of the studies included children, who may have different dietary preferences and behavioural influences then adults. Future studies could benefit from using longitudinal and interventional designs, such as quasi-experimental studies and cohort studies (Lee et al., 2009), evaluating the outcomes of relocation over longer follow-up periods and applying appropriate research methods to account for neighbourhood self-selection and concurrent life events. Additional data from geographically diverse areas, particularly from low-income and middle-income countries, would also add to the current literature.

Figure 3.1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Flow Diagram of Reviewed Research

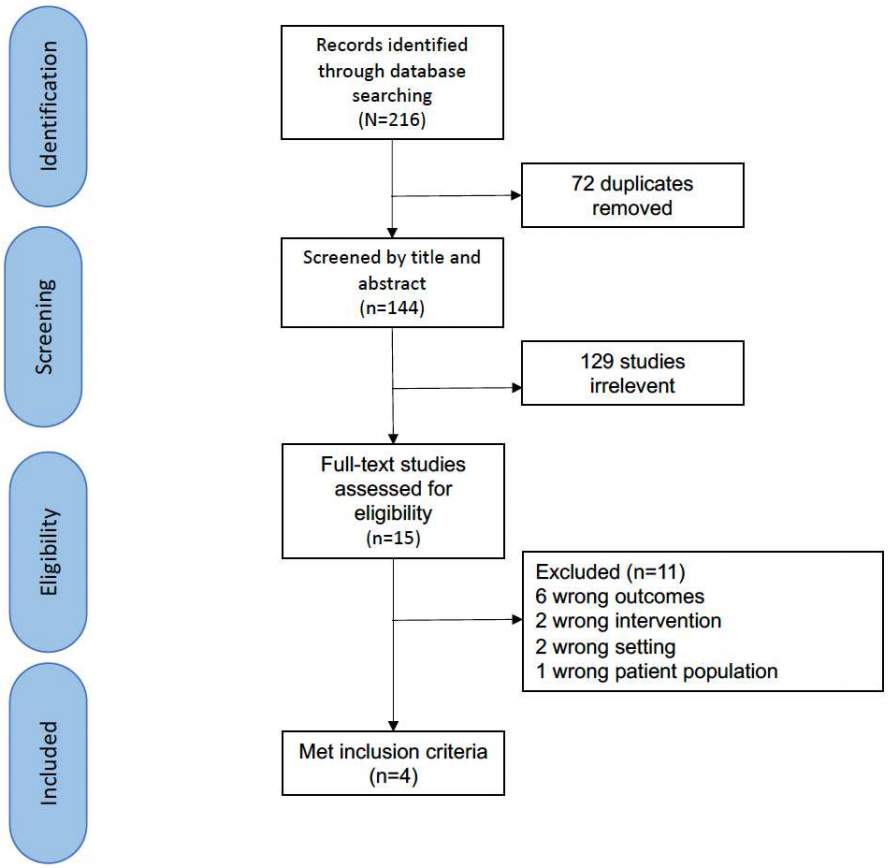

Table 3.1 Search Strategy for Article Identification

Concept	Search term
Physical Relocation	((physical or residential or residence* or home* or location* or neighborhood* or neighbourhood* or city or cities or urban or rural or town*) adj5 relocat*)
Food Intake and Food Selection	exp Feeding Behavior/ exp Food/ or exp "Diet, Food, and Nutrition"/ exp Nutrition Assessment/ (eat OR eats OR eating OR food* OR calorie* OR meal* OR fruit consum* OR vegetable* consum* OR beverage consum* OR water consum* OR diet* behavior?r* OR diet* qualit* OR diet* intak* OR diet* pattern* OR diet* habit* OR malnutr* OR nutrition* OR feeding behavior?r*)

Table 3.2 Characteristics of Included Studies (N = 4)

Characteristic	Number of articles	Percent
Geographical region		
Greece	1	25%
Australia	1	25%
USA	1	25%
Tanzania	1	25%
Study design		
Cross-sectional	2	50%
Longitudinal	2	50%
Outcomes (multiple aims possible)		
Food intake	4	100%
Food selection	4	100%
Food diversity score	1	25%
Calories/Macronutrients	1	25%
Outcome measurement methods (multiple measurements possible)		
Questionnaire	4	100%

Table 3.3 Summary of Results of Included Studies (Scoping Review, low- and high- income countries, 2004-2020, N = 4)

Author, Year, Publication Type, Country	Study Design	Aims and Objectives of The Study	Research Methods	Study Population	Neighbourhood Environmental Attributes	Intervention Results	Safety & Sociability	Conclusions and Additional Comments
Papadaki et al, 2007, Journal, Greece	Cross-sectional	· Assess the influence of relocating away from, or staying in the family home on the dietary habits of Greek undergraduate university students.	· Self-administered questionnaire about consumption of selected foods, general food habits and demographic characteristics.	· 84 under graduate students (61.9% female) aged 22.3 ± 1.8 years. · Findings suggests that food shopping plays a significant role in forming dietary habits; students still living at home where food shopping and cooking were usually performed by a family member did not change their diets in a major way since starting university.	· Urban migration may also explain some of the deterioration from the traditional Greek diet as individuals are purportedly further from fresh, seasonal local produce.	· Diets of university students living at home did not change after starting university. · Students who relocated when starting university modified their dietary habits in a generally undesirable direction; (decreased fresh fruit, raw and cooked vegetables, pulses, oily fish and seafood, olive oil consumption and increased sugar consumption). But, also small positives (decreased white bread and full fat Greek yogurt consumption).	· Greece has a strong cultural identity, with food playing an important role in everyday activities, religious festivals, family and social events. Family influence may have made students still living at home be less susceptible to change their dietary habits.	· Findings suggest the importance of the family environment in forming dietary habits. · Neither group of students achieved recommend intakes, with students who lived at home eating on average 5.2 servings of fruit and 8.3 servings of vegetables per week, while students who lived away from home consuming on average 4.7 servings of fruit and 4.3 servings of vegetables per week.

Butler et al, 2004, Journal, USA	Longitudinal	· Change in diet and body weight among freshman female college students during the first semester of university after relocation from home.	· Block food frequency questionnaire and Sallis exercise and nutrition self-efficacy questionnaire.	· 54 female subjects. 8.54% were 17 years old. 91.64% were 18 years old.		· Pre-relocation caloric intake of 2205/day. · Post-relocation caloric intake of 1857/day. · Post-relocation significant decrease in vegetables, bread/pasta, milk and meat food groups. · Post-relocation significant increase in alcohol consumed.	· Self-efficacy questionnaire suggests the stability of students' confidence to overcome diet obstacles because student perceptions about self-efficacy did not change over time. · Significant decreases in total physical, work, and sport activities, · Significant increase in leisure activities; primarily walking to and from classes.	· Deficiencies in both pre- and post- relocation intake of daily vegetables, fruits, breads and pasta, and meats. · Participants, however, seem to be consuming adequate amounts of milk at both time periods.
Bivoltsis et al, 2020, journal, Australia	Cross-sectional	· To examine the associations of changes in the local food environment, individual behaviours and perceptions, and changes in dietary intake,	· Participants completed a self-reported questionnaire on health, lifestyle behaviours, perceptions, usual food intake and socio-	· 1200 participants (38.3% male) aged 40.5 ± 11.8 years at baseline.	· New developments were typically located in outer suburban, greenfield areas and infill locations; further from the Perth Central Business District. · Compared with previous established neighbourhoods, the food environments	· Moving to a new residential development with more convenience stores, cafés and restaurants around the home was associated with an increase in unhealthy food intake. But, was partially mediated	· Increasing hours of work per week (and income) at baseline was associated with a decrease in unhealthy diet after relocation.	· Increased spatial exposure to convenience stores, cafés restaurants increased unhealthy food intake, whilst an increased percentage of healthy food

		following relocation from an established neighbourhood to a new residential development.	demographic variables prior to relocating and 1–2-years post move.		within the new developments were characterised by a lower percentage of healthy food outlets and greater distances from home to the nearest grocery store.	by individual behaviours and perceptions. · A greater percentage of healthy food outlets around the home following relocation was associated with an increase in fruit/vegetable intake.	· Participants with children < 18 years at home before moving had a significant increase in unhealthy diet following relocation.	outlets around the home increased healthy food intake.
Cockx et al, 2018, journal, Tanzania	Longitudinal	· To compare dietary patterns of individuals before and after relocation from rural to urban areas.	· One-week food consumption recall questionnaire at the household level, combined with a questionnaire on eating away from home at the individual level.	· Baseline: 16,058 individuals from 3,284 households. · Post relocation: 9,417 individuals living in 2580 households. · 913 individuals migrated during the 4-year study window (56% female); 710 moved to another rural area and 238 moved to an urban area.	· Although currently a low-income and low human development, Tanzania is one of the world's most rapidly growing and urbanizing countries; average annual urban population growth accounting to over 5% and average annual GDP per capita growth rate close to 3%. · Tanzania is also characterized by large internal migration movements. · Compared to rural, urban environments contain a proliferation of small mini-markets and clustered food shops.	· Relocating to urban areas caused a significant decrease in maize, cassava consumption and significant increase in bread, pasta, cereal products, sugar, sweet, pastries, sodas, tea, coffee, and meals/snacks consumed outside the house. · Moving to an urban area did not appear to contribute to higher intake of more nutritious food groups.	· Increased restaurant meals and food consumed away from home in urban relocated participants.	· Rural to urban migration men ate significantly more meals/snacks consumed outside of the house than women. · Average controlled direct effect (a measure of the role of a mediator in causal mechanism) of rural-urban migration indicated that income is an important mediator through which rural-urban migration effects dietary change.

Chapter 4. Study 2

Association of Physical Relocation with Healthy Eating Beliefs, Food Intake and Food Selection Among Older Adults

4.1 Abstract

Objective: Residential relocation provides a unique opportunity for studying possible environment-induced changes in food intake and food selection, and the related capability, opportunity and motivation for healthy eating behaviours (COM-B). This was the first cross-sectional study in Canada to compare food intake and selection between two groups of older adults: those who relocated within the past 12 months ("movers") and those who did not ("non-movers").

Methods: Participants included 155 English speaking older adults (aged ≥ 60 years), of which 68 were “movers” and 87 were “non-movers”, residing in Alberta across a mix of affordable, mixed-income, and market-rate housing in small, medium, and large urban regions. Quade Non-Parametric One-Way ANCOVA was used to compare differences by relocation status. Additionally, we investigated the reasons considered by movers in their decision to relocate and their perceived changes in diet since moving to their new neighbourhood.

Results: No significant differences were observed for food intake, food selection, or the COM-B constructs for healthy eating behaviours by relocation status. Notably, 36.8% considered ease of walking, biking, or wheeling to public transport as a very important factor in their decision to relocate. Additionally, 24.6% of movers reported consuming sugary drinks "a lot less now," while 7.7% and 6.2% reported consuming "a lot less now" of fruits (including 100% juice) and vegetables, respectively, in their new neighbourhoods compared to their previous ones.

Conclusion: The lack of observed associations underscores the complexity of dietary behaviours and the multitude of influences that can impact them. Future research should consider longitudinal designs, larger and more diverse samples, and objective measures of dietary intake to provide a more comprehensive understanding of the influence of physical relocation on dietary behaviours among older adults.

4.2 Introduction

The neighbourhood food environment plays a pivotal role in shaping food intake and food selection and, consequently, health outcomes (Caspi et al., 2012). Recent Canadian studies have further emphasized this connection, indicating that both the objective availability of healthy food outlets and individuals' perceptions of their neighbourhood food environment are influential determinants of dietary outcomes (Stevenson, Brazeau, Dasgupta, & Ross, 2019; Vaillancourt et al., 2024). While numerous studies have delved into the intricate relationship between the neighbourhood food environment and health outcomes, there exists a discernible gap in our understanding, particularly concerning older adult populations within Canada (Choi et al., 2022; Souza et al., 2022). Furthermore, previous research has often examined dietary habits and neighbourhood environments separately, with limited studies exploring them concurrently (Papas et al., 2007). Therefore, examining the influence of physical relocation, such as moving to another neighbourhood, can provide valuable insights into the role of the neighbourhood food environment on food intake and food selection, as individuals may be less likely to adhere to previously developed food habits due to the unfamiliarity of the new environment.

The limited literature that delves into the dietary patterns of non-refugees who have recently relocated, juxtaposing their self-reported food intake and food selection with those of their previous neighbourhood, calls for more research (Kouritzin et al., 2023). To date, no research has included older adults and applied appropriate research designs to account for neighbourhood self-selection. For example, older adults with mobility issues may choose different neighbourhoods than their more physically active counterparts, such as congregate-living housing which often contain social supports, cafeterias/restaurants, and elevators.

As global populations continue to age, there is increasing interest in understanding the intricate ways in which physical relocation can lead to changes in the neighbourhood food environment, subsequently influencing dietary behaviours (Kouritzin et al., 2023). This nuance stems from extensive research that highlights the influence of neighbourhood food environments on diet and obesity (Myers, 2023b). Older adults, often vulnerable to changes due to age-related factors, may undergo significant alterations in their daily routines and lifestyles when they relocate (Sanchini et al., 2022). The decision to move, driven by various factors such as health, economic circumstances, or familial reasons, can inadvertently influence an individual's food intake and food selection. This rapidly growing demographic have unique health needs and

present an important opportunity for public health initiatives to address associated health care cost concerns.

Research questions:

How is physical relocation associated with dietary outcomes?

A) How do the COM-B beliefs of movers compare to non-movers?

B) How does the self-reported food intake and food selection of movers compare to non-movers?

C) Among "movers"; how do they perceive a difference in food intake and food selection in their current neighbourhood compared to those in their previous neighbourhoods?

D) Among “movers”, what reasons were considered in their decision for relocating to their new neighbourhood?

E) To what extent do COM-B beliefs mediate physical relocation and self-reported food intake and food selection?

Hypotheses:

A) Relocation may alter the perceived capability (both physical and psychological) to access and prepare healthy foods, the perceived opportunity (external factors, such as neighbourhood food environments that facilitate or hinder behaviour), and the motivation (reflective and automatic processes directing behaviour) toward consuming fruits and vegetables. We hypothesize that older adults who have recently relocated may experience changes in these factors, therefore leading to potentially improved opportunities for consuming fruits and/or vegetables. This supposition is backed by existing literature suggesting that individuals might select their residential areas based on the availability of amenities such as essential food outlets (Lee et al., 2009).

B) Changes in the neighbourhood food environment, such as those caused by relocation, may influence dietary habits. For instance, studies have shown that a higher presence of healthful food establishments near one's residence post-relocation correlates with a rise in the consumption of fruits and vegetables (Bivoltsis et al., 2020). We hypothesize that older adults who have recently relocated will report alterations in their food intake and/or food selection, potentially leading to an increase in the consumption of fruits and/or vegetables.

C) We hypothesize that individuals who have relocated will perceive differences in their current self-reported food intake and selection compared to their previous neighbourhoods. This hypothesis is based on the premise that changes in the physical and social environment resulting

from relocation may influence food availability, accessibility, and social norms surrounding dietary habits. Previous research suggests that individuals' perceived food intake and selection are influenced by the characteristics of their residential areas, including the availability of healthy food options and social norms regarding dietary practices (McInerney et al., 2016).
D) We hypothesize that reasons for moving to a new neighbourhood will vary and may include factors such as ease of walking, biking, or wheeling to grocery stores or farmer's market, proximity to family or social support networks, and safety from crime. This hypothesis is based on the understanding that relocation decisions are multifaceted and influenced by a combination of personal, social, and environmental factors (Willibald, Mukiibi, & Limbumba, 2018).
E) We hypothesize that the COM-B beliefs will mediate the relationship between physical relocation and self-reported food intake and selection. This hypothesis is grounded in the theory that individuals choose residential areas based on various factors, including the availability of amenities such as grocery stores, farmers' markets, and restaurants offering healthy food options. Previous research has demonstrated that neighbourhood characteristics, such as walkability, availability of fresh produce, and access to food outlets, significantly influence dietary behaviours (Caspi et al., 2012). Therefore, we expect that physical relocation will influence COM-B beliefs and, consequently, the self-reported food intake and selection among older adults who have recently relocated.

4.3 Methods

4.3.1 Research Design

This cross-sectional study investigated self-reported capability, opportunity, and motivation for healthy eating behaviours (specifically, the consumption of fruits and vegetables) as measured by COM-B, and self-reported food intake and food selection, between two groups of older adults. The first group consists of individuals who have undergone physical relocation within the past 12 months, referred to as "movers." The second group comprises older adults who have not experienced relocation, referred to as "non-movers." The cross-sectional design provides a pragmatic and effective approach to assess the immediate associations of physical relocation on both COM-B beliefs and food intake and selection (Capili, 2021).

Furthermore, hierarchical regression was employed to explore the extent to which the COM-B beliefs mediate the relationship between physical relocation and self-reported food intake and selection. Figure 4.1 summarizes the hypothesized mediation analysis. Table 4.1 summarizes the relevant variables used as covariates.

4.3.2 Study Sites

The sites consisted of a mixture of affordable housing, mixed income and market rate housing located across large urban, medium urban and small urban regions of Alberta, Canada. This region experiences long, cold, and icy winters, and mild to hot summers.

The Christenson Group of Companies contributed two mixed income study sites for the project, situated in Leduc and Red Deer, and four market rate study sites, situated in Edmonton, Whitecourt, Rocky Mountain House, and Lacombe. Mixed income refers to housing developments where some of the units are offered at market rate, while others are subsidized, meaning eligible residents receive a discount on rent. Telford Mews in Leduc is a six-storey building that features 133 independent living suites, varying between 587 to 960 square feet. Southwoods Court in North Edmonton is a four-storey building that features 51 independent living one bedroom & den and two bedroom & den suites, varying between 730 to 1,485 square feet. Timberstone Mews in Red Deer is a three-story building that features 133 independent living one- and two-bedroom suites, varying between 728 to 1,223 square feet. The Manor in Whitecourt is a three-story building located centrally downtown with 17 independent living life lease units, 50 supportive living units and 2 hospice units, varying between 750 to 1,150 square feet. Ravines Park Avenue in Rocky Mountain House features 57 condominium style independent living apartments and 40 assisted living studio homes, varying between 665 to 1,331 square feet. Royal Oak Village in Lacombe features 73 one- and two-bedroom independent living suites and 88 one- bedroom supportive living suites, varying between 598 to 1,007 square feet.

The Greater Edmonton Foundation contributed three study sites for the project, all situated in Edmonton. Lauderdale Terrace offers 37 independent living units, Grade Garden Court has 35 units, and Gateway Manor consists of 36 units. These housing complexes are designed to provide subsidized accommodation - for low-income seniors aged 60 years and

older. Eligibility for these units requires an annual income of $46,500 or less for individuals, or $58,000 or less for couples. The units vary in size, ranging from 300 to 800 square feet. The units vary in size, ranging from 300 to 800 square feet.

4.3.3 Participants

Participants included 155 English speaking older adults (aged ≥ 60 years) who resided within Alberta, Canada and had no known cognitive defects, of which 68 had moved within the last 12 months (classified as “movers”) and 87 had been at the current residence ≥ 12 months (classified as “non-movers”). The 12-month timeframe was chosen based on evidence suggesting that significant changes in dietary habits can occur within this period following a change in environment (Bin Zarah, Enriquez-Marulanda, & Andrade, 2020; Haidar, Cherfan, Hallit, Rahal, & Safwan, 2023). Individuals aged 60 years and older, residing in an independent living unit at a designated study site received an invitation to participate in the research regardless of gender. Data analysis was adjusted for gender to account for potential variations in food intake and food selection. The exclusion criteria included individuals who were unable to give informed consent, individuals who had cognitive impairment or dementia, and individuals whose understanding of the English language might hinder their ability to accurately answer survey questions. Participants were offered a $25 gift card as a remuneration for completing the survey. Table 4.2 provides a summary of study sites and participant recruitment.

4.3.4 Measures

Participants were administered in-person paper surveys by a trained research assistant. Data from the paper surveys were entered by the administering research assistant into REDcap (Harris et al., 2019), hosted by the University of Alberta. Data entry was double checked by another independent research assistant to ensure accuracy. The questionnaire was developed for the "Designing Communities to Support Healthy Aging in Residents" Study, conducted by the Housing for Health team at the University of Alberta (Ethics approval from the University of Alberta: Pro00092947, and Pro00094863), which evaluated the influences of the neighbourhood environment on residents’ healthy living outcomes (Stearns, Ren, Spence, Avedzi, & Lee, 2021).

Table 4.3 summarizes the test-retest reliability coefficients of the survey questions used in this study.

Health outcomes such as food consumption, social connection, and physical activity were measured. Healthy food consumption was measured using eating behaviour items from the NEMS-P (Green & Glanz, 2015). Following the same formatting, we added questions to assess unhealthy food consumption. These questions were developed to align with the Canadian Food Guide Healthy Eating Recommendations (Canada's Food Guide, 2020). For instance, to address the directive 'limit highly processed foods,' we included questions on processed meat. To reflect the recommendation to 'prepare meals and snacks using ingredients that have little to no added sodium, sugars or saturated fat,' we assessed the consumption of salty snacks, canned soup, and sugary desserts. Lastly, the directive to 'replace sugary drinks with water' was captured by questions on the consumption of regular sodas or pop and other sweetened beverages.

To identify capability, opportunity, and motivation towards healthy food intake, the participants were asked to rate their physical capacity, psychological capacity, physical opportunity, social opportunity, automatic motivation, and motivation to eat fruits and vegetables on a scale from 1-10 (Keyworth, Epton, Goldthorpe, Calam, & Armitage, 2020). For example, to measure the construct of motivation; participants were asked "I am MOTIVATED to...Eat fruits and vegetables" and "I AUTOMATICALLY...Eat fruits and vegetables" on a scale of 0 = strongly disagree to 10 = strongly agree.

To measure the factors influencing the selection of a new neighbourhood among "movers," the questionnaire asked eight questions on reasons guiding their choice of the new locality. The items were adapted from McCormack et al. (2012). For example, participants were prompted to rate the importance of various factors in their decision-making process when selecting their CURRENT neighbourhood, such as "Ease of walking, biking, or wheeling to a grocery store or farmer's market." Responses were recorded on an ordinal scale, with options ranging from 99 for "Did not consider" to 1 for "Not at all important," 2 for "Somewhat important," 3 for "Very important," and 100 for "Don't know."

Two versions of the questionnaire were created: one for "movers," and another for "non-movers,". The "non-movers" survey asked participants about their current neighbourhood, while the "movers" survey asked participants about both their current and previous neighbourhoods. To see a list of all items, and their test-retest reliability refer to Table 3.

4.3.5 Data Analysis

Multiple statistical analysis were performed through Statistical Package for Social Science (SPSS) (IBM Corp, 2023). The primary outcome was fruit and vegetable consumption, which is universally recognized as a proxy for healthy eating(World Health Organization, 2019b). The secondary outcomes included salty food, processed meats, sugary desserts and sugar-sweetened beverages consumption, and the COM-B constructs.

To address research questions A and B, which investigated how physical relocation influences COM-B constructs, and self-reported food intake and food selection among older adults, respectively, analysis of covariance (ANCOVA) was employed. Given the unknown true effect size, a medium effect size was assumed for the analysis (Cohen's $f^2 = 0.25$). One treatment group (movers) and one control group (non-movers) will be considered, with a significance level of 0.05, 80% power, and five covariates (age, education, ethnicity, gender and mobility) included in the model. Based on these parameters, the calculated sample size for each group is determined to be 39, for a total of 78 participants. The R-Code for the ANCOVA power calculation is provided in Appendix-1.

To investigate research questions C and D, which explore whether "movers" perceive differences in food intake and food selection between their current and previous neighbourhoods, and the factors influencing their decision to relocate, frequencies of responses were compared using descriptive analysis.

To address research question E, which explored if COM-B constructs mediated the relationship between physical relocation and food intake and food selection, hierarchical regression was employed. A medium effect size was assumed for the analysis, with a significance level of 0.05 and 80% power. Eight predictor variables, including capability, opportunity, and motivation for healthy eating behaviours (COM-B), and five covariates (age, education, ethnicity, gender, and mobility) were considered in the model. Based on these parameters, the calculated sample size was determined to be 107 (Cohen, 1992).

4.4 Results

4.4.1 Study Participant Demographics

Table 4.4 provides a summary of the participants' demographics. Additional demographic information, including height, weight, and marital status, is available in Appendix 2. Participant demographics did not differ significantly by move status except for use of mobility aids ($p = 0.045$).

The participant demographics for the "movers" (N = 69) were as follows: A majority of participants were women (70.6%), with men comprising 29.4%, and one participant's gender data was missing. The average age was 77.7 ± 8.0 years, with one participant's age missing. Regarding mobility aid usage, 11.8% reported using one always, 33.8% used one sometimes, and 54.4% did not use a mobility aid, with one participant's data missing. In terms of highest education level achieved, 3.0% had no degree, certificate, or diploma; 31.8% had a secondary (high) school graduation certificate or equivalent; 21.2% had a trades certificate or diploma; 21.2% had another non-university certificate or diploma; 1.5% had a university certificate or diploma below the bachelor's level; 7.6% had a bachelor's degree; 4.5% had a university certificate or diploma above the bachelor's level; 1.5% had a master's degree; 7.6% had other types of education, and three participants' education data were missing. Ethnically, the majority were White (94.0%), with 1.5% identifying as Black, 1.5% as Indigenous, and 3.0% as Other, with two participants' ethnicity data missing.

The participant demographics for the "non-movers" (N = 86) were as follows: A majority of participants were women (66.27%), with men comprising 33.73%, with three participants' gender data missing. The average age was 80.4 ± 8.1 years, with four participants' age data missing. Regarding mobility aid usage, 31.40% reported using one always, 32.56% used one sometimes, and 36.05% did not use a mobility aid. In terms of highest education level achieved, 14.63% had no degree, certificate, or diploma; 21.95% had a secondary (high) school graduation certificate or equivalent; 12.20% had a trades certificate or diploma; 7.32% had another non-university certificate or diploma; 13.41% had a university certificate or diploma below the bachelor's level; 8.54% had a bachelor's degree; 3.66% had a university certificate or diploma above the bachelor's level; 1.22% had a degree in medicine, dentistry, veterinary medicine, or optometry; 8.54% had a master's degree; 1.22% had an earned doctorate; 7.32% had other types

of education, and four participants' education data were missing. Ethnically, the majority were White (87.21%), with 1.16% identifying as Chinese, 4.65% as South Asian, 1.16% as Indigenous, and 5.81% as Other.

4.4.2 Research Question A

Research Question A: How does the COM-B of movers compare to non-movers?

No outliers were detected in the data upon boxplot inspection. However, the assumption of normality was violated, necessitating the use of non-parametric tests (Lix, Keselman, & Keselman, 1996). Initially, a Kruskal-Wallis H test was employed to compare the groups, followed by a Quade Non-Parametric One-Way ANCOVA with the inclusion of covariates in the model.

Table 4.5 displays the median, interquartile range (IQR), F-values, degrees of freedom for error (DFE), and significance (Sig) values for the different COM-B constructs (physical opportunity, social opportunity, motivation, automatic motivation, physical capability, and psychological capability) between movers and non-movers.

Findings are reported as median (IQR). Participants were asked to record their responses on an ordinal scale of 0 = strongly disagree to 10 = strongly agree. Physical opportunity to eat fruits and vegetables was 8 (5-10) for the “non-movers” (N = 84) and 8 (6-10) for the “movers” (N = 69). Social opportunity to eat fruits and vegetables was 8 (4-10) for “non-movers” (N = 85) and 8 (5-10) for “movers” (N = 67). Motivation to eat fruits and vegetables was 8 (6-10) for “non-movers” (N = 83) and 8 (6-10) for “movers” (N = 69). Automatic motivation to eat fruits and vegetables was 8 (5-10) for “non-movers” (N = 81) and 8 (5-10) for “movers” (N = 69). Physical capability to eat fruits and vegetables was 9 (7-10) for “non-movers” (N = 82) and 9 (8-10) for “movers” (N = 69). Psychological capability to eat fruits and vegetables was 9 (7-10) for the “non-movers” (N = 81) and 9 (8-10) for the “movers” (N = 67).

No statistically significant differences were observed between relocation groups for: physical opportunity ($F(1, 139) = 0.042$, $p = 0.838$), social opportunity ($F(1, 137) = 0.007$, $p = 0.934$), motivation ($F(1, 138) = 0.541$, $p = 0.463$), automatic motivation ($F(1, 137) = 0.006$, $p = 0.939$), physical capability ($F(1, 138) = 1.529$, $p = 0.218$), and psychological capability ($F(1, 137) = 1.132$, $p = 0.289$).

4.4.3 Research Question B

Research Question B: How does the self-reported food intake and food selection of movers compare to non-movers?

No outliers were detected in the data upon boxplot inspection. However, the assumption of normality was violated, necessitating the use of non-parametric tests (Lix et al., 1996). Initially, a Kruskal-Wallis H test was employed to compare the groups, followed by a Quade Non-Parametric One-Way ANCOVA with the inclusion of covariates in the model.

Table 4.6 displays the median, IQR, F-values, DFE, and Sig values for various food intake categories (fruits, 100% fruit juice, green salad, vegetables, salty snacks, canned soup, processed meat, sugary desserts, regular sodas, and sweetened drinks) between movers and non-movers.

Findings are reported as median (IQR). Participants were asked to record their food intake in the past 30 days on an ordinal scale from: 7 = 2 or more times a DAY; 6 = Once a DAY; 5 = 5-6 times per WEEK; 4 = 3-4 times per WEEK; 3 = 1-2 times per WEEK; 2 = 1-3 times per MONTH; to 1 = Less than once a MONTH or never. Fruit, not counting juice, was 6 (5-7) for “non-movers” (N = 85) and 6 (5-7) for “movers” (N = 68). 100% fruit juice was 3 (2-6) for “non-movers” (N = 83) and 3 (1-5) for “movers” (N = 67). Green salad was 4 (3-5) for “non-movers” (N = 82) and 4 (3-5) for “movers” (N = 68). Vegetables, not counting potatoes or green salad, was 6 (4-7) for “non-movers” (N = 83) and 5 (4-6) for “movers” (N = 68). Salty snacks such as potato chips, French fries, crackers were 2 (1-4) for “non-movers” (N = 85) and 3 (2-4) for “movers” (N = 67). Canned soup was 1 (1-3) for “non-movers” (N = 77) and 1 (1-2) for “movers” (N = 67). Processed meat such as cold cuts, deli-style meat, hot dogs, sausage, bacon was 2 (1-4) for “non-movers” (N = 84) and 2 (1-3) for “movers” (N = 68). Sugary desserts, pastries, and candy (including low-fat and fat-free) was 4 (2-5) for “non-movers” (N = 85) and 4 (2-5) for “movers” (N = 68). Regular sodas or pop, not counting diet soda or sparkling water was 1 (1-2) for “non-movers” (N = 84) and 1 (1-2) for “movers” (N = 67). Sweetened drinks such as fruit drinks, specialty coffees, or iced tea was 2 (1-4) for “non-movers” (N = 84) and 2 (1-4) for “movers” (N = 67).

No statistical differences were between relocation groups for: fruit, not counting juice ($F(1, 140) = 1.06$, $p = 0.305$), 100% fruit juice ($F(1, 138) = 1.539$, $p = 0.217$), green salad (F (1,

134) = 0.651, p = 0.421), vegetables, not counting potatoes or green salad (F (1, 139) = 1.438, p = 0.233), salty snacks such as potato chips, French fries, crackers (F (1, 139) = 3.617, p = 0.059), canned soup (F (1, 126) = 0.013, p = 0.908), processed meat such as cold cuts, deli-style meat, hot dogs, sausage, bacon (F (1, 139) = 2.16, p = 0.144), sugary desserts, pastries, and candy (including low-fat and fat-free) (F (1, 140) = 1.538, p = 0.217), regular sodas or pop, not counting diet soda or sparkling water (F (1, 139) = 0.398, p = 0.529), sweetened drinks such as fruit drinks, specialty coffees or iced tea (F (1, 139) = 3.141, p = 0.079).

4.4.4 Research Question C

Research Question C: Among "movers", how do they perceive a difference in food intake and food selection in their current neighbourhood compared to those in their previous neighbourhoods?

Table 4.7 displays the perceived differences in food intake and food selection among movers in their current neighbourhoods compared to their previous neighbourhoods for various food categories including fruits and 100% fruit juice, vegetables and green salad, salty foods, sugary desserts, and sugary drinks.

Among the "movers," perceptions of their food intake and food selection in their current neighbourhood compared to their previous neighbourhoods are varied. For fruits and 100% fruit juice, 7.7% reported consuming a lot less now, 4.6% somewhat less, 73.8% about the same, 12.3% somewhat more, and 1.5% a lot more. For vegetables and green salad, 6.2% reported consuming a lot less, 10.8% somewhat less, 69.2% about the same, 10.8% somewhat more, and 3.1% a lot more. Regarding salty foods such as potato chips, French fries, canned soup, and processed meats, 12.3% reported consuming a lot less, 20.0% somewhat less, 64.6% about the same, and 3.1% somewhat more, with no one indicating they consume a lot more. For sugary desserts, pastries, and candy (including low-fat and fat-free varieties), 9.2% reported consuming a lot less, 15.4% somewhat less, 69.2% about the same, 4.6% somewhat more, and 1.5% a lot more. For sugary drinks such as coffees, lemonade, and soda (excluding diet soda), 24.6% reported consuming a lot less, 13.8% somewhat less, 60.0% about the same, and 1.5% somewhat more, with no one indicating they consume a lot more.

4.4.5 Research Question D

Research Question D: Among “movers”, what reasons were considered in their decision for relocating to their new neighbourhood?

Table 4.8 displays the reasons movers considered in their decision to relocate to their new neighbourhoods for various factors including ease of walking, biking, or wheeling to public transport, grocery stores, other stores and services, recreational facilities, parks, or trails, affordability of housing, safety from crime, sense of community, and closeness to family/friends.

For the ease of walking, biking, or wheeling to public transport, 8.8% did not consider this factor, 25.0% regarded it as not at all important, 26.5% found it somewhat important, and 36.8% considered it very important, with 2.9% unsure. Regarding the ease of walking, biking, or wheeling to grocery stores or farmer's markets, 10.3% did not consider this factor, 26.5% saw it as not at all important, 27.9% deemed it somewhat important, and 33.8% viewed it as very important, with 1.5% unsure. The ease of walking, biking, or wheeling to other stores and services was not considered by 7.4%, 35.3% felt it was not at all important, 26.5% found it somewhat important, and 29.4% considered it very important, with 1.5% unsure. For the ease of walking, biking, or wheeling to recreational facilities, parks, or trails, 10.3% did not consider this factor, 30.9% rated it as not at all important, 29.4% found it somewhat important, and 27.9% considered it very important, with 1.5% unsure. Affordability of housing was not considered by 5.9%, 33.8% found it not at all important, 57.4% regarded it as somewhat important, and 2.9% saw it as very important, with no respondents unsure. Safety from crime was not considered by 0.0%, 20.9% viewed it as not at all important, 62.7% found it somewhat important, and 13.4% considered it very important, with 3.0% unsure. A sense of community was not considered by 2.9%, 26.5% saw it as not at all important, 57.4% deemed it somewhat important, and 10.3% considered it very important, with 2.9% unsure. Closeness to family and friends was not considered by 7.4%, 32.4% found it not at all important, 47.1% regarded it as somewhat important, and 13.2% considered it very important, with no respondents unsure.

4.4.6 Research Question E

Research Question E: To what extent do the COM-B constructs mediate physical relocation and self-reported food intake and food selection?

A hierarchical multiple regression analysis would have been conducted to determine if the addition of physical opportunity, social opportunity, motivation, automatic motivation, physical ability, and psychological ability accounts for the association between relocation and food intake and selection. However, the analysis revealed no statistically significant associations, indicating that self-reported food intake and food selection do not differ significantly between movers and non-movers.

4.5 Discussion

The primary aim of this study was to examine if physical relocation is associated with dietary outcomes among older adults. Findings for the primary research question showed no statistical differences by relocation. Previous literature reporting differences in dietary outcomes after relocation often involved personal context changes following residential relocation. For example, studies by Butler et al. (2004) and Papadaki et al. (2007) included participants who moved out of the family home to a university campus, a significant contextual change. It may be that there was not enough change in context among older adults in our study to see a change in dietary outcomes. A study by Whitelock and Ensaff (2018) explored the food choices and dietary habits of older adults, revealing that many maintain a routine in their eating habits due to factors like reduced appetite, physical limitations, and the convenience of preparing familiar meals. This research highlighted that older adults often prefer the simplicity and predictability of consuming the same foods regularly. Another study by Takahashi et al. (2020) examined the solitary eating habits of older adults and identified "routinization" as a key theme. Given that 4.5% of movers had never been married, 1.5% were separated, 21.2% were widowed, and 21.2% were divorced, the lack of company during mealtimes may have also been a contributing factor.

Further analysis using the COM-B framework did not reveal significant differences between movers and non-movers. Studies with older adults, such as Whitelock and Ensaff (2018), provide valuable insights that complement our findings. Their research highlights that age-related changes, food access (physical opportunity), social isolation and living alone (social opportunity) substantially influence older adults' food choices and dietary habits. Whitelock and Ensaff (2018) identified that reduced appetite, physical limitations (physical capability), and the convenience of preparing familiar meals (automatic motivation) drive the dietary routines of

older adults. Their research suggests that stability in dietary habits may be a coping mechanism to maintain nutritional intake amidst the challenges of aging and social changes. Additionally, the influence of social isolation (social opportunity) and the challenges of cooking and eating alone (psychological capability) were prominent in their study, which corresponds with our observations regarding the high percentages of widowed, divorced, and never-married individuals among the movers. Comparing these findings with studies focusing on middle-aged adults, such as Timlin et al. (2021), who applied the COM-B model to understand dietary behaviour in 40-55 year-olds, reveals intriguing contrasts. For instance, Timlin et al. (2021) identified barriers like time constraints and work environments (physical and social opportunity) influencing dietary choices, whereas our study with older adults, a different set of dynamics may be at play.

Among the movers, I employed descriptive analysis to explore their perceptions of changes in food intake and selection in their current neighbourhoods compared to their previous ones. The majority of movers reported "about the same" consumption levels for various food categories: 73.8% for fruits and 100% fruit juice, 69.2% for vegetables and green salad, 64.6% for salty foods such as potato chips, French fries, canned soup, and/or processed meats, 69.2% for sugary desserts, pastries, and candy (including low-fat and fat-free), and 60.0% for sugary drinks such as coffee, lemonade, and/or soda (excluding diet soda). Interestingly, 24.6% of respondents indicated they consume sugary drinks "a lot less now," compared to 7.7% for fruits and 100% fruit juice and 6.2% for vegetables and green salad. Additionally, 12.3% reported consuming "somewhat more now" of fruits and 100% fruit juice, and 10.8% reported the same for vegetables and green salad, in contrast to 3.1% for salty foods, 4.6% for sugary desserts, and 1.5% for sugary drinks. Although these findings are based on descriptive data and do not allow for causal inferences, they provide insights into the dietary habits of older adults following relocation. Contrary to the stability observed in this study, some research suggests that older adults do change their dietary habits following significant life changes. For instance, Dean, Raats, Grunert, and Lumbers (2009) found that factors like changes in social support and living arrangements can significantly influence dietary patterns among older adults. Similarly, the Hertfordshire Cohort Study highlighted how community-dwelling older adults often adjust their diet quality based on changes in their physical and social environment (Bloom et al., 2017). These studies indicate that while routine and familiarity play crucial roles in the dietary habits of

older adults, substantial contextual shifts can lead to notable dietary adjustments. Given that we included independent living participants who were generally healthy, the lack of a significant contextual change may have contributed to the stability in their dietary habits.

Additionally, we investigated the reasons considered by movers in their decision to relocate to new neighbourhoods. Participants were asked to rate their level of agreement about the specific factors questioned in the survey. Ease of walking, biking, or wheeling to public transport was with most commonly selected in the “very important” category, with 36.8% of respondents considered it very important. When comparing this finding to existing literature, several key aspects emerge. Research indicates that older adults prioritize proximity to essential services such as grocery stores and health services, which supports their ability to perform daily activities and maintain independence (Levasseur et al., 2017). For example, a study on age-friendly communities within Canada highlighted the importance of access to public transportation, recreational facilities, and a safe neighbourhood environment as significant factors that contribute to positive health outcomes and social participation among older adults (Levasseur et al., 2017). Additionally, factors such as the affordability of housing, safety from crime and sense of community, with 57.4%, 62.7% and 57.4% of movers reporting it as “somewhat important”, respectively, were also notable considerations for the participants, reflecting broader trends seen in the literature on community selection by older adults. Research shows that older adults often prioritize safety, social connections, and affordability when choosing where to live. For instance, a systematic review highlighted that psychological and social factors, such as the sense of control over one's environment and relationships within the community, play crucial roles in housing decisions for older adults (Roy, Dubé, Després, Freitas, & Légaré, 2018). Another study found that older adults consider the accessibility of amenities, the safety of the living environment, and affordability as critical factors influencing their decisions to move or stay in their current homes (Franco et al., 2021). These findings align with the results of our study, indicating that movers' decisions are driven by similar considerations, highlighting the consistent importance of these factors in understanding older adults' housing preferences.

4.6 Limitations

This study has several limitations that should be considered when interpreting the results. Firstly, the cross-sectional design restricts the ability to infer causality between physical relocation and dietary outcomes. The temporal relationship between the variables cannot be established, meaning it is unclear whether relocation leads to changes in dietary behaviours or if other unmeasured factors influence both relocation and diet. Secondly, the reliance on self-reported data introduces the potential for recall bias and social desirability bias. Participants might not accurately remember their food intake or may report what they believe to be socially acceptable rather than their true eating habits. Thirdly, the study's sample is limited to older adults residing in various types of housing in Alberta, Canada, which may limit the generalizability of the findings to other populations or regions with different cultural, social, and environmental contexts.

Moreover, the study's exclusion criteria, such as excluding individuals with cognitive impairments or those who do not speak English, may have led to selection bias, potentially limiting the representation of the broader older adult population. Another limitation is the assumption of a medium effect size for the power calculations, which might not reflect the true effect size, thus impacting the study's statistical power and the robustness of the findings. Additionally, the use of non-parametric tests due to violations of normality assumptions may affect the comparability of the results with studies using parametric approaches.

This study also faced test-retest reliability constraints, with several questionnaire items having poor to moderate intraclass correlation coefficient (ICC). For instance, poor to moderate ICC were found for the food consumption items "fruit, not counting juice" (ICC 0.63, 95% CI 0.48-0.74), "regular sodas or pop" (ICC 0.62, 95% CI 0.47-0.74), and "sweetened drinks" (ICC 0.41, 95% CI 0.21-0.57). These measures may not consistently capture the behaviours they are intended to assess, potentially leading to attenuation of observed relationships.

Furthermore, it is important to consider that non-movers may exhibit characteristics similar to movers, particularly if they have lived in their current residences for extended periods. This could mean that non-movers have established routines and social connections that are similar to those of movers, potentially confounding the study's findings. Future studies should collect and analyze data on the length of time non-movers have lived in their current settings to better understand this potential overlap.

Finally, while the study sites included a mix of affordable, mixed-income, and market-rate housing across small, medium, and large urban regions, variations within these environments, such as access to food resources and community support, were not fully controlled for. This heterogeneity could influence the study outcomes and complicate the interpretation of the results. Future research should consider longitudinal designs, larger and more diverse samples, and objective measures of dietary intake to address these limitations and provide a more comprehensive understanding of the influence of physical relocation on dietary behaviours among older adults.

4.7 Conclusion

This study aimed to explore the relationship between physical relocation and dietary outcomes among older adults in Alberta, Canada. Despite the comprehensive approach, no significant associations were found between relocation and food intake, selection, or COM-B for healthy eating behaviours. This finding suggests that other factors, perhaps unmeasured in this study, might play a more critical role in influencing dietary behaviours among older adults than relocation alone.

The lack of observed associations underscores the complexity of dietary behaviours and the multitude of influences that can impact them. The study's limitations, including its cross-sectional design, reliance on self-reported data, and sample constraints, likely contributed to the inability to detect significant relationships. Additionally, the poor to moderate test-retest reliability of certain survey items might have attenuated potential associations.

Future research should focus on longitudinal designs to better capture the temporal dynamics of relocation and dietary behaviours. Incorporating objective measures of dietary intake and expanding the study to include more diverse populations can provide deeper insights. Furthermore, addressing the reliability issues of survey instruments will be crucial for enhancing the accuracy of future studies.

In conclusion, while this study did not find significant associations between physical relocation and dietary behaviours, it highlights the need for more robust research methodologies and the consideration of a wider range of influencing factors. Understanding the dietary behaviours, and related COM-B constructs of older adults requires a multifaceted approach that goes beyond physical relocation to include broader environmental and social determinants.

Future research efforts should aim to address these complexities to inform effective public health strategies for promoting healthy aging.

Table 4.1 Summary of Relevant Variables for Study #2

Covariate	Justification	Reference
Age	Age is associated with a range of physiological, cognitive, and mobility changes that can significantly influence how individuals interact with their neighbourhood food environment and can influence food taste preferences and choices.	(Drewnowski & Shultz, 2001)
Education	Education level is associated with health literacy, knowledge about nutrition, and awareness of healthy dietary practices. Higher education may lead to better understanding and utilization of environmental cues affecting food choices.	(Wardle, Parmenter, & Waller, 2000)
Ethnicity	Canada is a diverse country with various ethnic groups, each having distinct cultural and dietary practices. Including ethnicity as a covariate helps in examining how different cultural backgrounds influence the perception of the environment and dietary outcomes, specifically food intake and food selection.	(Cini, Caddeo, Pirchio, & Nenci, 2011)
Gender	Men and women may have different food preferences, cultural influences, and dietary habits, which could influence their response to perceived environmental variables related to food intake and food selection.	(Claudia, Anna, Raffaella, Fabio, & Aida, 2012)
Mobility	Mobility can influence access to food resources, while factors such as neighbourhood walkability, sidewalk availability, and the presence of food deserts can influence an individual's ability to engage in food-related activities and may influence dietary behaviours.	(Bertoli et al., 2006)

Table 4.2 Test-Retest Reliability Coefficient for Items Included in Study #2
Bolded coefficients represent Kappa Coefficients, non-bolded coefficients represent interclass correlation coefficients (ICC).

ITEM	MOVER			NON-MOVER		
	N	ICC / Kappa (CI)	Interpretation	N	ICC / Kappa (CI)	Interpretation
Grocery Store Consumer Environment						
It was easy to buy fruits and vegetables in my neighbourhood.	16	0.16 (-0.34, 0.59)	poor-moderate	31	0.44 (0.11, 0.68)	poor-moderate
The produce in my neighbourhood was of high quality.	16	0.38 (-0.11, 0.73)	poor-moderate	31	0.62 (0.34, 0.79)	poor-good
There was a large selection of fruits and vegetables in my neighbourhood.	16	0.45 (-0.02, 0.77)	poor-good	29	0.69 (0.44, 0.84)	poor-good
Food Consumption						
Fruit, not counting juice	83	0.63 (0.48, 0.74)	poor-moderate			
100% Fruit juice	82	0.76 (0.65, 0.84)	moderate-good			
Green salad	80	0.78 (0.68, 0.86)	moderate-good			
Vegetables (do not count potatoes or green salad)	82	0.8 (0.71, 0.87)	moderate-good			
Salty snacks such as potato chips, French fries, crackers	83	0.73 (0.61, 0.81)	moderate-good			
Canned soup	73	0.68 (0.53, 0.78)	moderate-good			
Processed meat such as cold cuts, deli-style meat, hot dogs, sausage, and bacon	82	0.79 (0.69, 0.86)	moderate-good			
Sugary desserts, pastries, and candy (including low-fat and fat-free)	83	0.69 (0.56, 0.79)	moderate-good			
Regular sodas or pop (do not count diet soda or sparkling water)	79	0.62 (0.47, 0.74)	poor-moderate			

Sweetened drinks such as fruit drinks, specialty coffees, or iced tea (do not count 100% fruit juice)	80	0.41 (0.21, 0.57)	poor-moderate			
Change in eating behaviours						
I eat fruits and 100% fruit juice…	28	0.5 (0.16, 0.73)	poor-moderate	49	0.54 (0.31, 0.71)	poor-moderate
I eat vegetables and green salad…	28	0.61 (0.32, 0.8)	poor-good	52	0.31 (0.05, 0.54)	poor-moderate
I eat salty foods such as potato chips, French fries, canned soup, and/or processed meats...	28	0.31 (-0.06, 0.6)	poor-moderate	51	0.63 (0.43, 0.77)	poor-moderate
I eat sugary desserts, pastries and candy (including low- fat and fat-free)	27	0.47 (0.13, 0.72)	poor-moderate	51	0.79 (0.66, 0.88)	moderate-good
I drink sugary drinks such as specialty coffee…	27	0.5 (0.17, 0.74)	poor-moderate	50	0.62 (0.41, 0.76)	poor-moderate

ICC interpretation: ICC<0.5= poor reliability, 0.5≤ICC<0.75= moderate reliability, 0.75≤ICC<0.9= good reliability, ≥0.90= excellent reliability (Koo & Li, 2016)
Kappa interpretation: ≤0 = no agreement, 0.01–0.20 = none to slight agreement, 0.21–0.40 = fair agreement, 0.41–0.60 = moderate agreement, 0.61–0.80 = substantial agreement, 0.81–1.00 = almost perfect agreement (McHugh, 2012)
N = Number of participants
HE = Healthy eating

Table 4.3 Summary of Study Sites and Participant Recruitment for Study #2

Sites	Housing Type	Building Developer	Location Type	Participants who answered the BASELINE survey (#)Movers	Participants who answered the BASELINE survey (#) Non-movers
Montgomery	Affordable Housing*	GEF	Large Urban	5	23
Stratchona	Affordable Housing*	GEF	Large Urban	1	11
Emerald Hills	Market Rate	Christenson	Large Urban	22	0
Gateway Manor	Affordable Housing*	GEF	Large Urban	2	11
Timbertsone Mews	Mixed Income**	Christenson	Large Urban	3	15
Southwoods	Market Rate	Christenson	Large Urban	0	8
Ravine's at Park	Market Rate	Christenson	Small Urban	4	3
Royal Oak Village	Market Rate	Christenson	Small Urban	1	12
Grace Garden	Affordable Housing*	GEF	Large Urban	0	3
Telford Mews	Mixed Income**	Christenson	Medium Urban	18	0
The Manor	Market Rate	Christenson	Small Urban	4	0
Lauderdale	Affordable Housing*	GEF	Large Urban	9	0
Total				69	86
				155	

*Affordable housing for low income residents
**Mixed income is a combination of affordable housing for low income residents and units as market rate

Figure 4.1 Mediation Analysis in Study #2

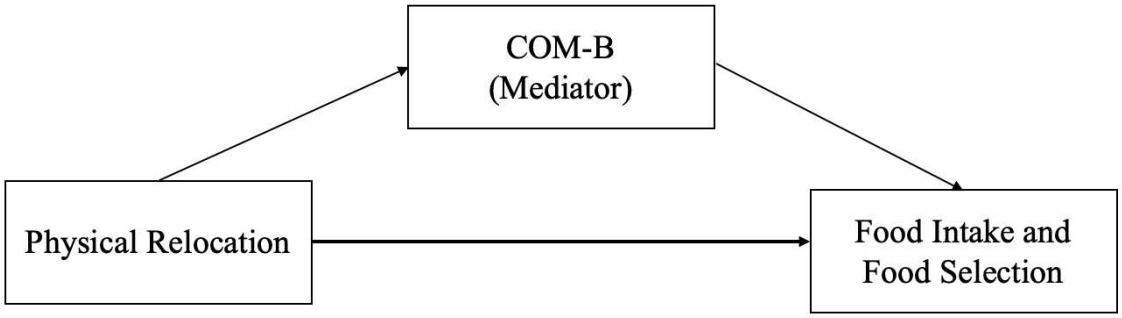

Table 4.4 Participant Demographics in Study #2

		Movers (N = 69)				Non-Movers (N = 86)					
		N	%	Mean	Std. Deviation	N	%	Mean	Std. Deviation	F	Sig
Gender	Men	20	29.4%			28	33.73%			0.26	0.61
	Women	48	70.6%			55	66.27%				
	Other	0				0					
	Missing	1				3					
Age	Missing	1		77.65	7.985	4		80.39	8.099	3.72	0.06
Mobility Aid	Yes, Always	8	11.8%			27	31.40%			4.1	0.045*
	Yes, Sometimes	23	33.8%			28	32.56%				
	No	37	54.4%			31	36.05%				
	Missing	1				0					
Education	No degree, Certificate, or Diploma	2	3.0%			12	14.63%			3.1	0.08
	Secondary (High) School Graduation Certificate or Equivalent	21	31.8%			18	21.95%				
	Trades Certificate or Diploma	14	21.2%			10	12.20%				
	Other Non-University Certificate or Diploma	14	21.2%			6	7.32%				
	University certificate or diploma below bachelor level	1	1.5%			11	13.41%				
	Bachelor's degree	5	7.6%			7	8.54%				
	University Certificate or Diploma Above Bachelor Level	3	4.5%			3	3.66%				
	Degree in Medicine, Dentistry, Veterinary Medicine, or Optometry	0	0.0%			1	1.22%				
	Master's Degree	1	1.5%			7	8.54%				
	Earned Doctorate	0	0.0%			1	1.22%				
	Other	5	7.6%			6	7.32%				
	Missing	3				4					

Note:* P< 0.05

Table 4.4 Participant Demographics in Study #2

		Movers (N = 69)				Non-Movers (N = 86)					
		N	%	Mean	Std. Deviation	N	%	Mean	Std. Deviation	F	Sig
Ethnicity	White	63	94.0%			75	87.21%			0.65	0.42
	Chinese	0	0.0%			1	1.16%				
	South Asian	0	0.0%			4	4.65%				
	Black	1	1.5%			0	0.00%				
	Filipino	0	0.0%			0	0.00%				
	Latin American	0	0.0%			0	0.00%				
	Southeast Asia	0	0.0%			0	0.00%				
	Arab	0	0.0%			0	0.00%				
	West Asia	0	0.0%			0	0.00%				
	Japanese	0	0.0%			0	0.00%				
	Korean	0	0.0%			0	0.00%				
	Indigenous	1	1.5%			1	1.16%				
	Other	2	3.0%			5	5.81%				
	Missing	2									

Note:* P< 0.05

Table 4.5 Research Question A: COM-B

		Descriptive			Quade Non-Parametric ANCOVA		
		N	Median	IQR	F	DFE	Sig
Physical Opportunity	Not Moved	84	8	5-10			
	Moved	69	8	6-10			
	Total	153	8	5-10	0.042	139	0.838
Social Opportunity	Not Moved	85	8	4-10			
	Moved	67	8	5-10			
	Total	152	8	4-10	0.007	137	0.934
Motivation	Not Moved	83	8	6-10			
	Moved	69	8	6-10			
	Total	152	8	6-10	0.541	138	0.463
Automatic Motivation	Not Moved	81	8	5-10			
	Moved	69	8	5-10			
	Total	150	8	5-10	0.006	137	0.939
Physical Capability	Not Moved	82	9	7-10			
	Moved	69	9	8-10			
	Total	151	9	7-10	1.529	138	0.218
Psychological Capability	Not Moved	81	9	7-10			
	Moved	67	9	8-10			
	Total	148	9	7-10	1.132	137	0.289

Table 4.6 Research Question B: Food Intake and Selection

		Descriptive			Quade Non-Parametric ANCOVA		
		N	Median	IQR	F	DFE	Sig
Fruit, not counting juice	Not Moved	85	6	5-7			
	Moved	68	6	5-7			
	Total	153	6	5-7	1.06	140	0.305
100% fruit juice	Not Moved	83	3	2-6			
	Moved	67	3	1-5			
	Total	150	3	2-6	1.54	138	0.217
Green Salad	Not Moved	82	4	3-5			
	Moved	68	4	3-5			
	Total	150	4	3-5	0.65	134	0.421
Vegetables, not counting potatoes or green salad	Not Moved	83	6	4-7			
	Moved	68	5	4-6			
	Total	151	6	4-7	1.44	139	0.233
Salty snacks such as potato chips, French fries, crackers	Not Moved	85	2	1-4			
	Moved	67	3	2-4			
	Total	152	2	1-4	3.62	139	0.059
Canned soup	Not Moved	77	1	1-3			
	Moved	67	1	1-2			
	Total	144	1	1-3	0.01	126	0.908
Processed meat such as cold cuts, deli-style meat, hot dogs, sausage, bacon	Not Moved	84	2	1-4			
	Moved	68	2	1-3			
	Total	152	2	1-4	2.16	139	0.144
Sugary desserts, pastries, and candy (including low-fat and fat-free)	Not Moved	85	4	2-5			
	Moved	68	4	2-5			
	Total	153	4	2-5	1.54	140	0.217
Regular sodas or pop, not counting diet soda or sparkling water	Not Moved	84	1	1-2			
	Moved	67	1	1-2			
	Total	151	1	1-2	0.4	139	0.529
Sweetened drinks such as fruit drinks, specialty coffees or iced tea	Not Moved	84	2	1-4			
	Moved	67	2	1-4			
	Total	151	2	1-4	3.14	139	0.079

Table 4.7 Research Question C: Perceived Change in Food Intake and Selection

	A lot less now		Somewhat less now		About the same		Somewhat more now		A lot more now			
	N	Percentage	N	Percentage	N	Percentage	N	Percentage	N	Percentage	Total	Missing
Fruits and 100% fruit juice	5	7.7%	3	4.6%	48	73.8%	8	12.3%	1	1.5%	65	4
Vegetables and green salad	4	6.2%	7	10.8%	45	69.2%	7	10.8%	2	3.1%	65	4
Salty foods such as potato chips, French fries, canned soup and/or processed meats	8	12.3%	13	20.0%	42	64.6%	2	3.1%	0	0.0%	65	4
Sugary desserts, pastries and candy (including low-fat and fat-free)	6	9.2%	10	15.4%	45	69.2%	3	4.6%	1	1.5%	65	4
Sugary drinks such as coffees, lemonade, and/or soda (not including diet soda)	16	24.6%	9	13.8%	39	60.0%	1	1.5%	0	0.0%	65	4

Table 4.8 Research Question D: Reasons Considered for Relocating to Their New Neighbourhood

	Did Not Consider		**Not At All Important**		**Somewhat Important**		**Very Important**		**Don't Know**			
	N	Percentage	N	Percentage	N	Percentage	N	Percentage	N	Percentage	Total	Missing
Ease of walking, biking, or wheeling to public transport	6	8.8%	17	25.0%	18	26.5%	25	36.8%	2	2.9%	68	1
Ease of walking, biking, or wheeling to grocery store or farmer's market	7	10.3%	18	26.5%	19	27.9%	23	33.8%	1	1.5%	68	1
Ease of walking, biking, or wheeling to other stores and services	5	7.4%	24	35.3%	18	26.5%	20	29.4%	1	1.5%	68	1
Ease of walking, biking, or wheeling to recreational facilities, parks, or trails	7	10.3%	21	30.9%	20	29.4%	19	27.9%	1	1.5%	68	1
Affordability of housing	4	5.9%	23	33.8%	39	57.4%	2	2.9%	0	0.0%	68	1
Safety from crime	0	0.0%	14	20.9%	42	62.7%	9	13.4%	2	3.0%	67	2
Sense of community	2	2.9%	18	26.5%	39	57.4%	7	10.3%	2	2.9%	68	1
Closeness to family/friends	5	7.4%	22	32.4%	32	47.1%	9	13.2%	0	0.0%	68	1

Chapter 5. Study 3

Association of Seasonal Variation with Perceptions of Neighbourhood Food Environment, Food Availability, Accessibility and Affordability, and Food Intake and Food Selection Among Older Adults

5.1 Abstract

Objective: Seasonal variations can influence dietary habits, perceptions of the neighbourhood food environment, and the perceived availability, accessibility, and affordability of food. This cross-sectional aimed to investigate whether perceptions of the neighbourhood food environment, as well as perceived food availability, accessibility, affordability, and food intake and selection, differ between two groups of older adults: those surveyed from December 1st to March 31st ("winter") and those surveyed during other times ("non-winter").
Methods: The study included 155 English-speaking older adults (aged ≥ 60 years) residing in independent units across Alberta, Canada. Participants were surveyed on their perceptions of the neighbourhood food environment, food availability, accessibility, affordability and their dietary habits. Quade Non-Parametric One-Way ANCOVA was used to compare seasonal differences.
Results: No significant differences were found in dietary outcomes or perceptions of the neighborhood food environment, food availability, accessibility, and affordability between winter and non-winter seasons. Participants consistently reported high ease of buying fruits and vegetables, quality of produce, and selection of fruits and vegetables in both seasons. However, perceptions of the price of fresh fruits and vegetables were lower, indicating that produce was considered expensive.
Conclusion: The findings suggest that older adults in Alberta perceive neighbourhood food availability, accessibility, and affordability, as well as self-reported food intake and selection, to remain stable across seasons. This stability may be attributed to consistent food availability facilitated by high import rates and established shopping habits among older adults. Future research should further investigate the interaction between seasonal variations and dietary outcomes using longitudinal designs, larger and more diverse samples, and objective measures of dietary intake.

5.2 Introduction

The perception of one's neighbourhood food environment can be influenced by various factors, including personal experiences, socio-cultural backgrounds, and seasonal variations (Black & Macinko, 2008). Seasonal variations, in particular, can significantly influence food accessibility and choices, especially in regions with distinct seasonal changes. The existing literature suggests that food consumption patterns exhibit seasonal variations (Cai et al., 2004; Ersoy et al., 2018; Smolková et al., 2004). Within Canada, prior research has primarily explored seasonal variations in terms of food insecurity within Inuit communities in Nunavut (Guo et al., 2015). This Canadian study highlights the unique challenges faced by Inuit communities, where food insecurity is influenced by seasonal access to traditional and market foods, reflecting broader issues of food accessibility and cultural practices.

Canadian studies have highlighted that the neighbourhood food environment plays a role in determining food access and dietary quality throughout the year. For example, Minaker et al. (2016) emphasized the need to consider both the retail food environment and climate differences when assessing food access in different Canadian regions. Additionally, Mercille et al. (2016) found that diet knowledge can moderate the impact of the food environment on diet quality among older adults, suggesting that both environmental and individual factors should be considered when evaluating seasonal influences on food accessibility.

In Alberta, Daily mean temperatures range in January from −8°C in the south to −24°C in the north, and in July from 24°C in the south to 16°C in the north (Alberta Agriculture, 2005). These significant temperature fluctuations can influence food access, necessitating a deeper investigation to understand the dynamics of the neighborhood food environment throughout the year.

Research questions:

How is seasonal variation associated with dietary outcomes?

A) How do self-reported perceptions of the neighbourhood food environment differ between older adults surveyed during the winter and those surveyed during the non-winter seasons?

B) How do self-reported perceptions of neighbourhood food availability, accessibility, and affordability differ between older adults surveyed during the winter and those surveyed during the non-winter seasons?

C) How does self-reported food intake and food selection differ between older adults surveyed during the winter and those surveyed during the non-winter seasons?
D) To what extent do self-reported perceptions of the neighbourhood food environment and food availability, accessibility and affordability mediate the relationship between seasonal variation and self-reported food intake and selection?

Hypotheses:

A) Given the potential limitations in access to fresh produce markets and affordability of fruits and vegetables during winter (Conner, Montri, Montri, & Hamm, 2009), we hypothesize that participants will perceive their neighbourhood food environment more negatively during winter compared to non-winter conditions.
B) Considering the challenges posed by winter weather on mobility among older adults (Clarke, Yan, Keusch, & Gallagher, 2015) and the increase in food prices due to higher transportation costs and reliance on imports during winter months (Agriculture and Agri-Food Canada, 2020), we hypothesize that during winter conditions, participants will report lower availability, accessibility, and affordability of food in their neighbourhood compared to non-winter seasons.
C) Drawing from research indicating seasonal variations in fruit and vegetable consumption (Stelmach-Mardas et al., 2016), we hypothesize that older adults will report decreased consumption of fruits and vegetables during winter compared to non-winter conditions.
D) Previous research suggests that seasonal variation can influence individuals' preferences and accessibility to food sources (Spence, 2021), and that regular visits to essential food stores may enhance dietary diversity (Zhang, Zhang, Zhou, & Ma, 2022). Therefore, we hypothesize that self-reported perceptions of the neighbourhood food environment, including food availability, accessibility, and affordability, will mediate the relationship between seasonal variation and self-reported food intake and selection among older adults. Specifically, negative perceptions of the food environment during winter will lead to poorer dietary outcomes.

5.3 Methods

5.3.1 Research Design

This cross-sectional study aimed to investigate how winter and non-winter seasonal variations affected perceptions of the neighbourhood food environment, food availability, accessibility, and affordability, as well as self-reported food intake and selection among older

adults. The cross-sectional design was chosen for its pragmatic and effective approach in assessing the immediate associations of seasonal variation on perceptions of the food environment, food availability, accessibility, and affordability, and food intake and selection (Capili, 2021).

Furthermore, hierarchical regression was employed to explore the extent to which perceptions of the food environment, food availability, accessibility, and affordability mediated the relationship between seasonal variation and self-reported food intake and selection. Figure 5.1 summarizes the hypothesized mediation analysis. Table 5.1 summarizes the relevant variables used as covariates.

5.3.2 Participants

Study sites are from the "Designing Communities to Support Healthy Aging in Residents" Study, conducted by the Housing for Health team at the University of Alberta (Ethics approval from the University of Alberta: Pro00092947, and Pro00094863). Participants included 155 English speaking older adults (aged ≥ 60 years) who resided within Alberta, Canada. Individuals aged 60 years and above, residing in an independent unit at a designated study site received an invitation to participate in the research, regardless of gender. Data analysis was adjusted for gender to account for potential variations in food intake and food selection. The exclusion criteria included individuals who were unable to give informed consent, individuals who had cognitive impairment or dementia, and individuals whose understanding of the English language might hinder their ability to accurately answer survey questions. Participants were offered a $25 gift card as a remuneration for completing the survey. Table 5.2 provides a summary of study sites and participant recruitment.

5.3.3 Measures

Perceived Neighbourhood Environment:

The perceived neighbourhood environment variables utilized in this study were derived from self-reported data collected through survey questionnaires administered as part of the "Designing Communities to Support Healthy Aging in Residents" Study. Table 5.3 summarizes

the test-retest reliability coefficients of the survey questions used in this study. Participants were prompted to rate their perceptions of various factors in their neighbourhood, such as the availability of stores and markets within walking distance. Questions were derived from the Physical Activity Neighbourhood Environment Scale (PANES) survey (Sallis et al., 2010). Responses were recorded on an ordinal scale, ranging from 5 ("strongly agree") to 1 ("strongly disagree"), with an additional option of 99 for "Don't Know."

Perceived Neighbourhood Food Availability, Accessibility and Affordability:

Perceived neighbourhood food environment variables, including food availability, accessibility, and affordability, were assessed using questions derived from the NEMS-P (Green & Glanz, 2015). Participants rated their perceptions of various neighbourhood factors, such as "It is easy to buy fruits and vegetables in my neighbourhood" and "The produce in my neighbourhood is of high quality." Responses were recorded on an ordinal scale, ranging from 5 ("strongly agree") to 1 ("strongly disagree"), with an option of 99 for "Don't Know."

Seasonal Variations:

For the purposes of this study, winter was defined as the timeframe extending from December 1st to March 31st, characterized by usual frozen ground or snow cover, as per the criteria outlined by the Ministry of Agriculture (2022).

5.3.4 Data Analysis

Multiple statistical analysis were performed through Statistical Package for Social Science (SPSS) (IBM Corp, 2023). The primary outcome of interest was fruit and vegetable consumption, which are universally recognized as a quantifiable measurement of healthy eating (World Health Organization, 2019b). The secondary outcomes included the consumption of salty food, processed meats, sugary desserts, and sugar-sweetened beverages, the frequency and duration of visits to each category of food destination (categories d, e, and f), expressed as a percentage of the total time spent in the community (encompassing categories a, b, c, d, e, f, and g), and perceptions of the neighbourhood food environment.

To address research questions A, B, and C, which explored how seasonal variations influenced perceptions of the neighbourhood food environment, food availability, affordability and accessibility, and food intake and food selection, respectively, ANCOVA was employed.

Given the unknown true effect size, a medium effect size was assumed for the analysis (Cohen's f^2= 0.25). One treatment group (winter conditions) and one control group (non-winter conditions) were considered, with a significance level of 0.05, 80% power, and five covariates (age, ethnicity, gender, mobility, and relocation) included in the model. Based on these parameters, the calculated sample size for each group was determined to be 39, for a total of 78 participants. The R-Code for the ANCOVA power calculation is provided in Appendix-1.

To address research question D, which explored if perceptions of the neighbourhood food environment, food availability, affordability and accessibility mediated the relationship between seasonal variation and food intake and food selection, hierarchical regression was employed. A medium effect size was assumed for the analysis, with a significance level of 0.05 and 80% power. Eight predictor variables including essential food stores, sit-down food establishments, and quick-service food outlets, and five covariates (age, ethnicity, gender, mobility, and relocation) were considered in the model. Based on these parameters, the calculated sample size was determined to be 107 (Cohen, 1992).

5.4 Results

5.4.1 Study Participant Demographics

Table 5.4 provides a summary of the participants' demographics. Additional demographic information, including height, weight, education, and marital status, is available in Appendix 2.

Participant demographics did not differ significantly by move status except for use of mobility aids ($p = 0.045$).

The participant demographics for the "winter" group (N = 69) were as follows: A majority of participants were women (68.3%), with men comprising 31.7%, and nine participants' gender data were missing. The average age was 79.8 ± 8.1 years, with nine participants' age data missing. Regarding mobility aid usage, 16.9% reported using one always, 27.1% used one sometimes, and 55.9% did not use a mobility aid, with ten participants' data missing. Ethnically, the majority were White (82.0%), with 6.6% identifying as South Asian, 1.6% as Chinese, 1.6% as Indigenous, and 8.2% as Other, with eight participants' ethnicity data missing. Regarding relocation status, 88.7% had moved in the last 12 months, and 11.3% were non-movers, with seven participants' relocation data missing.

The demographics for the "non-winter" group (N = 86) were as follows: A majority of participants were women (69.57%), with men comprising 30.43%, and seventeen participants' gender data were missing. The average age was 78.8 ± 7.8 years, with twenty participants' age data missing. Regarding mobility aid usage, 21.74% reported using one always, 13.04% used one sometimes, and 65.22% did not use a mobility aid, with seventeen participants' data missing. Ethnically, the majority were White (98.46%), with 1.18% identifying as Indigenous and 1.18% as Other, with twenty-one participants' ethnicity data missing. Regarding relocation status, 44.29% had moved in the last 12 months, and 55.71% were non-movers, with sixteen participants' relocation data missing.

5.4.2 Research Question A-1

Research Question A: How do self-reported perceptions of the neighbourhood food environment differ between older adults surveyed during the winter and those surveyed during the non-winter seasons?

No outliers were detected in the data upon boxplot inspection. However, the assumption of normality was violated, necessitating the use of non-parametric tests (Lix et al., 1996). Initially, a Kruskal-Wallis H test was employed to compare the groups, followed by a Quade Non-Parametric One-Way ANCOVA with the inclusion of covariates in the model.

Table 5.5 displays the median, IQR, F-values, DFE, Sig values for perceptions of the neighbourhood food environment across different components between winter and non-winter seasons.

Findings are reported as median (IQR). For the first eight neighbourhood food environment perception questions, participants were asked to record their responses on an ordinal scale of 4 = strongly agree to 1 = strongly disagree, with 99 = not sure or don’t know. "Many shops, stores, markets, or other places to buy things I need are within easy walking distance of my home" was rated 3.0 (2-4) for "winter" (N = 54) and 2.5 (2-3) for "non-winter" (N = 38). "It is within a 10-15-minute walk to a transit stop (such as bus or train) from my home" was rated 4.0 (3-4) for "winter" (N = 54) and 4.0 (3-4) for "non-winter" (N = 40). "The crime rate in my neighbourhood makes it unsafe to go on walks at night" was rated 3.0 (2-3) for "winter" (N = 53) and 3.0 (2-3) for "non-winter" (N = 40). "The presence of animals such as dogs, coyotes, bears, and cougars makes it unsafe to go on walks" was rated 2.0 (1-3) for

"winter" (N = 53) and 2.0 (1-3) for "non-winter" (N = 40). "The sidewalks in my neighbourhood are well maintained (paved, with few cracks)" was rated 3.0 (2-4) for "winter" (N = 54) and 3.0 (2-4) for "non-winter" (N = 40). "Places for bicycling (such as bike paths) in and around my neighbourhood are well maintained and not obstructed" was rated 4.0 (3-4) for "winter" (N = 52) and 3.5 (3-4) for "non-winter" (N = 40). "The crime rate in my neighbourhood makes it unsafe to go on walks during the day" was rated 1.5 (1-2) for "winter" (N = 54) and 2.0 (1-2) for "non-winter" (N = 40). "There are many places to go within easy walking distance of my home" was rated 3.0 (2-3) for "winter" (N = 55) and 3.0 (2-4) for "non-winter" (N = 40).

No statistically significant differences were reported between groups for: "Many shops, stores, markets, or other places to buy things I need are within easy walking distance of my home" ($F(1, 87) = 0.046$, $p = 0.83$), "It is within a 10-15-minute walk to a transit stop (such as bus or train) from my home" ($F(1, 87) = 0.755$, $p = 0.387$), "The crime rate in my neighbourhood makes it unsafe to go on walks at night" ($F(1, 86) = 1.647$, $p = 0.203$), "The presence of animals such as dogs, coyotes, bears, and cougars makes it unsafe to go on walks" ($F(1, 86) = 0.013$, $p = 0.911$), "The sidewalks in my neighbourhood are well maintained (paved, with few cracks)" ($F(1, 87) = 0.527$, $p = 0.47$), "Places for bicycling (such as bike paths) in and around my neighbourhood are well maintained and not obstructed" ($F(1, 86) = 0.019$, $p = 0.89$), "The crime rate in my neighbourhood makes it unsafe to go on walks during the day" ($F(1, 87) = 0.505$, $p = 0.479$), and "There are many places to go within easy walking distance of my home" ($F(1, 88) = 0.000$, $p = 0.987$).

5.4.2 Research Question A-2

Research Question A: How do self-reported perceptions of the neighbourhood food environment differ between older adults surveyed during the winter and those surveyed during the non-winter seasons?

Table 5.6 displays the median, IQR, F-values, DFE, Sig values for perceptions of the neighbourhood food environment across additional components between winter and non-winter seasons.

Findings are reported as median (IQR). For the second set of four questions regarding perceptions of the neighbourhood food environment, participants were asked to record their

responses on an ordinal scale of 4 = strongly agree to 1 = strongly disagree, with 99 = not applicable and 100 = don't know. "There are sidewalks on most of the streets in my neighbourhood" was rated 1 (1-1) for "winter" (N = 64) and 1 (1-1) for "non-winter" (N = 44). "There are facilities to bicycle in or near my neighbourhood, such as special lanes, separate paths or trails, shared use paths for cycles and pedestrians" was rated 2 (1-2) for "winter" (N = 47) and 1 (1-2) for "non-winter" (N = 28). "There is so much traffic on the streets that it makes it difficult or unpleasant to walk in my neighbourhood" was rated 3 (2-4) for "winter" (N = 56) and 3 (2-4) for "non-winter" (N = 32). "There is so much traffic on the streets that it makes it difficult or unpleasant to ride a bicycle in my neighbourhood" was rated 3 (2-4) for "winter" (N = 40) and 3 (2-3.75) for "non-winter" (N = 32).

No statistically significant differences were reported between groups for: "There are sidewalks on most of the streets in my neighbourhood" ($F(1, 97) = 1.968$, $p = 0.164$), "There are facilities to bicycle in or near my neighbourhood, such as special lanes, separate paths or trails, shared use paths for cycles and pedestrians" ($F(1, 70) = 0.464$, $p = 0.498$), "There is so much traffic on the streets that it makes it difficult or unpleasant to walk in my neighbourhood" ($F(1, 80) = 0.115$, $p = 0.735$), and "There is so much traffic on the streets that it makes it difficult or unpleasant to ride a bicycle in my neighbourhood" ($F(1, 66) = 1.160$, $p = 0.285$).

5.4.3 Research Question B

Research Question B: How do self-reported perceptions of neighbourhood food availability, accessibility, and affordability differ between older adults surveyed during the winter and those surveyed during the non-winter seasons?

Table 5.7 displays the median, IQR, F-values, DFE, Sig values for perceptions of the neighbourhood food availability, accessibility and affordability between winter and non-winter seasons.

Findings are reported as median (IQR). Participants were asked to record their responses on an ordinal scale of 5 = strongly agree to 1 = strongly disagree, with 99 = don't know. For the last neighbourhood food environment perception question, participants were asked to record their responses on an ordinal scale of 1 = very inexpensive to 4 = very expensive, with 99 = don't know. "It is easy to buy fruits and vegetables in my neighbourhood" was rated 5 (4-5) for

"winter" (N = 40) and 5 (4-5) for "non-winter" (N = 52). "The produce in my neighbourhood is of high quality" was rated 5 (4-5) for "winter" (N = 40) and 5 (4-5) for "non-winter" (N = 52). "There is a large selection of fruits and vegetables in my neighbourhood" was rated 5 (4-5) for "winter" (N = 40) and 5 (4-5) for "non-winter" (N = 52). "How would you rate the price of fresh fruits and vegetables?" was rated 3 (3-3) for "winter" (N = 40) and 3 (2-4) for "non-winter" (N = 51).

No statistically significant differences were observed between seasonality groups for: "It is easy to buy fruits and vegetables in my neighbourhood" ($F(1, 86) = 0.65$, $p = 0.424$), "The produce in my neighbourhood is of high quality" ($F(1, 86) = 0.557$, $p = 0.458$), "There is a large selection of fruits and vegetables in my neighbourhood" ($F(1, 86) = 0.144$, $p = 0.705$), and "How would you rate the price of fresh fruits and vegetables?" ($F(1, 85) = 0.733$, $p = 0.394$).

5.4.4 Research Question C

Research Question C: How does self-reported food intake and food selection differ between older adults surveyed during the winter and those surveyed during the non-winter seasons?

No outliers were detected in the data upon boxplot inspection. However, the assumption of normality was violated, necessitating the use of non-parametric tests (Lix et al., 1996). Initially, a Kruskal-Wallis H test was employed to compare the groups, followed by a Quade Non-Parametric One-Way ANCOVA with the inclusion of covariates in the model.

Table 5.8 displays the median, IQR, F-values, DFE, and Sig values for various food intake categories (fruits, 100% fruit juice, green salad, vegetables, salty snacks, canned soup, processed meat, sugary desserts, regular sodas, and sweetened drinks) between winter and non-winter seasons.

Findings are reported as median (IQR). Participants were asked to record their food intake in the past 30 days on an ordinal scale from: 7 = 2 or more times a DAY; 6 = Once a DAY; 5 = 5-6 times per WEEK; 4 = 3-4 times per WEEK; 3 = 1-2 times per WEEK; 2 = 1-3 times per MONTH; to 1 = Less than once a MONTH or never. "Fruit, not counting juice" was rated 6 (5-7) for winter (N = 62) and 6 (4-7) for non-winter (N = 67). "100% fruit juice" was rated 3 (1-5) for winter (N = 61) and 2.5 (1-4) for non-winter (N = 66). "Green salad" was rated 4 (3-5) for winter (N = 60) and 5 (4-6) for non-winter (N = 65). "Vegetables, not counting potatoes

or green salad" was rated 5 (4-6) for winter (N = 60) and 5 (4-6) for non-winter (N = 67). "Salty snacks such as potato chips, French fries, crackers" was rated 2 (1-3) for winter (N = 62) and 2 (1-3) for non-winter (N = 66). "Canned soup" was rated 1 (1-2) for winter (N = 56) and 2 (1-3) for non-winter (N = 64). "Processed meat such as cold cuts, deli-style meat, hot dogs, sausage, bacon" was rated 2 (1-3) for winter (N = 61) and 2 (1-3) for non-winter (N = 67). "Sugary desserts, pastries, and candy (including low-fat and fat-free)" was rated 4 (2-5) for winter (N = 62) and 3 (2-5) for non-winter (N = 67). "Regular sodas or pop, not counting diet soda or sparkling water" was rated 1 (1-2) for winter (N = 61) and 1 (1-2) for non-winter (N = 67). "Sweetened drinks such as fruit drinks, specialty coffees or iced tea" was rated 2 (1-3) for winter (N = 61) and 2 (1-3) for non-winter (N = 67).

No statistical differences were reported between groups for: fruit, not counting juice ($F(1, 121) = 0.496$, $p = 0.482$), 100% fruit juice ($F(1, 119) = 0.309$, $p = 0.579$), green salad ($F(1, 117) = 2.348$, $p = 0.128$), vegetables, not counting potatoes or green salad ($F(1, 120) = 2.303$, $p = 0.132$), salty snacks such as potato chips, French fries, crackers ($F(1, 120) = 1.403$, $p = 0.239$), canned soup ($F(1, 112) = 0.121$, $p = 0.728$), processed meat such as cold cuts, deli-style meat, hot dogs, sausage, bacon ($F(1, 120) = 0.446$, $p = 0.505$), sugary desserts, pastries, and candy (including low-fat and fat-free) ($F(1, 121) = 0.03$, $p = 0.864$), regular sodas or pop, not counting diet soda or sparkling water ($F(1, 121) = 0.306$, $p = 0.581$), sweetened drinks such as fruit drinks, specialty coffees or iced tea ($F(1, 120) = 0.054$, $p = 0.817$).

5.4.5 Research Question D

Research Question D: To what extent do self-reported perceptions of the neighbourhood food environment and food availability, accessibility and affordability mediate the relationship between seasonal variation and self-reported food intake and selection?

A hierarchical multiple regression analysis would have been conducted to determine whether the addition of self-reported perceptions of the neighbourhood food environment, food availability, accessibility, and affordability accounts for the association between seasons and food intake and selection. However, the analysis revealed no statistically significant differences in self-reported food intake and food selection between winter and non-winter seasons.

5.5 Discussion

The primary aim of this study was to examine if seasonal variation is associated with dietary outcomes among older adults. The findings indicated no statistically significant differences between winter and non-winter conditions. Previous literature that reported differences in dietary outcomes among seasons often highlighted changes in the availability of fresh produce due to weather conditions. For instance, studies have shown that the consumption of fruits and vegetables tends to increase in the summer months when produce is more abundant and affordable (Wang et al., 2014). Given that the question "It is easy to buy fruits and vegetables in my neighbourhood" had a median of strongly agree for both winter and non-winter, the perceived stability in fruit and vegetable access across seasons may have been a contributing factor to why no differences were seen. Furthermore, studies specifically utilizing food frequency questionnaires (FFQs) over more open-ended food intake measurement methods, such as those by Shahar et al. (2001), suggest that dietary habits are often more stable and less influenced by seasonal changes. Our study's measurement tool may have also been a contributing factor to our finding that older adults maintain consistent dietary habits regardless of seasonal variations.

Further analysis on self-reported perceptions of the neighbourhood food environment revealed no significant differences between winter and non-winter seasons. Given that overall perceptions of the neighbourhood food environment were very poor, with "there are sidewalks on most of the streets in my neighbourhood" rated with a median of strongly disagree for both winter and non-winter, the lack of significant difference indicates consistent dissatisfaction regardless of season. Previous research that explored how perceptions of neighbourhood environments can vary with seasons among older adults provide contrasting results. For example, Tucker-Seeley, Subramanian, Li, and Sorensen (2009) found that older adults perceived greater barriers to physical activity during winter months, including concerns about safety and walkability. Similarly, Nagel, Carlson, Bosworth, and Michael (2008) reported that older adults were less likely to engage in outdoor physical activities during colder months, attributing it to both environmental and safety concerns. These studies highlight how seasonal changes can significantly influence older adults' perceptions of their neighbourhood environment, particularly in terms of safety. Possible reasons for the lack of significant differences in our study could include uniformly poor safety conditions throughout the year, overshadowing any seasonal

variations. Additionally, the demographic and geographic specifics of our study population (average age = 79, Canada) differ from those in previous research (Tucker-Seeley et al. (2009), average age = 65, USA; Nagel et al. (2008), average age = 74, USA), leading to varying influences of seasonal changes on perceptions of the neighbourhood environment.

Analysis on self-reported perceptions of neighbourhood food availability, accessibility, and affordability revealed no statistical differences between winter and non-winter seasons. Studies, such as Wang et al. (2014), which reported that produce is perceived as more abundant and affordable in the summer months, typically utilized populations outside of Canada. For instance, Sharkey et al. (2010) found that in rural areas of the United States, older adults reported lower availability and higher prices of fresh produce during winter months. Similarly, a study by Liu and Yu (2022) conducted in urban areas of China found that older adults perceived significant seasonal variations in food availability and prices, with winter months experiencing reduced availability and higher prices of fresh produce. This contrasts with our findings, suggesting that geographic and climatic factors, as well as import reliance, may play a role in the stability of perceived food environments across different seasons. It may be that perceived food availability, accessibility, and affordability remain constant in Canada given that about 80% of Canada's fruits and 60% of its vegetables are imported from other countries (Canadian Agri-Food Policy Institute, 2023). The perceived stability in food prices and quality across seasons in our study could also be influenced by the participants' adaptation to seasonal variations over time. Older adults, who often have fixed routines and shopping habits, might develop strategies to cope with seasonal fluctuations, thus perceiving less variation in food availability and affordability. This idea is supported by studies such as those conducted by Blanck et al. (2009), which found that established habits and adaptive strategies can mitigate the influence of seasonal changes on dietary practices.

5.6 Limitations

This study has several limitations that should be considered when interpreting the results. Firstly, the cross-sectional design limits the ability to infer causality between seasonal variations and dietary outcomes. Without a longitudinal approach, we cannot definitively determine whether seasonal changes cause shifts in food perceptions and behaviours or if other unmeasured

factors are influencing these outcomes. Secondly, the reliance on self-reported data introduces the potential for recall bias and social desirability bias. Participants might not accurately remember their food intake or might report what they believe to be socially acceptable rather than their true behaviours. This issue has been documented in the literature, where self-reported measures often do not align with objective assessments, leading to potential inaccuracies in the data (Lytle & Sokol, 2017).

The sample size, while calculated to achieve sufficient power for detecting medium effect sizes, remains relatively small (40 in the winter group and 32 in the non-winter group for the question with the least participant responses), which may reduce the study's ability to identify statistically significant differences. Additionally, relocation within the last 12 months showed a significant difference between groups, and although accounted for as a covariate, may have contributed to differing perceptions of the neighbourhood food environment.

Furthermore, the study's sample is limited to older adults residing in Alberta, Canada. This geographic and demographic specificity may restrict the applicability of the findings to other regions or populations with different cultural, social, and environmental contexts. Weather patterns in Canada can differ significantly between provinces; for instance, Alberta typically experiences cold, snowy winters and warm summers, while coastal provinces like British Columbia have milder, rainier winters and cooler summers (Phillips, 1990). Additionally, the study faced challenges with sample representativeness due to the exclusion of participants with cognitive impairments or those who do not speak English, which may introduce selection bias and limit the broader applicability of our results, especially for newcomers to Canada who may not speak English and are less accustomed to cold winters.

Another limitation lies in the use of non-parametric tests due to violations of normality assumptions. While appropriate for the data, these tests can limit the comparability of our findings with other studies employing parametric approaches. Additionally, some survey items related to food environment perceptions and food intake showed poor to moderate test-retest reliability, potentially attenuating observed relationships. For instance, “It is easy to buy fruits and vegetables in my neighbourhood” had an ICC of 0.44 (95% CI 0.11-0.68). Moreover, the PANES survey, used to assess the neighbourhood environment, has never been specifically validated in older adults. Although PANES has been validated for use in 11 different countries in

adults (ages 18–65 years), its applicability to older adults is untested prior to our utilization (Ding et al., 2013).

Lastly, the study did not fully control for variations within the different environments studied, such as differing access to food resources and levels of community support. This heterogeneity could influence the study outcomes and complicate the interpretation of the results. Future research should consider employing longitudinal designs, larger and more diverse samples, and objective measures of dietary intake to address these limitations and provide a more comprehensive understanding of how seasonal variations influence dietary behaviours among older adults.

5.7 Conclusion

This was the first study to measure seasonal variations in self-reported food intake and food selection of older adults in Canada. No significant differences were found, suggesting that dietary habits remain stable across winter and non-winter seasons. The lack of observed seasonal differences in in self-reported diet could indicate that older adults in Alberta maintain consistent eating patterns throughout the year. This stability might be influenced by established routines or the availability of diverse food options year-round.

Furthermore, no differences were observed in perceived neighbourhood food environment, or food availability, accessibility, and affordability. Given that perceptions of the neighbourhood food environment's sidewalks and facilities for bicycling were strongly disagree and disagree, respectively, the lack of significant difference may be from consistent dissatisfaction regardless of season.

Future research should continue to explore the interplay between seasonal variations and dietary outcomes, employing longitudinal designs, larger and more diverse samples, and objective measures of dietary intake. Such efforts will provide deeper insights into how seasonal changes influence the dietary outcomes of older adults, ultimately guiding more effective public health interventions.

Table 5.1 Summary of Relevant Variables for Study #3

Covariate	Justification	Reference
Age	Age can have a significant influence on food destination choices and travel behaviours. Older adults may have different dietary preferences and mobility patterns compared to younger individuals. Research has shown that age influences food preferences and access to food outlets.	(Kerr et al., 2012)
Ethnicity	Ethnicity influences food preferences and dietary habits due to cultural and traditional factors. Different ethnic groups often have unique cuisines, cooking methods, and food-related customs.	(Carrus, Cini, Caddeo, Pirchio, & Nenci, 2011)
Gender	Men and women may have different food preferences, mobility patterns, and safety perceptions, which may influence older adults' choices of food destinations and access to food retail outlets.	(Claudia et al., 2012)
Mobility	Physical Mobility can significantly influence an individual's ability to engage in various activities, including grocery shopping, cooking, and food preparation.	(Bertoli et al., 2006)
Relocation	Physical relocation within the last 12 months can affect an individual's food-related behaviours. Those who have lived in a location for an extended period may have a better understanding of local food sources, become more integrated into the community, and adapt their dietary choices accordingly.	(Kouritzin et al., 2023)

Table 5.2 Test-Retest Reliability Coefficient for Items Included in Study #3
Bolded coefficients represent Kappa Coefficients, non-bolded coefficients represent interclass correlation coefficients (ICC).

ITEM	MOVER			NON-MOVER		
	N	ICC / Kappa (CI)	Interpretation	N	ICC / Kappa (CI)	Interpretation
PANES						
Many shops, stores, markets, or other places to buy things I needed were within easy walking distance of my home	26	0.61 (0.3, 0.8)	poor-moderate	52	0.73 (0.58, 0.84)	moderate-good
It was within a 10-15-minute walk to a transit stop (such as bus or train) from my home	25	0.81 (0.62, 0.91)	moderate-excellent	54	0.52 (0.3, 0.69)	poor-moderate
The crime rate in my neighbourhood made it unsafe to go on walks at night	25	0.88 (0.74, 0.94)	moderate-excellent	43	0.74 (0.57, 0.85)	moderate-good
The sidewalks in my neighbourhood were well maintained (paved, with few cracks)	26	0.32 (-0.06, 0.62)	moderate-good	53	0.49 (0.25, 0.67)	moderate-good
Places for bicycling (such as bike paths) in and around my neighbourhood were well maintained and not obstructed	24	0.37 (-0.03, 0.67)	moderate-good	44	0.38 (0.1, 0.61)	moderate-good
The crime rate in my neighbourhood made it unsafe to go on walks during the day	28	0.68 (0.43, 0.84)	poor-good	49	0.43 (0.17, 0.63)	poor-moderate
There were many places to go within easy walking distance of my home	28	0.41 (0.05, 0.67)	poor-moderate	55	0.69 (0.52, 0.8)	moderate-good
There were sidewalks on most of the streets in my previous neighbourhood	26	0.85 (0.7, 0.93)	moderate-excellent	51	0.75 (0.61, 0.85)	moderate-good
There were facilities to bicycle in or near my neighbourhood, such as	23	0.59 (0.25, 0.8)	poor-excellent	44	0.65 (0.44, 0.79)	poor-excellent

special lanes, separate paths or trails, shared use paths for cycles and pedestrians						
There was so much traffic on the streets that it made it dificult or unpleasant to walk in my neighbourhood	22	0.7 (0.41, 0.86)	poor-excellent	53	0.5 (0.27, 0.67)	poor-moderate
There was so much traffic on the streets that it made it dificult or unpleasant to ride a bicycle in my neighbourhood	17	0.66 (0.28, 0.86)	poor-excellent	37	0.33 (0.01, 0.58)	poor-moderate
Grocery Store Consumer Environment						
It was easy to buy fruits and vegetables in my neighbourhood.	16	0.16 (-0.34, 0.59)	poor-moderate	31	0.44 (0.11, 0.68)	poor-moderate
The produce in my neighbourhood was of high quality.	16	0.38 (-0.11, 0.73)	poor-moderate	31	0.62 (0.34, 0.79)	poor-good
There was a large selection of fruits and vegetables in my neighbourhood.	16	0.45 (-0.02, 0.77)	poor-good	29	0.69 (0.44, 0.84)	poor-good
Food Consumption						
Fruit, not counting juice	83	0.63 (0.48, 0.74)	poor-moderate			
100% Fruit juice	82	0.76 (0.65, 0.84)	moderate-good			
Green salad	80	0.78 (0.68, 0.86)	moderate-good			
Vegetables (do not count potatoes or green salad)	82	0.8 (0.71, 0.87)	moderate-good			
Salty snacks such as potato chips, French fries, crackers	83	0.73 (0.61, 0.81)	moderate-good			
Canned soup	73	0.68 (0.53, 0.78)	moderate-good			
Processed meat such as cold cuts, deli-style meat, hot dogs, sausage, and bacon	82	0.79 (0.69, 0.86)	moderate-good			

Sugary desserts, pastries, and candy (including low-fat and fat-free)	83	0.69 (0.56, 0.79)	moderate-good
Regular sodas or pop (do not count diet soda or sparkling water)	79	0.62 (0.47, 0.74)	poor-moderate
Sweetened drinks such as fruit drinks, specialty coffees, or iced tea (do not count 100% fruit juice)	80	0.41 (0.21, 0.57)	poor-moderate

ICC interpretation: ICC<0.5= poor reliability, 0.5≤ICC<0.75= moderate reliability, 0.75≤ICC<0.9= good reliability, ≥0.90= excellent reliability (Koo & Li, 2016)
Kappa interpretation: ≤0 = no agreement, 0.01–0.20 = none to slight agreement, 0.21–0.40 = fair agreement, 0.41–0.60 = moderate agreement, 0.61–0.80 = substantial agreement, 0.81–1.00 = almost perfect agreement (McHugh, 2012)
N = Number of participants
PA = Physical activity
HE = Healthy eating
SC = Social connection
PANES = Physical Activity Neighbourhood Environment Scale

Table 5.3 Summary of Study Sites and Participant Recruitment for Study #3

Sites	Housing Type	Building Developer	Location Type	Participants who answered the BASELINE survey (#) Winter	Participants who answered the BASELINE survey (#) Non-Winter
Montgomery	Affordable Housing*	GEF	Large Urban	26	2
Stratchona	Affordable Housing*	GEF	Large Urban	0	12
Emerald Hills	Market Rate	Christenson	Large Urban	0	22
Gateway Manor	Affordable Housing*	GEF	Large Urban	13	0
Timbertsone Mews	Mixed Income**	Christenson	Large Urban	0	18
Southwoods	Market Rate	Christenson	Large Urban	5	3
Ravine's at Park	Market Rate	Christenson	Small Urban	7	0
Royal Oak Village	Market Rate	Christenson	Small Urban	13	0
Grace Garden	Affordable Housing*	GEF	Large Urban	3	0
Telford Mews	Mixed Income**	Christenson	Medium Urban	2	16
The Manor	Market Rate	Christenson	Small Urban	0	4
Lauderdale	Affordable Housing*	GEF	Large Urban	0	9
Total				69	86
				155	

Figure 5.1 Mediation Analysis in Study #3

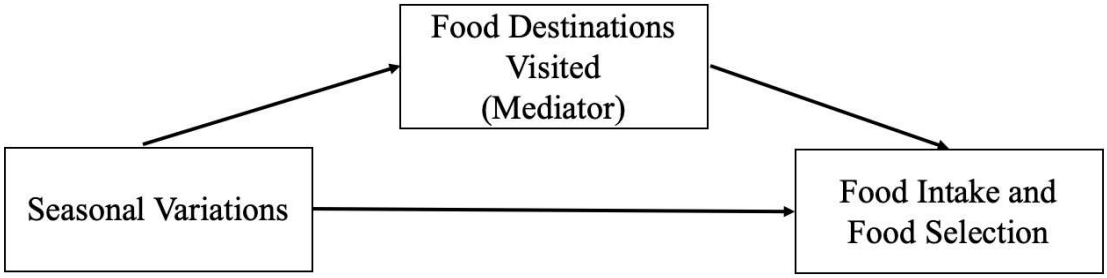

Table 5.4 Participant Demographics in Study #3

		Winter (N = 69)				Non-Winter (N = 86)					
		N	%	Mean	Std. Deviation	N	%	Mean	Std. Deviation	F	Sig
Gender	Men	19	31.7%			21	30.43%			0.022	0.881
	Women	41	68.3%			48	69.57%				
	Other	0				0					
	Missing	9				17					
Age	Missing	9		79.8	8.119	20		78.794	7.839	0.508	0.478
Mobility Aid	Yes, Always	10	16.9%			15	21.74%			0.1	0.752
	Yes, Sometimes	16	27.1%			9	13.04%				
	No	33	55.9%			45	65.22%				
	Missing	10				17					
Ethnicity	White	50	82.0%			64	98.46%			3.278	0.073
	Chinese	1	1.6%			0	0.00%				
	South Asia	4	6.6%			0	0.00%				
	Black	0	0.0%			0	0.00%				
	Filipino	0	0.0%			0	0.00%				
	Latin American	0	0.0%			0	0.00%				
	Southeast Asia	0	0.0%			0	0.00%				
	Arab	0	0.0%			0	0.00%				
	West Asia	0	0.0%			0	0.00%				
	Japanese	0	0.0%			0	0.00%				
	Korean	0	0.0%			0	0.00%				
	Indigenous	1	1.6%			0	0.00%				
	Other	5	8.2%			1	1.54%				
	Missing	8				21					
Relocation	Moved in last 12 months	55	88.7%			31	44.29%			35.92	<0.001**
	Non-Mover	7	11.3%			39	55.71%				
	Missing	7				16					

Note:* P< 0.05, ** P<0.001

Table 5.5 Research Question A1: Perceived Neighbourhood Food Environment

		Descriptive			Quade Non-Parametric ANCOVA		
		N	Median	IQR	F	DFE	Sig
Many shops, stores, markets, or other places to buy things I need are within easy walking distance of my home	Winter	54	3.0	2-4	0.05	87	0.83
	Non-Winter	38	2.5	2-3			
	Total	92	3.0	2-4			
It is within a 10-15-minute walk to a transit stop (such as bus or train) from my home	Winter	54	4.0	3-4	0.76	87	0.39
	Non-Winter	40	4.0	3-4			
	Total	94	4.0	3-4			
The crime rate in my neighbourhood makes it unsafe to go on walks at night	Winter	53	3.0	2-3	1.65	86	0.2
	Non-Winter	40	3.0	2-3			
	Total	93	3.0	2-3			
The presence of animals such as dogs, coyotes, bears, and cougars make it unsafe to go on walks	Winter	53	2.0	1-3	0.01	86	0.91
	Non-Winter	40	2.0	1-3			
	Total	93	2.0	1-3			
The sidewalks in my neighbourhood are well maintained (paved, with few cracks)	Winter	54	3.0	2-4	0.53	87	0.47
	Non-Winter	40	3.0	2-4			
	Total	94	3.0	2-4			
Places for bicycling (such as bike paths) in and around my neighbourhood are well maintained and not obstructed	Winter	52	4.0	3-4	0.02	86	0.89
	Non-Winter	40	3.5	3-4			
	Total	92	4.0	3-4			
The crime rate in my neighbourhood makes it unsafe to go on walks during the day	Winter	54	1.5	1-2	0.51	87	0.48
	Non-Winter	40	2.0	1-2			
	Total	94	2.0	1-2			
There are many places to go within easy walking distance of my home	Winter	55	3.0	2-3	0	88	0.99
	Non-Winter	40	3.0	2-4			
	Total	95	3.0	2-4			

Table 5.6 Research Question A2: Perceived Neighbourhood Food Environment

		Descriptive			Quade Non-Parametric ANCOVA		
		N	Median	IQR	F	DFE	Sig
There are sidewalks on most of the streets in my neighbourhood	Winter	64	1	1-1	1.968	97	0.164
	Non-Winter	44	1	1-1			
	Total	109	1	1-1			
There are facilities to bicycle in or near my neighbourhood, such as special lanes, separate paths or trails, shared use paths for cycles and pedestrians	Winter	47	2	1-2	0.464	70	0.498
	Non-Winter	28	1	1-2			
	Total	75	2	1-2			
There is so much traffic on the streets that it makes it difficult or unpleasant to walk in my neighbourhood	Winter	56	3	2-4	0.115	80	0.735
	Non-Winter	32	3	2-4			
	Total	88	3	2-4			
There is so much traffic on the streets that it makes it difficult or unpleasant to ride a bicycle in my neighbourhood	Winter	40	3	3-4	1.160	66	0.285
	Non-Winter	32	3	2-3.75			
	Total	72	3	2-4			

Table 5.7 Research Question B: Perceived Neighbourhood Food Availability, Accessibility and Affordability

		Descriptive			Quade Non-Parametric ANCOVA		
		N	Median	IQR	F	DFE	Sig
It is easy to buy fruits and vegetables in my neighbourhood	Winter	40	5	4-5	0.645	86	0.424
	Non-Winter	52	5	4-5			
	Total	92	5	4-5			
The produce in my neighbourhood is of high quality	Winter	40	5	4-5	0.557	86	0.458
	Non-Winter	52	5	4-5			
	Total	92	5	4-5			
There is a large selection of fruits and vegetables in my neighbourhood	Winter	40	5	4-5	0.144	86	0.705
	Non-Winter	52	5	4-5			
	Total	92	5	4-5			
How would you rate the price of fresh fruits and vegetables?	Winter	40	3	3-3	0.733	85	0.394
	Non-Winter	51	3	2-4			
	Total	91	3	2-4			

Table 5.8 Research Question C: Food Intake and Selection

		Descriptive			Quade Non-Parametric ANCOVA		
		N	Median	IQR	F	DFE	Sig
Fruit, not counting juice	Winter	62	6.0	5-7	0.496	121	0.482
	Non-Winter	67	6.0	4-7			
	Total	129	6.0	4-7			
100% fruit juice	Winter	61	3.0	1-5	0.309	119	0.579
	Non-Winter	66	2.5	1-4			
	Total	127	3.0	1-5			
Green Salad	Winter	60	4.0	3-5	2.348	117	0.128
	Non-Winter	65	5.0	4-6			
	Total	125	4.0	3-6			
Vegetables, not counting potatoes or green salad	Winter	60	5.0	4-6	2.303	120	0.132
	Non-Winter	67	5.0	4-6			
	Total	127	5.0	4-6			
Salty snacks such as potato chips, French fries, crackers	Winter	62	2.0	1-3	1.403	120	0.239
	Non-Winter	66	2.0	1-3			
	Total	128	2.0	1-3			
Canned soup	Winter	56	1.0	1-2	0.121	112	0.728
	Non-Winter	64	2.0	1-3			
	Total	120	2.0	1-3			
Processed meat such as cold cuts, deli-style meat, hot dogs, sausage, bacon	Winter	61	2.0	1-3	0.446	120	0.505
	Non-Winter	67	2.0	1-3			
	Total	128	2.0	1-3			
Sugary desserts, pastries, and candy (including low-fat and fat-free)	Winter	62	4.0	2-5	0.03	121	0.864
	Non-Winter	67	3.0	2-5			
	Total	129	3.0	2-5			
Regular sodas or pop, not counting diet soda or sparkling water	Winter	61	1.0	1-2	0.306	121	0.581
	Non-Winter	67	1.0	1-2			
	Total	128	1.0	1-2			
Sweetened drinks such as fruit drinks, specialty coffees or iced tea	Winter	61	2.0	1-3	0.054	120	0.817
	Non-Winter	67	2.0	1-3			
	Total	128	2.0	1-3			

Chapter 6. General Discussion

6.1 Overview

The overall goal of this dissertation is to advance the field of knowledge on the associations between the neighbourhood food environment and dietary intake, specifically among older adults in Canada. This dissertation addresses several research gaps identified from the scoping review, including: 1) the influence of relocation on dietary habits among older adults, 2) examining the relationships between the neighbourhood food environment, COM-B constructs, and dietary behaviours, and 3) understanding how changes in the neighbourhood food environment, such as seasonal variation, influence dietary behaviours and related perceptions of the food environment among older adults. This chapter will summarize the key findings of the three studies, outline overarching strengths and limitations of the research, and identify key implications for future research.

In pursuing these objectives, the dissertation explores how physical relocation affects food intake and selection, as well as related COM-B constructs, and the reasons for relocation and perceived changes in dietary behaviours in Study 2. This is followed by an examination of how seasonal variations affect food intake, selection, and perceptions of the neighbourhood food environment, including food availability, accessibility, and affordability in Study 3. This work contributes to a better understanding of the complex interplay between environmental factors and dietary behaviours in older adults.

This chapter will also discuss the broader implications of these findings for public health interventions, urban planning, and policy development aimed at promoting healthier dietary behaviours in aging populations.

6.2 Summary of Findings

Study 1 found that moving to an urban neighbourhood with more convenience stores, cafés, and restaurants around the home was associated with an increase in unhealthy food intake in adult populations. Additional factors such as income, vehicle access, cost, availability, and perceptions of the local food environment played a role in shaping food selection and food intake.

Study 2 found no significant differences in food intake and food selection by relocation status among older adults. Overall, older adults reported high fruit and vegetable consumption with the median for fruit, not counting juice of 6 (5-7), 100% fruit juice of 3 (2-6), green salad of 4 (3-5) and vegetables, not counting potatoes or green salad of 6 (4-7). Low intakes of salty snacks and processed meat were reported with medians of 2 (1-4) and 2 (1-4), respectively. Finally, relatively low intakes of sugar were reported with a median of 4 (2-5) for sugary desserts, 1 (1-2) for regular soda and 2 (1-4) for sweetened drinks. As a whole, the older adults surveyed reported similar dietary habits to the recommendations provided in Canada's food guide; specifically, to prioritize fruit and vegetable consumption and limit consumption of sodium, free sugars, and saturated fat (Government of Canada, 2022).

Furthermore, study 2 found no significant differences in COM-B constructs for healthy eating behaviours by relocation status among older adults in Alberta, Canada. Overall, older adults reported strong COM-B constructs, with the median physical opportunity to eat fruits and vegetables rated at 8 (5-10). Social opportunity was also rated highly, with a median of 8 (4-10). Motivation and automatic motivation to eat fruits and vegetables were strong, with both groups rating these components at a median of 8 (6-10) and 8 (5-10), respectively. Physical capability and psychological capability were also highly rated, both with a median of 9 (7-10).

Study 3 explored older adults' perceptions of their neighbourhood food environment between winter and non-winter seasons. No statistical differences were found. Participants reported consistent availability of shops and transit stops throughout the year, with median ratings of 3 (2-4) and 4 (3-4), respectively. Participants perceived higher crime rates at night (median of 3 [2-3]) compared to during the day (median of 2 [1-2]). They reported well-maintained sidewalks and many places to go within easy walking distance, with median ratings of 3 (2-4) for both. Places for bicycling and transit stops within a 10-15-minute walk from home received positive perceptions with median ratings of 3 (2-4) and 4 (3-4), respectively. However, the questions "There are sidewalks on most of the streets in my neighbourhood" and "There are facilities to bicycle in or near my neighbourhood, such as special lanes, separate paths or trails, shared use paths for cycles and pedestrians" had the lowest perceptions with medians of 1 (1-1) and 2 (1-2), respectively. This suggests that while sidewalks and places for bicycling are well maintained, they are lacking in quantity.

Study 3 also assessed older adults' perceptions of food availability, accessibility, and affordability in their neighbourhoods across winter and non-winter seasons. No statistical differences were found between the seasons. Participants consistently reported high ease of buying fruits and vegetables, quality of produce, and selection of fruits and vegetables, with a median rating of 5 (4-5) for all three categories. However, perceptions of the price of fresh fruits and vegetables were lower, with a median rating of 3 (2-4), indicating that the produce was considered expensive. These findings suggest that while older adults do not face difficulties in the availability and accessibility of fruits and vegetables, affordability remains a concern.

Overall, the findings from these studies provide valuable insights into the different dimensions of the neighbourhood food environment and dietary outcomes among older adults in Alberta, Canada.

6.3 Strengths and Limitations

The specific strengths of each study are discussed in detail in Chapters 3-5. However, some common strengths were observed across the studies. One of the major strengths of this dissertation is that it includes the first studies to examine the influence of relocation on dietary behaviours among older adults and seasonal variations in dietary behaviours among older adults in Canada. Prior research has primarily explored relocation and dietary outcomes in adults (Bivoltsis et al., 2020; Butler et al., 2004; Cockx et al., 2018; Papadaki et al., 2007). Within Canada, prior research has primarily explored seasonal variations in terms of food insecurity within Inuit communities in Nunavut (Guo et al., 2015). Additionally, the studies benefited from a heterogenous mixture of participants from affordable housing, mixed-income, and market-rate housing located across large, medium, and small urban regions throughout Alberta. Another strength is the use of the COM-B model to assess behavioural determinants, providing a comprehensive understanding of the factors influencing dietary behaviours.

The specific limitations of each study are discussed in detail in Chapters 3-5. However, important limitations are addressed here. Firstly, Study 1 was limited by restricting studies to English-language publications and exclusion of gray literature. In study 2 and 3, daily food intake and selection were estimated through FFQ, which is subject to measurement error from incorrect recording of food intake and potential reluctance to report consumption of unhealthy

foods. For instance, previous literature shows that up to 50% of participants may incorrectly self-report food intake and selection (Cook et al., 2000). Second, while the cross-sectional design was chosen in study 2 and 3 for its pragmatic and effective approach in assessing the immediate associations of the neighbourhood food environment and food intake and selection it limits the ability to infer causality between seasonal variations and dietary outcomes. Lastly, the studies did not account for potential confounding factors such as physical activity levels and individual health conditions, which could also influence dietary behaviours.

6.4 Implications and Future Directions

The first implication of this research is that the hypothesis that relocation would influence dietary outcomes and related COM-B constructs in older adults was not supported. Specifically, we found no statistical differences in self-reported food intake, selection, or COM-B constructs between movers and non-movers. One possible explanation is that both movers and non-movers reported high levels of COM for healthy eating behaviours, potentially overshadowing any changes due to relocation. Future studies should consider testing this hypothesis using longitudinal designs to measure within-individual changes over time. Additionally, objective measurements of food intake and selection would help prevent errors from incorrect recording and potential reluctance to report unhealthy food consumption. Furthermore, while the inclusion of participants from mixed-income, market-rate, and affordable housing provided a diverse sample, focusing on each group individually would have allowed for more informative comparisons.

The second implication of this research is that the hypothesis that seasonal variation would influence dietary outcomes, perceptions of the neighbourhood food environment, and food availability, accessibility, and affordability was not supported. One possible explanation is that older adults maintain habitual dietary patterns regardless of the season. Furthermore, given that the study's sample was limited to older adults residing in Alberta, Canada, these findings may be province-specific, given that weather patterns in Canada can differ significantly between provinces. This regional specificity suggests that future research should consider the climatic diversity across different provinces to better understand the potential influence of seasonal variations on dietary behaviours in older adults. Additionally, expanding the study to include a

broader geographic area would help determine if the findings are consistent across different environmental contexts.

Thirdly, the timeframe during which our data was collected may have been a critical factor. Data collection began when restrictions related to COVID-19 in Alberta were lifted in June 2022. Participants may have adjusted their dietary behaviours due to the lockdown and may have been reluctant to explore new food destinations immediately after restrictions were lifted. The pandemic's impact on food purchasing and consumption habits could have influenced the findings, as older adults might have developed new routines and preferences during the lockdown that persisted even after restrictions were eased. Future studies should consider the long-term effects of the pandemic on dietary behaviours and assess whether these changes are temporary or represent a lasting shift in habits.

6.5 Conclusion

This dissertation has made significant contributions to our understanding of the associations between the neighbourhood food environment and self-reported food intake and food selection among older adults in Canada.

Firstly, the findings indicate that relocation does not significantly influence self-reported food intake and selection, or COM-B constructs related to healthy eating behaviours in older adults. This suggests that older adults maintain consistent dietary habits despite changes in their residential environment, likely due to established routines and strong behavioural determinants. Future research should employ longitudinal designs to capture within-individual changes over time and use objective measurements to minimize reporting errors.

Secondly, the hypothesis that seasonal variation would influence dietary outcomes, perceptions of the neighbourhood food environment, and food availability, accessibility, and affordability was not supported. Older adults in Alberta appear to maintain habitual dietary patterns regardless of seasonal changes. This finding underscores the importance of considering regional climatic diversity in future studies to determine if these results are consistent across different environmental contexts in Canada.

Thirdly, the timing of data collection post-COVID-19 restrictions may have influenced the findings, as older adults might have adapted their dietary behaviours during the lockdown

and been hesitant to change these habits immediately after restrictions were lifted. The lasting impact of the pandemic on food purchasing and consumption behaviours should be a focus of future research to assess whether these changes are temporary or represent a permanent shift.

The strengths of this dissertation include its pioneering exploration of relocation and seasonal variation influences on dietary behaviours among older adults in Canada and its use of the COM-B model to comprehensively assess behavioural determinants. The diverse sample of participants from various housing types and urban regions in Alberta further enriches the findings. However, limitations such as the reliance on self-reported food intake, cross-sectional study designs, and unaccounted potential confounding factors highlight areas for improvement in future research.

In conclusion, this dissertation provides valuable insights into the complex interplay between environmental factors and dietary behaviours in older adults. The findings have important implications for public health interventions, urban planning, and policy development aimed at promoting healthier dietary behaviours among aging populations. By addressing the identified limitations and building on the strengths of this research, future studies can further advance our understanding and support the development of effective strategies to enhance the nutritional well-being of older adults in Canada and beyond.

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Appendix-1

Search Strategy for Study #1

Medline Search Strategy

1. ((physical or residential or residence* or home* or location* or neighborhood* or neighbourhood* or city or cities or urban or rural or town*) adj5 relocat*).mp.
2. exp Feeding Behavior/
3. exp Food/ or exp "Diet, Food, and Nutrition"/
4. exp Nutrition Assessment/
5. (eat or eats or eating or food* or calorie* or meal* or fruit consum* or vegetable* consum* or beverage consum* or water consum* or diet* behavio?r* or diet* qualit* or diet* intake* or diet* pattern* or diet* habit* or malnutr* or nutrition* or feeding behavio?r*).mp.
6. 2 or 3 or 4 or 5
7. 1 and 6

Results = 36

Embase Search Strategy

1 ((physical or residential or residence* or home* or location* or neighborhood* or neighbourhood* or city or cities or urban or rural or town*) adj5 relocat*).mp.
2 exp feeding behavior/
3 exp nutritional assessment/
4 exp food/
5 (eat or eats or eating or food* or calorie* or meal* or fruit consum* or vegetable* consum* or beverage consum* or water consum* or diet* behavio?r* or diet* qualit* or diet* intake* or diet* pattern* or diet* habit* or malnutr* or nutrition* or feeding behavio?r*).mp.
6 2 or 3 or 4 or 5
7 1 and 6

Results = 54

Cinahl Search Strategy

S1 ((physical or residential or residence* or home* or location* or neighborhood* or neighbourhood* or city or cities or urban or rural or town*) N5 relocat*)
S2 (MH "Eating Behavior+")
S3 (MH "Food") OR (MH "Food Preferences") OR (MH "Food Habits") OR (MH "Health Food+") OR (MH "Food Quality+") OR (MH "Food Intake+") OR (MH "Food Deserts") OR (MH "Food and Beverages+") OR (MH "Dietary Carbohydrates+") OR (MH "Dietary Fats+") OR (MH "Dietary Proteins+") OR (MH "Fruit+") OR (MH "Meals+") OR (MH "Meat+") OR (MH "Nutrients+") OR (MH "Raw Foods") OR (MH "Salads") OR (MH "Vegetables+") OR (MH "Meat Substitutes") OR (MH "Soy Foods+") OR (MH "Seafood+") OR (MH "Snacks") OR (MH "Seeds+") OR (MH "Nuts+") OR (MH "Mushroom, Edible") OR (MH "Infant Food+") OR (MH "Honey") OR (MH "Herbs, Seasoning") OR (MH "Functional Food") OR (MH "Food, Fortified") OR (MH "Fast Foods") OR (MH "Dairy Products+")
S4 (MH "Nutritional Assessment")

S5 (eat or eats or eating or food* or calorie* or meal* or “fruit consum*” or “vegetable* consum*” or “beverage consum*” or water consum* or “diet* behavio?r*” or “diet* qualit*” or “diet* intake*” or “diet* pattern*” or “diet* habit*” or malnutr* or nutrition* or “feeding behavio?r*”)
S6 S2 OR S3 OR S4 OR S5
S7 S1 AND S6

Results = 15

Scopus Search Strategy
TITLE-ABS-KEY((physical OR residential OR residence* OR home* OR location* OR neighborhood* OR neighbourhood* OR city OR cities OR urban OR rural OR town*) W/5 relocat*) AND TITLE-ABS-KEY(eat OR eats OR eating OR food* OR calorie* OR meal* OR "fruit consum*" OR "vegetable* consum*" OR "beverage consum*" OR "water consum*" OR "diet* behavio?r*" OR "diet* qualit*" OR "diet* intake*" OR "diet* pattern*" OR "diet* habit*" OR malnutr* OR nutrition* OR "feeding behavio?r*")

Results = 110

R- Code for ANCOVA Power Calculation

```
# Load the pwr package
library(pwr)

# Set parameters
effect_size <- 0.15  # Cohen's f²
alpha <- 0.05        # Significance level
power <- 0.80        # Desired power
groups <- 2          # Number of treatment groups
covariates <- 5      # Number of covariates

# Calculate sample size
sample_size <- pwr.ancova.test(f = effect_size, k = covariates, sig.level = alpha, power = power)

# Display the result
sample_size
```

Appendix-2

Supplementary Participant Demographics for Study #2

		Movers (N = 69)				Non-Movers (N = 86)			
		N	%	Mean	Std. Deviation	N	%	Mean	Std. Deviation
Height (cm)	Missing	3		162.3662	12.18107	12		163.134	10.89104
Weight (kg)	Missing	3		77.585	16.788	12		75.67	20.2436
Marital Status	Never Been Married	3	4.5%			9	10.47%		
	Common Law/Married	34	51.5%			18	20.93%		
	Separated	1	1.5%			6	6.98%		
	Divorced	14	21.2%			14	16.28%		
	Widowed	14	21.2%			33	38.37%		
	Missing	3				6	6.98%		

Supplementary Participant Demographics for Study #3

		Winter (N = 69)				Non-Winter (N = 86)			
		N	%	Mean	Std. Deviation	N	%	Mean	Std. Deviation
Height (cm)	Missing	10		163.4666	10.248	28		161.706	13.693
Weight (kg)	Missing	10		75.958	20.542	28		75	17.675
Education	No degree, Certificate, or Diploma	11	19.0%			4	6.25%		
	Secondary (High) School Graduation Certificate or Equivalent	13	22.4%			18	28.13%		
	Trades Certificate or Diploma	7	12.1%			8	12.50%		
	Other Non-University Certificate or Diploma	4	6.9%			10	15.63%		
	University certificate or diploma below bachelor level	5	8.6%			6	9.38%		
	Bachelor's degree	5	8.6%			6	9.38%		
	University Certificate or Diploma Above Bachelor Level	4	6.9%			2	3.13%		
	Degree in Medicine, Dentistry, Veterinary Medicine, or Optometry	0	0.0%			1	1.56%		
	Master's Degree	5	8.6%			3	4.69%		
	Earned Doctorate	1	1.7%			0	0.00%		
	Other	3	5.2%			6	9.38%		
	Missing	11				22			
Marital Status	Never Been Married	9	15.8%			2	2.99%		
	Common Law/Married	12	21.1%			28	41.79%		
	Separated	5	8.8%			2	2.99%		
	Divorced	10	17.5%			13	19.40%		
	Widowed	21	36.8%			22	32.84%		
	Missing	12				19			