The Retail Food Environment: A Rural Perspective

Thesis Submitted By

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ABSTRACT

Through a series of manuscripts, this thesis has critically reviewed, analyzed and discussed the contextual factors that are significant to measuring and intervening in the rural retail food environment.

In order to encourage action and influence change, it is most effective to produce evidence that is meaningful to policymakers, retail owners, and other key stakeholders, guiding them in prioritized and informed decision making. To do this, we need to promote greater transparency in reporting methodology; providing explicit definitions and rationales so that findings are more accessible to knowledge users and can be used to guide future research and policy direction. Reporting on all aspects of the food environment including availability, quality and price as well as the exposure to nutritious and non-nutritious foods are critical to capturing barriers and potential areas for intervention in rural communities.

Improving food access in rural communities will require a comprehensive and multi-sectoral effort. A direct and prioritized approach that addresses the fundamental barriers to food access in rural communities is essential to making impactful improvements in the accessibility of nutritious foods in rural communities and the health and well-being of those who live there.

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LIST OF ABBREVIATIONS

CCHS	Canadian Community Health Survey
HCSNL	Healthy Corner Store Newfoundland
HFAI	Healthy Food Availability Index
HFFI	Healthy Food Financing Initiative
NAICS	North American Industry Classification System
NCC	Nutrition North Canada
NEMS	Nutrition Environment Measures Survey
NEMS-CS	Nutrition Environment Measures Survey for Corner Stores
NEMS-NL	Nutrition Environment Measures Survey Newfoundland and Labrador
NEMS-S	Nutrition Environment Measures Survey for Stores
NL	Newfoundland and Labrador
SSBs	Sugar Sweetened Beverages
TCII	NL Department of Tourism, Culture, Industry and Innovation
ToNEMS	Toronto Nutrition Environment Measures Survey

SECTION I

Background, Rationale & Objectives

CHAPTER 1: Issue History & Theoretical Frameworks Influencing Obesity

1.1 ISSUE HISTORY

Overweight and obesity has been a national concern for over two decades. Data collected by the Canadian Community Health Survey (CCHS) in 2014 revealed that 54% of Canadian adults are defined as overweight or obese.[1] In the same survey, 68% of adults in Newfoundland and Labrador (NL) were classified as overweight or obese, this was the highest rate seen in all of Canada's provinces and territories.[1]

Overweight and obesity is associated with numerous chronic health conditions, including but not exclusive to, type 2 diabetes, cardiovascular disease, hypertension, osteoarthritis and certain types of cancer.[2] According to the CCHS, 25% of Newfoundland adults suffer from hypertension, and 9% have been diagnosed with diabetes; not only do these rates exceed the national average, they are the highest provincial/territorial rates in Canada.[1] Further, 40% of Newfoundland's population live in rural or remote communities.[3] It has been consistently documented that people living in rural and remote communities have poorer health status than Canadians who live in urban areas.[4] Canadians living in rural areas are more likely to be of poor socio-economic status, practice less healthy behaviors and to have higher overall mortality rates than urban residents[4], making them even more vulnerable to the negative health outcomes related to overweight and obesity.

Overweight and obesity is a complex issue with multiple contributing factors. In the simplest description, an individual will become overweight or obese when their energy intake consistently exceeds their energy output.[5] Numerous factors contribute to

overweight and obesity but one of the most influential contributors is poor nutrition. It has been widely accepted that poor diet quality, including diets that are high in fat, sugar, salt and contain fewer nutrient dense foods such as fruits, vegetables and whole grains, can lead to the energy imbalance that causes overweight and obesity.[5] Currently, Newfoundland has the second lowest fruit and vegetable consumption in Canada; only 26% of individuals 12 and older consuming at least 5 servings of vegetables and fruit per day.[1]

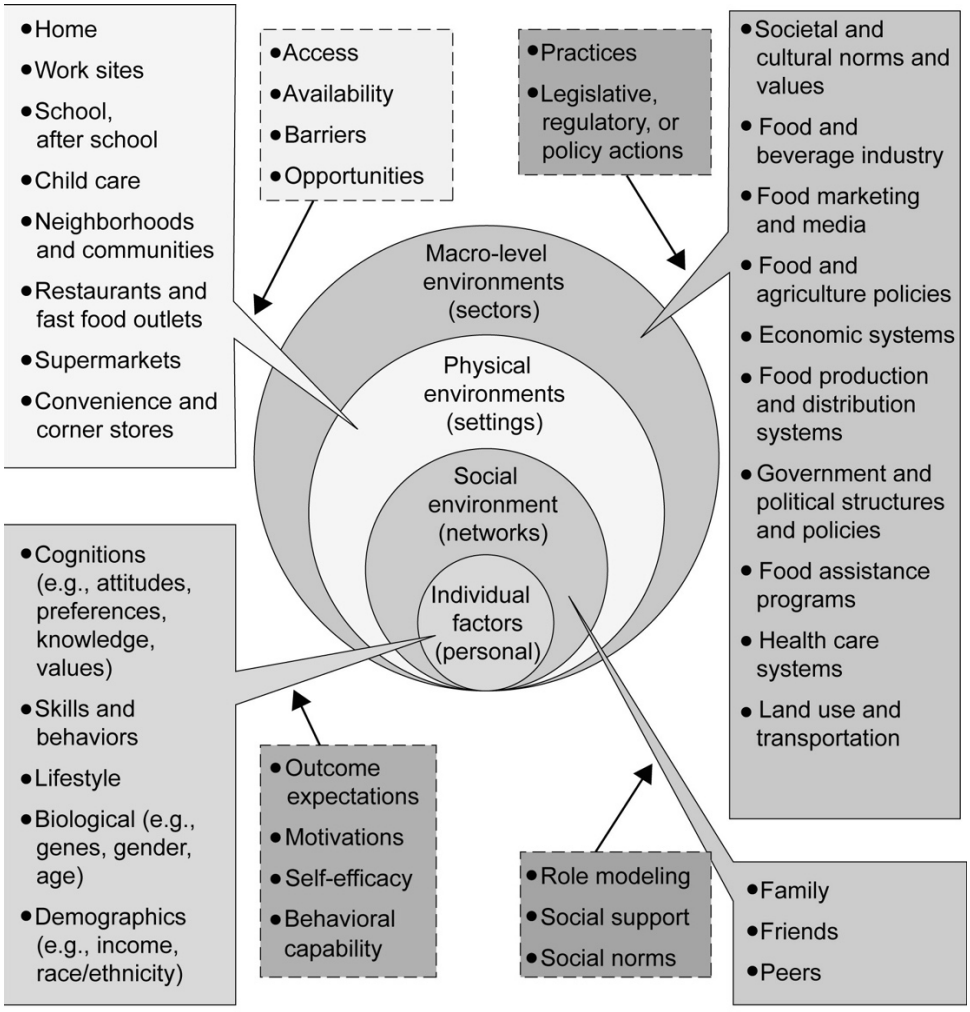
1.2 THEORETICAL FRAMEWORKS OF FACTORS INFLUENCING OBESITY

What public health researchers have become increasingly interested in is which factors contribute to poor dietary behaviors.[6] Peripheral to the biological reasons people eat (i.e. hunger, appetite and taste), various other factors of the social and built environments can independently and collectively work to influence individual food choice.[6] Researchers across disciplines have dedicated efforts to understanding how these factors work and interact as determinants of dietary behavior.

Using an ecological framework, Story et.al, illustrated the multifactorial influences on dietary behavior as a nested model (Figure1-1).[6] They have defined the most exterior determinants as macro-level environments and sectors which include societal and cultural norms and values as well as legislative, regulatory or policy action within government and industry. Within macro-level environments are physical environments (home, work, school) and community environments and the access, availability, barriers and

opportunities to interact with food within these settings. Within physical environments are social environments, an individuals' family, friends and peer networks, social norms and social supports. Finally, within social networks there are the individual level or personal factors, including biological and socioeconomic demographics, attitudes, preferences, and knowledge and skills surrounding food.[6]

Figure 1-1 Ecological framework of multifactorial influences on diet

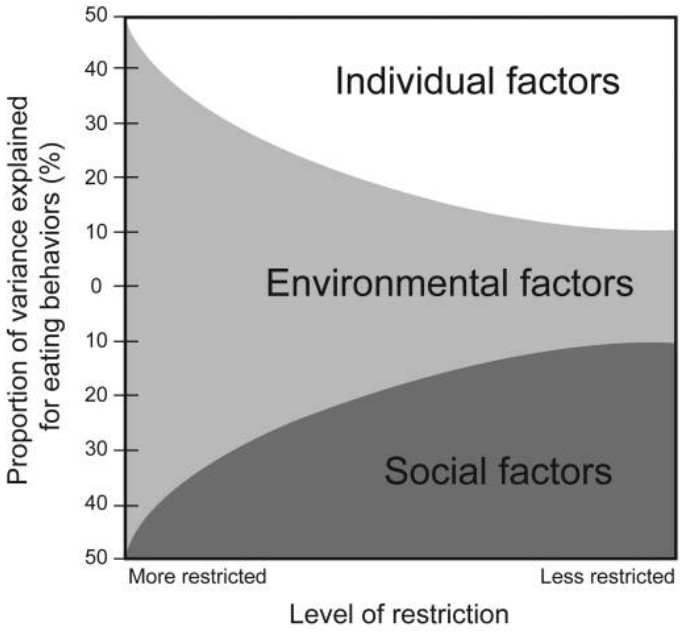


Story, M. et al. 2008. Reproduced with permission.

Recognizing how these factors and systems have changed to impact the food environment is imperative to the investigation into individual food choice and understanding the obesity epidemic. Macro-level systems have evolved and have become more sophisticated; cultivating an increase in the marketing, availability and affordability of highly processed, high fat and high sugar food and drink, larger portion sizes and increased dependence on and accessibility to low nutrition fast foods and ready-made items.[6] As a result, these changes are interacting and influencing physical environments, social systems and individual level preferences and behaviors.[6]

Lytle conceptualized this relationship between environmental factors and individual and social factors using a visual schematic (Figure 1-2).[7] The model demonstrates that as the availability and accessibility of healthy options become more restricted, the stronger the influence the physical environment may have on individual food choice. Alternatively, as availability and accessibility increase, the influence of the physical environment may decrease and the influence of individual behavior and social factors may increase.[7]

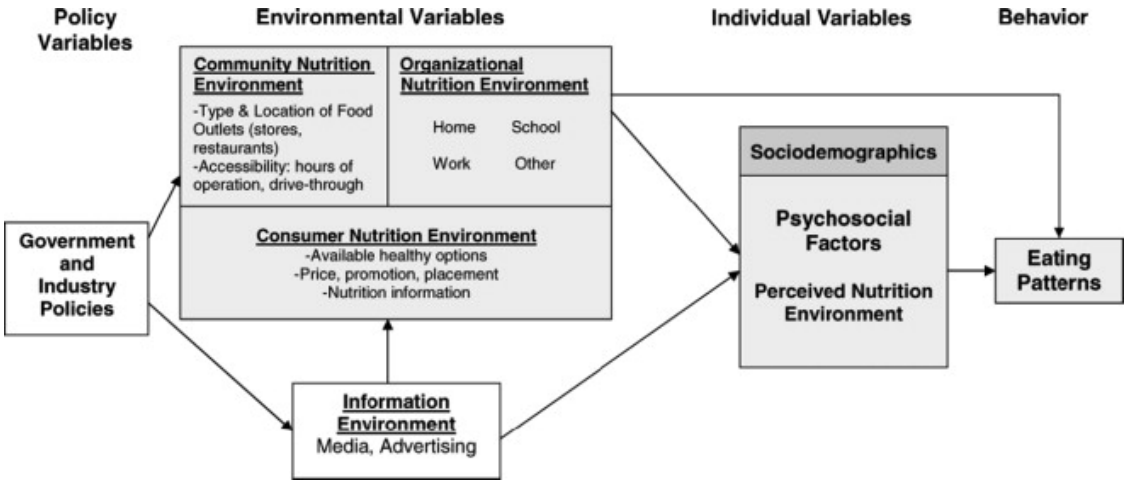
Figure 1-2 The relationship among individual, environmental and social factors



Lytle, L. 2009. Reproduced with permission.

Acknowledging the significant transformation in the physical environments and the concept that in order to observe change in individual behaviors there must be supportive environments in which to make healthy choices, Glanz and colleagues [8] took a narrower scope, inspecting the elements of the physical food environment while also considering how it is affected by the multiple levels of interacting influences. They divided the physical food environment into 3 components: the *community nutrition environment*, defined as the type and location of food outlets; the *organizational nutrition environment* including those within work, schools and home; and the *consumer nutrition environment*, involving the availability of foods and the price, promotion and placement within an outlet (Figure 1-3).[8]

Figure 1-3 Model of community nutrition environment



Glanz, K. et, al. 2008. Reproduced with permission.

This research has been conducted under the lens of the Glanz model. Combining the scope of the consumer and community nutrition environment, we have investigated the retail (consumer) food environment within the context of the geographic accessibility and the in-store availability, quality and price of nutritious food across a defined area or community.

CHAPTER 2: Existing Evidence & Local Context

2.1 EXISTING EVIDENCE

In response to the concerning rates of obesity and other diet related diseases, the study of the physical food environment has commanded attention among nutrition and public health researchers in recent years.[9] A 2013 review by Health Canada[9] included as many as 81 food environment articles, all which have been published since 2000. A more recent review, published in 2016[10], included 88 Canadian food environment articles, 75% of which had been published in the last 5 years. Unfortunately, as recognized in the Health Canada review and by others, the majority of literature available on food environments has been conducted within low income urban areas and few researchers have considered the food environment in a rural context.[9,10]

The taxonomy of rurality is multifaceted and this complexity will be explored at more detail throughout this thesis. However, at the broadest interpretation, and for the purpose of this thesis, rural areas are anything outside of what is generally considered urban. Rural communities differ from their urban areas because they have smaller populations over a larger area of land.[4] Rural residents are further from the metropolitan area and often have to travel a significant distance for some of their basic necessities.[4] Public transportation is often limited in rural communities[4], therefore, residents that do not have access to a vehicle may have increased reliance on nearby food retailers. As a consequence of these disparities, it may be inappropriate to generalize food environment research conducted in urban areas to rural food environments.

The research that has been done within rural food environments has indicated geographic access to supermarkets and grocery stores is significantly limited in rural communities and there is a higher density of small convenience stores compared to their urban counterparts.[11] This is concerning because of evidence indicating that most often, larger supermarkets and grocery stores have a larger variety of affordable nutrient dense foods while smaller convenience and corner stores have a higher availability of less nutritious, energy dense, snack foods.[11] When healthier items are available in small stores, they tend to be of a higher price and lower quality.[11]

Research conducted by Leise and colleagues surveying store density and store distribution in a primarily rural South Carolina county found that 60% of rural communities in the county had no supermarket and 40% had no grocery store, while 49% of the county's convenience stores were located in the rural areas.[12] Comparably, Vilaro et al. measured the food environment in rural Florida and found that 72% of the food retailers in the community of interest were convenience stores.[13] Dean et al. analyzed the community food environment by distance and documented that it was on average 8.9 miles to the nearest supermarket or supercenter in rural areas and only 3.0 miles in urban areas.[14] Similarly, Michimi and Wimberly found it was on average 8.1 miles to the nearest supermarket or supercenter in rural areas compared to 3.6 miles in urban areas [15].

This geographic disparity is troubling because research has shown the lack of access to supermarkets and grocery stores can have a significant impact on the types of food available to those in rural communities.[11] The work by Leise et al. also examined food

availability in rural supermarkets, grocery stores and convenience stores, revealing that the availability of healthy foods including low-fat/fat-free milk, apples, high fibre bread and eggs was considerably higher in supermarkets and grocery stores.[12] Only 2% of convenience stores offered any produce, only 2% offered low-fat/non-fat milk and only 4% offered high fiber bread.[12] The most frequently offered healthy items included low fibre bread (86%) and whole milk (68%) [12] A similar study by Jithitikulchai et al. had comparable findings.[16] All of the surveyed items were available at all urban supermarkets but fewer were available in rural supermarkets.[16] Canned vegetables were the most common type of vegetables sold in rural convenience stores, only 3% had fresh apples, bananas, onions and tomatoes and even fewer had oranges and carrots.[16] Very few of the rural convenience stores sold fresh meat or poultry and skim milk and whole wheat options were rare.[16] Both studies also measured the price of healthier options and found that the average cost of healthy items (when available) including fresh produce, eggs, low-fat/fat free milk and whole grains, were substantially higher at convenience stores than at supermarkets and grocery stores.[12,16]

Using a comprehensive approach, Vilaro et al. examined the availability, price and quality within retail stores using scoring system.[13] Supermarkets scored on average 21.33 out of a possible 30 points for the availability of healthy items, while convenience stores had a mean score of 2.88.[13] When comparing price between healthy and unhealthy items, supermarkets scored an average of 4.67 out of 17 possible points while convenience stores scored 0. When measuring quality of fresh produce, supermarkets scored an

average 6.00 out of 6 possible points compared to an average of 3 points in convenience stores.[13]

The evidence provided in this sample of food environment literature demonstrates the significant barriers to food access in rural communities. The geographic access to supermarkets in rural communities is limited and as a result rural residents may be forced to rely on smaller convenience stores for their groceries. Convenience stores were shown to have limited availability of healthy items and what was available was considerably more expensive than they were at larger supermarkets and grocery stores.

2.2 THE LOCAL CONTEXT

These findings are of particular concern to Newfoundland due to the significant proportion of the population residing in rural or remote areas.[3] Research has also shown Newfoundland has the highest number of convenience stores per capita of any province/territory in Canada (~1 per 495) and the highest proportion of convenience stores in rural areas (72%), suggesting convenience stores play a larger role in food choices in Newfoundland than elsewhere in Canada.[17] Unfortunately, despite the evidence that poor food environments exist in Newfoundland and Labrador, few provincial policies and strategies are in place to improve access to healthy nutritious food, demonstrating an urgency for action.[18]

Researchers at the Food Policy Lab at Memorial University acknowledged the need for investigation and have launched the Healthy Corner Stores NL project.[17,19] The aim of the project is to implement a pilot program to define and test the potential for healthier foods in Newfoundland convenience stores.[17,19] To inform their project, researchers have conducted Nutrition Environment Measures Surveys (NEMS), collecting data on the availability, quality and price of healthy foods in 78 convenience stores across the Avalon Peninsula.[19] To date, only preliminary analysis has been conducted on the availability of select items and further analysis is needed to get comprehensive perspective of all relevant features of the food environment.[19]

CHAPTER 3: Evidence to Action: Measuring the Food Environment and an Introduction to the Nutrition Environment Measures Survey

3.1 MEASURING THE FOOD ENVIRONMENT

In order to encourage action and influence change, it is most effective to produce evidence that is meaningful to policymakers, retail owners and other key stakeholders, guiding them in prioritized and informed decision making. This concept is referred to as the element of "response" in a 3 tiered model of the factors to consider when deciding on a food environment assessment strategy proposed by Dr. Leia Minaker, a food environment researcher at the University of Waterloo.[20] In the model she refers to three considerations that should drive food environment assessment: resources, relevance and response. Resources refers to the consideration of what is feasible and appropriate within the community of interest before conducting a food environment assessment. Relevance refers to how food environment problems are related to an outcome of interest. Finally, response refers to the ability of policy-makers to find meaning out of and act on the evidence presented.[20]

Despite the increasing interest in the food environment, there are limited recognized and standardized methods available to measure the key constructs of the food environment in a way that will portray the overall healthfulness of a retailer and identify priority areas where change is needed.[21] A review by Kelly et.al in 2009, explored the available methods and measures of the food environments and identified an extensive list of classification tools, instruments and indices that are being used to measure and define community and consumer food environments.[21] The Health Canada review "Measuring the Food Environment in Canada" has also highlighted the number of existing food

environment assessment methods, referring to a database of over 500 assessment tools compiled by the United States National Cancer Institute.[22] However, as acknowledged by Dr. Minaker, "There are thousands of food environment features that are measurable, but not all measures are equal in terms of their ability to raise awareness or inform policy priorities.".[20]

Methods relevant to the retail food environment can be classified into two categories: consumer (retail) nutrition environment measures and community nutrition environment measures, corresponding with the priority concepts of the food environment as modeled by Glanz et al [10,21] Community nutrition environment measures are defined as those examining geographic access by measuring the density, proximity or variety of food retailers within a defined area. [9,10,] Based on the evidence that grocery stores and supermarkets have a higher availability of nutritious foods compared to convenience stores, some researchers define the healthfulness of food environments using exclusively geographic access. Many researchers will use a pre-existing database of food retailers developed by related organizations, such as the provincial food establishment license database.[10,21] Often these databases will code stores by store type, one of the most commonly used systems is the North American Industry Classification System (NAICS). Once the geographic coordinates of the relevant food retailers have been determined, the distance, density or variety of store types within the study area can be measured.[10,21] The disadvantage of this method is that it relies on the accuracy of existing databases and the assumption that findings in previous literature are generalizable.[21] The appeal to this method is that it is simpler and requires minimal resource and time, allowing researchers

to measure the food environment in large areas more efficiently. This approach is most effective for environmental scans or needs assessments; it allows researchers to identify whether food environment disparities exist, but is limited in its ability to measure or describe the key constructs of the food environment that are necessary to guide community level action.

Direct observation of the consumer food environment has been considered a more sophisticated and robust measure of the food environment.[21,23] Consumer food environment measures involve assessment of the availability, quality and price of food within stores.[10,21] A variety of different tools are available to measure the constructs of the consumer food environment. Market baskets have been used to measure food affordability, checklists and surveys to collect data on the availability, price or quality of foods and shelf base measures which assess the prominence of food within stores.[10,21] These approaches are more resource intensive, however, the benefit of working in rural areas that there are few and smaller retailers, making it more feasible to measure the actual availability, price and quality of foods within the community.[20]

3.2 NUTRITION ENVIRONMENT MEASURES SURVEY

Among the most widely used consumer nutrition environment measurement tools is the Nutrition Environment Measurement Survey (NEMS). NEMS is an observational survey designed by Glanz et al., to survey the consumer nutrition environments including the availability, pricing and quality of food within retail food environments.[24] The items

included in the survey were selected based on the types of food that contribute the most fat and calories to an average American diet and those that are most recommended for healthful eating. The development of the food list was informed by publications from various relevant federal government agencies, health professional organizations and researchers.[24] Items in the NEMS are organized into 11 categories and with the exception of fruit and vegetables, each category has "regular" options and "healthful" options. Points are awarded for having the healthy options of the audited items and for some items additional points are awarded for having increasing variety.[24] Price is measured comparatively, therefore, points are given for having the healthy option priced lower than the regular option for each audited item and points are subtracted if the healthful option is priced higher than the regular option.[24] Quality is measured for fresh fruit and vegetables only and points are awarded based on the proportion of all fruit items and the proportion of all vegetable items that have been recorded as acceptable.[24] Scores are calculated for availability, quality, and price, and an overall score combines the 3 dimensions. A higher score indicates higher quality, availability, and/or lower prices for the healthier items.[24]

Although there is no gold standard in food environment measures, NEMS frequently serves as the "proxy" gold standard in food environment evaluation tools in North America.[25,26,27,28] The NEMS survey was tested in 88 stores and found high values for both interrater and test-retest reliability.[24] As obesity and diet related disease remain an urgent public health crisis, food environment research continues to grow, propagating research using the NEMS methods. A non-exhaustive list of publications on the NEMS website documents over 60 journal articles using the NEMS method since 2008.[29] Since

its development in 2007, the observational Nutrition Environment Measures Survey has been adapted for use in restaurants, grocery stores and supermarkets, corner stores, and vending machines.[24,29] Most relevant to the retail food environment are the NEMS-S (Nutrition Environment Measures for Stores), which is designed to evaluate grocery stores, supermarkets and corner stores and NEMS-CS (Nutrition Environment Measures for Corner Stores), a modified version of NEMS-S designed to evaluate corner stores and convenience stores.[24,29] With the exception of two added categories, NEMS-S and NEMS-CS are identical, therefore are frequently referred interchangeably as NEMS-S.[24,29]

One of the main benefits of a NEMS-S score is that it can provide both sub scores for availability quality and price and composite scores. Although more resource intensive, this approach measures the key constructs of the food environment and allows for comprehensive comparison among and within store type and is valuable for research investigating analytical correlations.

Unfortunately, the standard methods used to analyze data collected using NEMS-S are less accessible in a community setting; without context, the NEMS-S scores may have little meaning to decision makers, retail owners or their consumers.[20] However, with the expansion of food environment research, many users have begun to adapt the NEMS-S by modifying the items audited, altering the scoring rubric, or tailoring the method of analysis to suit their study objective and less is known about the efficacy of these approaches in producing evidence that is more suitable for dissemination to decision makers and stakeholders.

Researchers have modified the NEMS-S survey to reflect culturally appropriate diets or locally available foods, specific demographics, certain store programs or policies and specific diets or food groups. Some users make minor changes: Lasley et al. modified their survey to reflect local produce availability in rural Iowa by changing the type of pears and tomatoes included in the survey[30], while others make significant changes. Martins et al. made extensive changes to the original survey to create a NEMS-S appropriate for urban Brazil.[31] Changes involved creating three main groups: unprocessed or minimally processed foods (healthier), refined ingredients for use in culinary preparations and the food industry (intermediate), and ultra-processed products (less healthy).[31] Paek et al. adapted their survey to evaluate the changes made in stores after the implementation of healthy corner store intervention (FIT) in Detroit Michigan[32] and Andreyeva, et al. modified the survey to focus on WIC (nutrition assistance program) approved foods[33]. Some researchers choose to look at only certain food groups or nutrients, Johnson et al. was interested in fruit and vegetable consumption therefore only collected NEMS-S data on fresh produce[34], while Hermstad et al. modified the survey to only collect data on items that were low fat or lean.[35]

NEMS-S users are not only adapting the items included in the survey, but they are also making changes in how it is analyzed and evaluated. Some users have decided not to use the score, analyzing the data using descriptive statistics only. Andreyava, et al. reported their data by the percentage of stores within the community that had each item audited, reported mean price of each item and calculated a market basket price and quality was reported as the percent of stores that had overall fair, good, or excellent quality produce.[33]

Others have collected data using the NEMS-S survey but adapted the scoring system. Franco et al. used a Healthy Food Availability Index (HFAI).[36] HFAI considers only the availability of healthy foods, ranging from 0-27 with higher scores indicate greater availability of healthy foods. They then analyzed the scores by categorizing them into tertiles: high, medium and low based on the sample scores and reported the percentage of stores in each community falling within each category.[36]

While research reviewing food environment measures has been done in the past, none to our knowledge have focused exclusively on the NEMS-S method and less is known about how users may be adapting the Nutrition Environment Measures Survey to evaluate the food environment. Since NEMS-S is currently the serving as the gold standard in consumer food environment research and publications featuring the NEMS-S method are increasing, it is imperative that we understand the ways in which the survey is being used, modified, and analyzed to adopt key learnings and identify methods of analysis that are more meaningful in a community context and will expose priority areas where change is needed.

CHAPTER 4: Research Rationale, Objectives & Design

4.1 RATIONALE

NL currently has the second lowest fruit and vegetable consumption in Canada and has the highest prevalence of some of the most leading diet related diseases, including obesity, diabetes and hypertension.[1] Recently, increased attention has been given to the role of the food environment on diet quality and the development of diet related diseases; suggesting, those who live in disadvantage food environments where the accessibility, availability and affordability of nutritious food is limited, may be more vulnerable to the development of diet related diseases.[10]

Community food environment research has shown that geographic access to supermarkets and grocery stores is significantly limited in rural communities and there is a higher density of small convenience stores compared to their urban counterparts.[11] This has been proven to be true in Newfoundland, where 72% of rural food retailers are convenience stores.[18] Food environment measures have also indicated that convenience stores in rural communities are less likely to stock quality, affordable, nutritious food.[11] These findings are troubling considering that 41% of the provincial population living in rural or remote communities[3] where there may little to no access to nutritious foods. Unfortunately, there are currently no direct provincial programs or policies in place aimed at improving equitable access to healthy foods in rural Newfoundland.[18]

Recognizing the need for further investigation into the food environment in Newfoundland and Labrador researchers from the Food Policy Lab at Memorial

University launched the Healthy Corner Store Newfoundland project (HCSNL).[19]As part of the project, NEMS-S were conducted in 78 stores across the Avalon Peninsula. To date, only preliminary analysis has been conducted on the data and more work is needed to describe and define the healthfulness of the retail food environment in Newfoundland.[19]

Although standard approaches in analyzing and evaluating NEMS-S research serve a valuable purpose in the assessment of the food environments, they are less meaningful in a community context.[20] In order to support action, it is necessary to produce evidence that is effective in selecting an appropriate process through which to make change and will work to inform prioritized strategies and interventions. Over 60 articles using the NEMS-S method have been published since 2008 and to our knowledge there have been no synthesis of the ways in which the survey has been used, modified, and analyzed.[29]

For these reasons, the objectives of this research were to review and synthesize the methods used in the analysis and evaluation food environment data collected using the NEMS-S method in rural communities. By applying 2 models gathered through the scoping review (healthy food assessment only, healthy and unhealthy food assessment) to the secondary NEMS dataset collected by HCSNL, our goal was to compare the outcomes produced by each model. While working toward achieving this goal, we simultaneously evaluated the food environment across the Avalon Peninsula. Finally, we proposed and analyzed two fiscal based policy options to improve availability and affordability of nutritious food in rural Newfoundland and Labrador.

The ultimate purpose of our project was to identify approaches to describe rural food environments in a format that is transferable to prioritized policy development and will lead to the implementation of impactful change and improvement within rural communities, while providing necessary and accessible evidence needed to guide informed decision making regarding strategies and interventions aimed at improving the availability and accessibility of healthy nutritious food in Newfoundland and Labrador.

4.2 OBJECTIVES

1. Identify the factors and methods being used to describe and define healthfulness of the rural consumer food environment

2. Determine the significance and implications of assessing the consumer food environment using healthy food only (and not unhealthy)

3. Identify and analyze potential policy options to increase the availability and accessibility of nutritious foods in rural retail food outlets in Newfoundland and Labrador

4.3 DESIGN

To achieve our research objectives, we have conducted a scoping review of the literature evaluating the healthfulness of retail food environments in rural communities using the Nutrition Environment Measures Survey. The literature was reviewed and synthesized to

identify key themes and methodological approaches. Using the data collected through the review, we identified 2 models for the analysis and evaluation of objective consumer food environment measures in rural communities. Next, we conducted secondary analysis of cross-sectional quantitative data previously collected as part of Healthy Corner Store NL project by applying each model of analysis to the dataset and describing and comparing the outcomes. Finally, using individual reflection based on the knowledge gained in the previous steps, supplemented by a critical examination of relevant scientific and grey literature, we proposed and analyzed two potential policy options to improve access to nutritious foods in rural Newfoundland using the framework developed by National Centre for Healthy Public Policy.

4.4 ETHICS

The scoping review and policy analysis involve no human participants, personal or sensitive information, therefore employs minimal ethical risks. Analysis of secondary data collected as part of the Healthy Corner Stores NL has been previously granted ethical approval by the Newfoundland and Labrador Health Research Ethics Board (HREB #15.145).

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SECTION II

Manuscript Series

CHAPTER 5: The Nutrition Environment Measures Survey in Rural Communities: A Scoping Review

AUTHORSHIP STATEMENT

TITLE: The Nutrition Environment Measures Survey in rural communities: A scoping review

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Contributions

RH and CM devised the idea for the review and conceptualized the design and implementation plan. RH conducted literature review. RH created the search strings which were reviewed by CM. RH conducted the database search and screened articles for inclusion, CM conducted an abstract review of the final list of articles to confirm inclusion. RH developed coding template for data extraction, CM reviewed. RH conducted full text review and coded the articles. CM conducted full text review to confirm coding. RH conducted data synthesis and interpretation, CM reviewed. LM was a key consultant throughout the literature search, data extraction, synthesis and interpretation, contributing thoughts and feedback.

All drafts of the manuscript (including all sections) were written by RH with initial, intermediate, and final edits and suggested revisions by CM. Manuscript was sent to LM for intermediate and final editing and suggested revisions. RH devised final draft and completed citation and works cited. RH formatted and prepared the manuscript for submission for publication.

5.1 ABSTRACT

The Nutrition Environment Measures Survey (NEMS-S) is one of the most widely used food environment assessment tools. This systematic literature review focuses on evaluation of rural retail food environments using the NEMS-S, with particular attention to methodological adaptations. The review demonstrates the use of heterogeneous terminology combined with a lack of transparency in some of the language used to describe key constructs of the research methodology including: community classification, store enumeration and store classification. This is important for rural food environments which appear to vary more widely than urban settings. To increase comparability across the literature, future research should work to increase the transparency in the methodology; providing explicit definitions and rationales.

5.2 INTRODUCTION

Research on the retail food environment encompasses the *community* nutrition environment (the type and location of food outlets within a defined geographic area)[1,] and the *consumer* food environment (the availability and marketing of foods and beverages encountered in food outlets).[1] The retail food environment may contribute to population dietary quality and health outcomes.[2,3] Direct observation of the consumer food environment is considered among the most robust measures of the food environment.[4-9] The Nutrition Environment Measures Survey for Stores (NEMS-S)[10] currently serves as the gold standard in consumer food assessment tools.[9,11,12] NEMS-S is a checklist measure designed by Glanz and colleagues for store audits of availability (including variety), price and quality of food and beverage products.[10]

The NEMS-S was designed to evaluate grocery stores and supermarkets.[10] The NEMS-CS (Nutrition Environment Measures for Corner Stores) is based on the NEMS-S, designed for corner stores and convenience stores, and contains two additional measures.[13] For the purposes of this article, and because they are closely related, we will refer to both collectively as NEMS-S. The NEMS-S collects data on both *regular* and *healthier (*e.g., lower fat, lower sugar) alternatives for foods and beverages that contribute the most fat and calories to the American diet.[10,14]

The NEMS-S scoring system consists of three sub-scores reflecting food availability, price and quality, summed in a composite score.[10,14] Points for availability are awarded

for healthful alternatives to regular items, and for some items, additional points are awarded for variety.[10,14] Price is measured comparatively, assessing whether the healthful option is priced equal to or lower than a given regular item.[10,14] Quality is measured for fresh produce only, based on the proportion of items that have been recorded as acceptable (i.e., not withered, bruised, or wilted).[10,14]

An important area of consumer food environment research is the emerging work in rural areas, where vulnerability to diet related disease is greater.[15,16] Evidence suggests that the variability in the quality of food environments in rural and remote regions is greater than in urban areas[15] and NEMS-S research is a valuable way to contextualize these differences at the consumer interface inside stores.

One of the challenges of existing NEMS-S research is that the scores may not have practical significance for decision makers, retail store owners, or their consumers.[17] In order to plan interventions and influence healthy changes in the food environment, it is important to understand how evidence can be made accessible to knowledge users for decision making. However, with the expansion of the food environment research literature, many users have begun to adapt the NEMS-S by modifying the items audited, altering the scoring rubric, or tailoring the method of analysis to suit their study objective[14,18] and it is unclear how these adaptations capture the variables necessary to guide intervention planning and policy development.

For these reasons, the objective of this research was to systematically review the literature to synthesize how features of the NEMS-S are used to measure the rural consumer food environment. Our secondary objective is to contribute to efforts to refine methods to analyze and evaluate rural and remote food environment data in formats that are accessible to knowledge users.

5.3 METHODS

This review follows the framework of a scoping review as defined by Arksey and O'Malley.[19] We began first by posing our research question and objectives, next we identified relevant literature, selected the applicable studies, and then extracted the data. Finally, we summarized and collated the data into key themes.

Data Sources

Literature was collected using database search, reference search and expert consultation in September of 2016. The database search was conducted in PubMed, Web of Science, and Scopus using predetermined search strings (Figure 5-1).

Study Selection

Peer-reviewed journal articles published from 2007-2016 were eligible for inclusion to correspond with articles published after the initial publication of the NEMS-S method.[10] All types of study designs gathering and analyzing data on the rural consumer food environment using NEMS-S/NEMS-CS were included. For the purposes of this review,

any study that defined the assessed community as “rural” or “remote” was included. Grey literature, including reports, editorials, and news articles, were excluded. Research exclusively assessing restaurants, hospitals, schools, or other primarily organizational food environments, were excluded.

A total of 55 papers were screened in through the database searches. First, 18 duplicates were removed. Next, five were identified as review articles and were scanned for relevant references and removed from the collection. Finally, 2 papers were added based on expert consultation, resulting in 34 articles for full text review. During full text review, 16 records were excluded because they did not use the NEMS-S. One record was removed because it did not address rural areas (Figure 5-1).

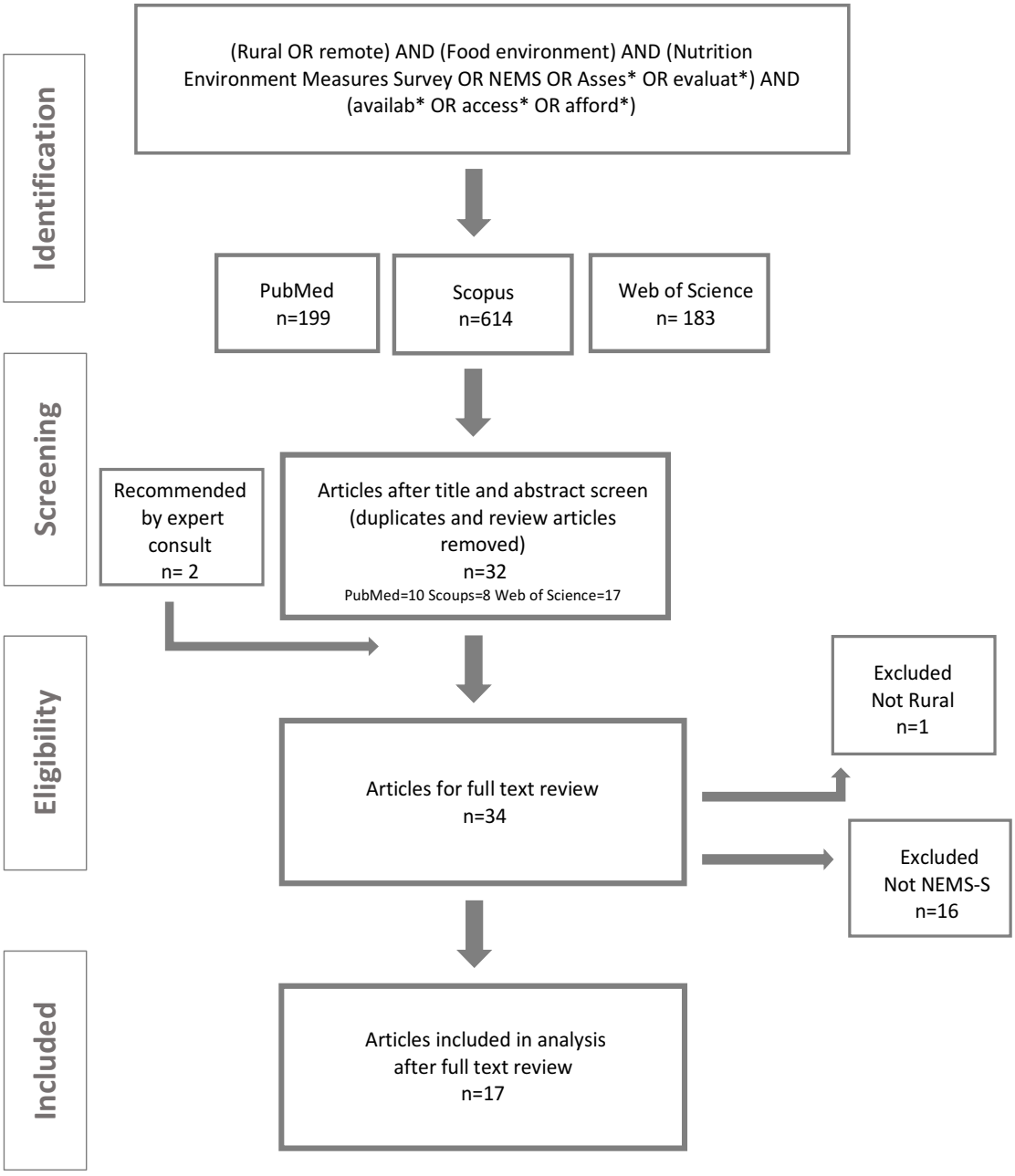
Data Extraction

A total of 17 articles met the criteria for inclusion in the review. Two researchers independently reviewed each paper for key concepts and themes to develop a common code template, which was used to independently code the literature, then all team members deliberated upon the coding until consensus was reached.

Data was extracted on study design, jurisdiction, store type, store enumeration methods (the process used to identify and locate the audited food outlets), survey adaptions, reported NEMS-S features, and scoring methods. All included studies were of the same design: cross-sectional, descriptive analyses of the consumer food environment. Where

possible, studies were also coded as evaluation or formative research, including baseline and outcome studies associated with evaluating a program or policy.

Figure 5-1 Review Literature Selection



5.4 RESULTS

Study Design

All studies were cross-sectional in nature. Three studies assessed food environment associations with area-level diet or health factors[20-22]. Fourteen articles[23-36] were descriptive research, describing food environment features by store type (n=8)[24-26,28,30,31,34,36], community size or rurality (n=7)[23-25, 29,30,33,34], or community or population sociodemographics (n=2)[25,28]. Of these, eight were evaluations[32, 34-36] or formative research[27-29,31].

Jurisdiction

All 17 studies were conducted in the United States (US). Eleven articles exclusively observed rural areas[20-22,26-28,30,31,33,35,36] while the remaining six articles examined both urban and rural areas[23-25,29,32,34.] Only nine articles provided an explicit explanation for how they defined rural [21,23,24,27,30,32,33,34,36] (Figure 5-1). Of these, three studies used the US Department of Agriculture rural-urban continuum codes[21,23,33]. Two articles[32,34] used the local school National Center for Education Statistics rural/urban designation to classify the community. One article[36] used a local health department definition for rural designation, and two used the federal Census definition for rural[24,30].

Store Type

Grocery stores/supermarkets were the most frequently (n=13)[20-26, 28-31, 33, 35] surveyed store type, followed by convenience/corner stores (n=9)[20-22, 24, 26, 28-31]. Other store types

examined included dollar stores, pharmacies, supercentres, and specialty stores[21,22,24,25,26,28]. Store type was identified differently across the reviewed literature: three studies defined store type based on revenue[30,32,34]; one classified stores based on size, number of cash registers and food availability[26]; and two of the included studies used Standard Industrial Classification (SIC) codes[25,29], a federally recognized system to classify stores by industry using a four-digit code. Four articles referred to ambiguous classification systems, but did not elaborate or explicitly define store types[21,22,24,28]. Seven studies did not classify stores or provide store type definitions[20,23,27,31,33,35,36].

Store Enumeration

Twelve of the 17 articles[20-26, 28-30, 32-34] described their store enumeration methods. Eleven papers[20-22, 24-26, 28,30,32-34] indicated that they had used administrative datasets for store enumeration, of which four[21,22,26,30] also used ground-truthing methods (systematic direct observation in the field) to corroborate the administrative list of stores. The remaining paper[29] consulted with community organizations for store enumeration.

Survey Adaptations

The majority of included papers [20-29, 32-34, 36] made some type of modification or adaptation to the original NEMS-S survey. The most common rationale for modification (nine studies)[20-25, 27, 28,33] was to adapt the survey to collect data on a specific food group, diet type, or nutrient considered to be relevant to the study population. Eight papers [23,24,26,32,34,36] adapted the survey to make it more appropriate for ethno-cultural dietary behaviors or to address the local food supply. Three adapted the survey to collect

data on a specific store program or policy[32,34,36] and two papers used surveys modified for low-income populations[25,29].

Regular and Healthier Foods

Although the original NEMS-S survey collects data on both regular and healthier options, less than half (seven)[25,26,29-32,35] of the included papers reported on both healthy and unhealthy options. Ten articles reported on healthier foods only[20-24,27,28,33,34,36], with three reporting on fresh fruit and vegetables only[23,27,33].

Availability, Price and Quality

Approximately half of the included studies (nine)[21, 24, 27,30-35] reported on all three aspects of the NEMS-S survey. Two reported data on availability and price[23,29]. Six reported data on availability only [20,22,25,26,28,36] (Table 5-1).

Availability

All of the included studies reported on food availability. In the original NEMS-S survey, availability is assessed using three measures: item available in stock (yes/no), number of varieties available (fruit and vegetables only), and shelf space (milk only). Only three of the included articles reported all three aspects of availability[31,32,34], seven measured stock and variety[22,25,26,28-30,33], and six reported on stock only[20,21,23,24,27,36]. Variety was measured and reported in many ways. Six articles used the NEMS-S method (or similar), analyzing number of varieties using pre-determined tertiles or quartiles[25,28-31,33]. Two articles used a similar categorical system but categories were developed based on the variety counts in

the sample[22,26]. Two articles measured raw variety and reported a mean number of variety of items by store type.[32,34]

Price

Eleven[21,23,24,27,29-35] of the 17 studies reported on price. Of those that reported on price, two[29,31] of the included studies measured price according to NEMS-S protocol; two studies[21,25] modified the pricing method to classify the price of an item as higher or lower than the *median range* of prices in a category across all stores and three studies[23,32,34] looked at raw or absolute price of an item and one study[30] used both raw price and relative price (healthy vs unhealthy and relative to other store types). Two articles[33,35] modified the original NEMS-S survey and provided limited detail on how they distributed points for price. The final paper[27], used a separate tool to measure price.

Quality

Nine [21,24,27,30-35] of the 17 articles reported on the quality of fresh produce. Three studies[27,32,34] analyzed quality independent of a scoring system; all three analyzed quality by calculating the proportion of items determined to be acceptable using a dichotomized outcome.

Scoring

Few studies analyzed their data using the original NEMS scoring method. Only four of the included studies used the NEMS-S composite score[29-31,33] (Table 5-1), all of which also used the NEMS-S sub-scores. Two studies used the availability sub-score only [20,28],

one of which considered fat only[20]. Five studies[21,22,24,25,35] used independent scoring systems (Table 5-1), defined as any scoring system other than the NEMS or significant adaptations to the NEMS score.

Table 5-1 Summary of Review Findings

	Rurality Defined	Store Enumeration		Store Types Defined	Reported Measures					Score	
		Ground-Truthing	Secondary Source		Healthy Items	Unhealthy Items	Availability	Price	Quality	NEMS-S	Independent
Lasley, E (2008)	✓	*	*		✓		✓	✓			
Hermstad, A (2010)			✓		✓		✓				
Gantner, L (2011)		✓	✓		✓	✓	✓				
Hartley, D (2011)	✓	✓	✓		✓		✓	✓	✓		✓
Hubley, T (2011)	✓		✓		✓		✓	✓	✓		✓
Johnson, J (2012)	✓				✓		✓	✓	✓		
Chau, C (2013)			✓		✓		✓				
Gantner, L (2013)		✓	✓	✓	✓		✓				✓
Pitts, S (2013)			✓	✓	✓	✓	✓	✓		✓	
Vilaro, M (2013)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Pererira, R (2013)		*	*		✓	✓	✓	✓	✓	✓	
Tisone, C (2014)	✓		✓	✓	✓	✓	✓	✓	✓		
Byker-Shanks, C (2015)	✓		✓		✓		✓	✓	✓	✓	
Lu, W (2015)	✓		✓	✓	✓		✓	✓	✓		
Martinez-Donate, A (2015)		*	*		✓	✓	✓	✓	✓		✓
Olendizki, B (2015)			✓	✓	✓	✓	✓				✓
Steeves, E (2015)	✓	*	*		✓		✓				

*Insufficient detail provided to draw conclusion

5.5 DISCUSSION

The objective of this research was to systematically review the literature to synthesize how features of the NEMS-S are used to measure the rural consumer food environment, to examine how the NEMS-S has been adapted in rural food environment settings, and consider the implications for knowledge users. Six key findings emerged from our review, which can be broadly categorized as having methodological implications or implications for reporting and knowledge translation.

Methodological Implications

One of the most commonly-acknowledged barriers to advancing retail food environment research is the heterogeneity of measures and methodology within the field[2,3,7,37,38,] and our findings corroborated this concern. A lack of transparency in the methods used in data compilation and data classification, and few standardized definitions have been acknowledged as challenges in synthesizing food environment evidence and drawing robust conclusions [2,3,7,37,16].

Defining Rurality

Defining rurality in health research is challenging: a wide range of communities and populations are considered rural on the urban-rural continuum[39-42]. In the reviewed studies, classification methods and definitions for what is considered a rural community varied considerably across studies and included densities, relative proximity, and absolute populations.

Reviews on the most frequently used taxonomies to define urban and rural in US public health research and policy have been done in the past.[39-41] Rural demography is complex and a single definition cannot justifiably capture all aspects. Dichotomous definitions are limited in their ability to capture the heterogeneity among degrees of rurality and remoteness, and evidence suggests that when possible more precise definitions should be applied.[39-41] Rural classification should be applied judiciously, based on the context of the research question[39-41], and ideally with consultation from geographic professionals.[41] Our findings emphasize food environment researchers should explicitly indicate how they define rurality, accompanied with a clear rationale. When making comparisons across studies, researchers should be aware of discrepancies in rurality, consider revising definitions, and avoid aggregating data with dissimilar geographic units.

Store Enumeration

Systematic direct observation in the field (ground-truthing) has been recognized as the gold standard to enumerate neighbourhood foodscapes.[16,43] To save time and resources, researchers commonly start with secondary analysis of administrative datasets including online directories, commercial business directories, and government administrative databases.[43] A strength of using the NEMS-S is that completing the on-site survey provides an opportunity to confirm administrative spatial data. Relying on secondary data to identify stores for consumer food environment assessments creates the potential for outlets to be missed during surveying because they were not listed, misclassified, or could not be found.

In this review, only four studies reported verification using ground-truthing; evidence suggests error is more likely for small or independent stores[44,45] and in rural areas.[44-46] Secondary sources should be verified with direct field observation when possible, or at the minimum be combined with additional secondary sources.

Store Classification

Classifying store types can be difficult in rural food environments as the retail presence in rural communities is often comprised of non-traditional or "hybrid" food outlets.[16,47] Ten of the 17 included studies in this review did not note their classification system or provide explicit store type definitions; the remaining seven used a variety of standardized and independently-established criteria to classify stores. A review by Gamba et al.[3] reviewed 51 retail food environment articles and found over 32 store types/definitions. An earlier review by Larson et al[48] made similar observations. Methods of classification in the literature have included store size, annual sales, number of cash registers, number of employees, variety of foods offered, owner interpretation and federally established industry classification codes.[3,48]

Despite efforts within the field, there is yet to be a standardized classification system recognized as the gold standard. However, the North American Industry Classification System (NAICS) is among the most widely used classification systems in nutrition environment literature.[6,3,48] NAICS, a successor to the Standardized Industry Classification (SIC) codes, was designed for statistical purposes and to provide common definitions and increase comparability across the three countries.[49] A potential limitation

in using datasets with preassigned NAICS codes is that some investigations have demonstrated misclassification of NAICS codes in secondary sources which can impact the sensitivity and positive predictive value of the data source and contribute to both an under-count and over-count of store types.[44,50] Manual verification is recommended.

Implications for Reporting

Unhealthy Food Environments

Results of this synthesis indicate that researchers are predominately using the NEMS-S to report on healthier food options only, contributing to a notable gap in the literature in measuring and intervening in consumer exposures to non-nutritious foods. Recent evidence within community food environment research examining geographic associations with diet and health outcomes suggests that relative exposures may be more influential than absolute exposures when exploring food environment associations with key outcomes such as dietary behaviors[51] purchasing patterns[52] and weight status[53]. These findings have led to recommendations for a wider use of relative measures in food environment research and the development of interventions to improve the balance between healthy and unhealthy exposures in retail food environments.[51-54] This is also of importance in considering food environments outside of the United States. For example, in Canada, there is better evidence for widespread food 'swamps' (relative predominance of unhealthy food sources amplifying material disadvantage) than food deserts.[37]

Quality and Price

A strength of the NEMS-S is that it includes multifaceted measures of food access in the consumer food environment. Although poor quality and high prices are known barriers to food access in rural and remote communities[55-58], these features are frequently overlooked in food environment assessment[2]. Only nine of the 17 included studies in our review reported on all three aspects of the survey[21,24,27,30-35].

Despite the evidence from qualitative and perceived food environment assessment indicating that quality impacts food accessibility for rural dwellers[55-58], little research has directly assessed food quality in rural retail stores[2]. Offering and maintaining high quality supplies of fresh food is often a challenge for small rural stores due to remote location, access to suppliers, limited turnover, and other infrastructural limitations.[59]

In the reviewed studies, price was measured and evaluated in various ways. Consumer food environment researchers should consider their study objectives carefully when deciding how to operationalize and evaluate price, as well as how the evidence generated will be used to inform knowledge users, the public, and to design potential interventions. Analyzing relative price disparities between regular (less healthy) and healthier items within a store is effective in examining whether the retail food environment offers health-promoting environmental features and incentivizes consumers to make healthful choices, but it does not capture overall price nor does it allow for comparisons among stores or geographic areas. For example, if a rural store sells a loaf of white bread for $6.00 and a

loaf of whole grain bread for $6.50 and an urban store sells white bread for $3.50 and whole grain bread for $4.00, both stores would be scored equally and the overall price discrepancy between the jurisdictions is not captured. Both relative and absolute measures are pertinent when it comes to price, so depending on study objectives, researchers may want to consider using both measures. The median price is also a valuable benchmark for comparisons between urban and rural areas.

Score

The NEMS-S composite score is easily interpreted and allows for a global assessment of a store. This is useful for those measuring area-level variations or in intervention studies. However, without context, scores may have little meaning to knowledge users.[18] For decision-makers at the retail 'front-line' such as public health practitioners and retail store owners, managers and consumers, or for policymakers, it is critical to identify where change is needed inside the store, and how both incremental and larger changes could be made. A combination of both composite scores and description is likely the most appropriate way to identify priority areas for improvement, and to promote multiple kinds of evidence-informed policy and decision making.

Limitations

This review had a few limitations. First, we focused on NEMS-S and NEMS-CS research only. As such, the identified gaps that we detected, such as the varied and limited reporting on unhealthy foods, may not be generalizable to other consumer food environment literature. However, it is reasonable to posit that since NEMS is considered a

gold standard method, the variation may be even greater in other studies. Second, all of the literature captured in this review was from the United States. Consumer food environment research is growing worldwide, including rural and remote studies. Given the wide variability in the quality of rural food environments, it will be important to capture methodological trends as they emerge in other jurisdictions, through other synthesis strategies.

5.6 CONCLUSION & RECOMMENDATIONS

This is the first review to exclusively consider rural consumer food environment research using the NEMS-S measure. Our review demonstrates considerable heterogeneity in the terminology and taxonomies used to describe and define key constructs of the methodology including: community classification, store enumeration and store classification. Our findings also indicate that the majority of NEMS-S research in rural areas uses an adapted version of the original tool. Many researchers report availability only and fewer report the price and quality of foods. Most researchers do not report unhealthy items and few are using the original NEMS-S scoring system.

Consumer food environment researchers should consider their study objectives when deciding how to classify, define, and operationalize variables of interest. Echoing earlier reviews, we encourage greater transparency in reporting methodology; and providing explicit definitions and rationales so that knowledge users may consider the context of the

research when interpreting the findings. When making comparisons across studies, researchers should be aware of discrepancies and avoid aggregating dissimilar methods.

Availability, quality, and price, both relative and absolute, are important features in measuring the foodscape, especially in rural areas where populations face unique barriers to food accessibility. Future research should consider elaborating upon all of these features of the consumer food environment.

In order to inform interventions and influence healthy changes in the retail food environment, it is essential to produce evidence that is readily applied by decision makers. A combination of both composite scores and descriptive analysis will allow researchers to describe the food environment in a format that is meaningful to key stakeholders, improving their ability to interpret and act on the evidence.

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CHAPTER 6: The Nutrition Environment Measures Survey Newfoundland and Labrador: An Exploratory Analysis into the Significance of Assessing the Retail Food Environment Using Healthy Food Only

AUTHORSHIP STATEMENT

TITLE: The Nutrition Environment Measures Survey Newfoundland and Labrador: An Exploratory Analysis into the Significance of Assessing the Retail Food Environment Using Healthy Food Only

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Contributions

RH proposed the concept for this manuscript. RH and CM devised a design and implementation plan. RH conduced the literature review. Data for this manuscript was initially collected by the Healthy Corner Store Newfoundland and Labrador research team. RH prepared the data by creating the revised NEMS-S scoring template, CM and LM reviewed template. Next, RH exported, cleaned, recoded and scored data according to scoring template. RH devised analysis plan with consultation from CM with additional input from JV and LM. RH analyzed and interpreted data.

All drafts of the manuscript (including all sections) were written by RH. Initial and intermediate versions were sent to CM and JV for edits and suggested revisions. Final versions were sent to LM for edits.

6.1 ABSTRACT

The objective of this study was to explore the significance of assessing rural consumer food environments using healthy food availability only. To achieve our objective, we assessed healthy, regular (less healthy) and total (both healthy and regular) food availability in a census of supermarkets and convenience stores in rural Newfoundland and Labrador.

Using a scored checklist measure, supermarkets earned greater scores for the availability of healthy, regular and total food availability. Both convenience stores and supermarkets offered most regular food and beverage options while there was greater variability among the availability of healthier items.

However, our results demonstrated a strong and positive correlation between healthy food availability scores and regular food availability scores, supporting theories that high exposure to healthy items is often accompanied by a comparably high exposure to unhealthy items. Although healthy food availability may be an appealing measure to capture the variability among stores, it may not represent the overall consumer food environment and the exposures people experience while shopping.

6.2 BACKGROUND

Over several decades, public health efforts to prevent and reverse the growing burden of obesity and diet-related diseases[1] have progressively taken a socio-ecological perspective. In order to observe change in individual behaviors, there must be supportive built, socioeconomic, and policy environments, in which to make healthy choices.[2,3,4] Considerable attention has been given to the retail food environment and its potential influence on food choice and dietary behavior. The retail food environment, as defined by Glanz and colleagues, can be organized into 2 main components: the *community nutrition environment* defined as the proximity or density of varying types of food outlets within a defined area and the *consumer nutrition environment,* the availability, price and quality of healthy food and beverage within a retail food outlet.[2]

A growing body of literature has illustrated both the significance and variability of the availability, affordability and quality of food and beverage within wide-ranging geographic and socioeconomic environments.[5,6,7,8,9] Among the most vulnerable environments are rural areas, where evidence has illustrated access to full service supermarkets and grocery stores is significantly limited and there is a higher proportion of small convenience stores compared to urban communities.[5,10,11,12] This is concerning because of evidence that indicates larger supermarkets and grocery stores have a wider variety of affordable nutrient dense foods compared to smaller convenience and corner stores where there is a higher availability of less nutritious, energy dense, snack

foods.[5,10,11,12] When healthier items are available in small stores, they tend to be of a higher price and lower quality.[5,10,11,12]

In Canada, although the population is urbanizing, there is considerable variation in the proportion of population living in rural and remote areas between jurisdictions. For example, in the province of Newfoundland and Labrador (NL), 40% of the population continue to reside in rural or remote areas.[13] Consistent with other rural food environment literature, food access in many NL communities is limited; industry data as well as a recent census of rural stores by our team, indicates that about 7 in 10 stores in rural communities in NL are convenience stores, suggesting convenience stores play a substantial role in food choices in rural NL.[14]

Diet quality and diet-related health status is also of concern in NL. Only 26% of individuals 12 and older consume at least 5 servings of vegetables and fruit per day compared to the national average of 40%.[2] NL leads the nation in the prevalence of overweight and obese individuals, with over two thirds of the provincial population classified as overweight or obese.[15] These estimates exceed those in all other provinces and territories. NL also faces a high burden of other diet-related diseases including type 2 diabetes, hypertension, cardiovascular disease and osteoarthritis.[15,16]

Early food environment research in rural areas has drawn the interest of researchers, policy makers and other key stakeholders and has demonstrated an urgency for action. However, in order to encourage action and guide priority-setting for policy and decision

making, it is essential for researchers to capture accurate measures of the rural foodscape. Much of retail food environment research has been dedicated to measuring spatial access to healthy food and the concept of *food deserts*[5,6,7,8], which are communities or other geographic areas in which inadequate access to healthy foods exacerbates economic disadvantage.[17] However, in more recent work, researchers have begun to acknowledge and measure the increasing accessibility to non-nutritious food and beverages.

In 2009 Rose and colleagues introduced the concept of the *food swamp*, defined as areas with relatively few healthy options or where "large relative amounts of energy-dense snack foods, inundate healthy food options".[18] This has encouraged researchers to become more attentive to the relative availability of healthy food compared to unhealthy foods, in contrast to healthy food availability alone. [19,20,21,22,23,24,25,26,27,28,29,30] Still-advances in relative food environment assessment have largely been conducted in the context of community-level food environment (the relative density and proximity of food retailers that have been generally accepted as healthy or unhealthy[31]) and few researchers have applied concepts of relative food availability to in-store assessment within the consumer food environment.[20,23,25 26,27,28,29,30]

Consumer food environment assessment usually involves direct observation of the retail food environment and has been considered a more sophisticated and robust measure of the food environment compared to community-level assessment.[32,33] Direct observation can include checklists, variety counts, display counts or shelf space measures of the foods and beverages within stores. Although some of these approaches are relatively resource

intensive, checklist measures of select indicator items can be an efficient and effective method for those with limited resources.

A recent review on food environment assessment indicated that the use of checklist measures to audit stores has more than doubled since the publication of a previous review in 2007, and they are now the most frequently used tools to evaluate the retail food environment.[4] However, despite emerging literature on the importance of relative food environment measures, many of those using checklist measures are assessing healthy food availability only. Our review of rural food environment research using the Nutrition Environment Measures Survey for Stores (a checklist and gold standard in consumer food environment tools assessing the availability, price and quality of 'healthier' and 'regular' (less healthy) options of food and beverages) demonstrated that many researchers (59%) reported on measures of healthier food and beverages only and not "regular options" (typically the same food or beverage product with additional fat, sugar, or salt) to measure store healthfulness. [34]

This is a substantial research gap, as researchers who have implemented relative food environment measures using checklists have demonstrated a strong relationship between healthy food availability and unhealthy food availability, suggesting that stores that offer a high variety of healthy foods may also offer a high variety of unhealthy foods.[28,30] Research using shelf space or display count measures have shown that many supermarkets, often coded as healthy food sources in community food environment

research, dedicate a greater volume of shelf space to energy dense snack foods compared to fruits, vegetables and other nutritious food.[23,29,25,27]

These findings suggest the relative exposure of healthy and unhealthy food may be more influential than absolute exposures when exploring food environment associations with key outcomes of interest such as dietary behaviors[21], purchasing patterns[22], and weight status[19]. These findings raise questions regarding measuring accessibility to healthy foods only and the adequacy of this method as an indicator of store healthfulness and merits further investigation.

6.3 OBJECTIVES AND RESEARCH DESIGN

The objective of this study is to use the NEMS-S checklist measure to assess healthy food availability, regular (less healthy) food availability and total food availability (both healthy and regular food availability) in a census of retail food stores in eastern Newfoundland, and to compare and critically discuss measurement outcomes. The ultimate goal of our research was to gain a greater understanding of the significance and implications of assessing the consumer food environment using healthy food only, most specifically through the NEMS-S checklist measures which is among the most widely used consumer food environment tools.

Data for this project was provided by the Healthy Corner Stores Newfoundland and Labrador (HCSNL) project, a pilot program to define and test the potential for healthier

foods in Newfoundland convenience stores. In HCSNL, researchers used an adapted version of the Nutrition Environment Measures Survey (NEMS-NL) to collect data on the availability (including variety), quality and price of healthy foods in a census (n=78) of rural food stores across the Avalon Peninsula in Eastern NL.

6.4 METHODS

Sample

HCSNL conducted NEMS-NL in census of rural food stores across the Avalon Peninsula, the most populous region of the province. Although over 50% of the provincial population live within the Avalon, 75% of residents on the Avalon live in the capital city, St. John's, and the surrounding metropolitan area, leaving a rural population density of only 7.7 people per square mile.

"Rural" was defined as the area outside the metropolitan region within the Avalon Peninsula. Stores were further classified by rurality into one of six categories according to the NL-Accessibility Remoteness index: Highly accessible, Accessible, Somewhat Accessible, Moderately Remote, Remote and Extremely Remote.[35] The NL-Accessibility Remotes index classifies community remoteness by level of accessibility using a complex algorithm that takes into account population size and travel time to various community services (i.e, public schools, primary health care). "Food Store" was defined as any retailer classified into one of three North American Industry Classification System codes: Supermarkets and Other Grocery, Convenience Stores and Gas stations with Convenience

Stores".[36] More detailed definitions for remoteness levels and store types can be found in in Appendix 6-A, as well as from their respective sources.[35,36]

The final census assessed by HSCNL was n=78, including 17 grocery stores, 48 convenience stores and 18 gas stations with convenience stores. For the purposes of the current analysis we collapsed both convenience store types (both with and without gas stations) into a single category. Eight stores were classified as highly accessible, 44 were accessible, 17 were somewhat accessible and 9 were classified as moderately remote. No stores were classified as remote or extremely remote

Data Collection Tool

The Nutrition Environment Measures Survey for Stores (NEMS-S) is an environmental survey to facilitate direct, observational measurement of food and beverage availability, pricing, and quality within retail food stores. NEMS-S collects data on both "healthier" and "regular" alternatives for food and beverages that are part of an *average* American diet and those recommended for healthy eating. The NEMS-S classifies an item as a "healthier" or "regular" option in relative terms within individual measures (i.e. white bread and whole wheat bread, full fat chips and baked chips).[37,38] This model allows for researchers to measure the consumers' opportunity to make healthier choices for items that are part of their usual diet. NEMS-S is accompanied by a scoring system in which points are awarded for having healthier items available at a lower prices and acceptable quality. Sub-scores for availability, price and quality can be summed for a total score intended to represent overall store healthfulness.[37,38]

NEMS-S was adapted for use in Toronto (ToNEMS-S) by Lo and colleagues to reflect local diet and consumer patterns as well as Canada's Food Guide dietary recommendations.[39] The HCSNL researchers collected NEMS-NL data using a modified version of the ToNEMS-S adapted to reflect the dietary pattern and food availability in NL. The finalized NEMS-S-NL tool collected information on the availability, price and quality of 98 food and beverage items (including both healthy and regular versions) organized into 14 categories. Further details of the NEMS-NL tool and collection for the HSCNL project have been described elsewhere.[14]

Data Preparation

To investigate the significance of evaluating store healthfulness using healthy food availability only, we modified the original NEMS-S scoring system to develop a "healthy food availability" score, a "regular food availability" score and a "total food availability" score.[37,38]

In the NEMS-S scoring system, items classified as healthier and items classified as regular are not equally nutritious or non-nutritious but this varying degree of healthfulness is not reflected in point distribution. For example, under the healthy category, stores are awarded 2 points for the availability of whole wheat bread but are also awarded 2 points for the availability of baked chips.

Recognizing the limitations of classifying foods as healthy or regular using dichotomized classification, we further classified items by healthfulness using a three-tiered system, similar to the approach taken in school nutrition or traffic light guidelines. This classification system was guided by both Canada's Food Guide and the National Document for the Development of Nutrient Criteria for Foods and Beverages in Schools.[40] Healthy items were classified as healthiest, less healthy or least healthy and regular items were classified as least unhealthy, less unhealthy or most unhealthy. Points were distributed according to healthfulness classification and summed to give a healthy food availability score and a regular food availability score. Total food availability score was derived by subtracting the retailer's regular food availability score from the healthy food availability score. Scoring templates can be found in Appendix 6B.

Data Analysis

The NEMS-NL scores were analyzed using SPSS Statistics (version 24) software package. We calculated mean healthy scores, regular scores and total scores, then compared means across rurality and store type.

Mean healthy scores, regular scores and total scores by level of remoteness and store type were compared using ANOVA and independent sample t tests. Correlations among scores were tested using Spearman's rank correlation test.

We also conducted a series of independent sample t tests to analyze differences in scores for individual measures (i.e. fruit, meat, cereal) among store types to provide a more

detailed description of the variability among stores. By evaluating individual measures, we can provide data that is more meaningful to key stakeholders, policy makers and store owners. For example, our previous work has suggested that fresh and frozen produce including fruits, vegetables and meat are limited in small and rural stores[14] by reporting on individual measures we can identify these potential gaps and other priority areas where change is needed.

6.5 RESULTS

A total of 78 stores were surveyed (n=61 convenience stores, n=17 supermarkets). Over half of stores were classified as accessible (n=44), followed by somewhat accessible (n=17), moderately remote (n=9) and highly accessible (n=9). No stores were classified as remote or extremely remote.

Remoteness

Mean healthy, regular and total scores did not differ significantly by level of store remoteness (Table 6-1).

Table 6-1 Mean scores by remoteness

Remoteness	N	Healthy Score (SD) F=0.01 p=0.99	Regular Score (SD) F=0.11 p=0.96	Total (SD) F=0.16 p=0.92
Highly Accessible	8	52.4 (23.4)	32.8 (11.6)	19.6 (12.8)
Accessible	44	51.7 (21.6)	34.66 (11.4)	17.0 (12.6)
Somewhat Accessible	17	52.0 (18.1)	35.2 (10.4)	16.8 (10.4)
Moderately Remote	9	51.1 (13.3)	35.22 (6.9)	15.9 (8.0)

Store Type

Healthier, Regular & Total Availability Scores

Supermarkets scored significantly higher than convenience stores in both healthy food availability and total food availability ($p<0.01$). However, they also scored significantly higher for availability of regular food items, earning a mean score of 40.3 out of a possible 47 points.

Table 6-2. Mean scores by store type

Store Type	N	Healthy Score (SD)	Regular Score (SD)	Total Score (SD)
Supermarket	17	68.1* (19.9)	40.3* (10.7)	27.8* (11.7)
Convenience Store	61	47.2 (17.5)	33.1 (10.2)	14.1 (9.7)

* Significant at $p <0.01$

Individual Measure Availability Score

In individual healthy measures, supermarkets scored significantly higher for the availability of most items (Appendix 6C). Many of the remaining items (in which there

were no statistical differences in availability scores), could be considered “staple” items and were readily available in both store types. These items include: low fat milk, eggs, healthier cheese, whole wheat bread, healthier baked goods, meat alternatives, healthier chips, healthier beverages and low sugar cereals.

In contrast, in the individual regular measures, there was little difference in availability of regular food and beverages among supermarkets and convenience stores. Supermarkets earned comparable scores to convenience stores in almost all items, with both store types scoring highly for the availability of most items. Processed meat, processed cheese and sugary cereals were the only items in which supermarkets scored significantly higher than convenience stores. Individual measure scores by store type can be found in Appendix 6C.

Correlations

Correlation tests demonstrated a positive correlation (0.88) between healthy and regular scores at $p<0.01$ indicating that higher healthy food availability scores are often complemented by higher regular food availability scores.

6.6 DISCUSSION

This study found that there were no significant differences in availability of healthier or regular items among stores at different degrees of rurality; this could be a result of the lack of data points at the higher end of the remoteness index (remote and extremely

remote) and the high proportion of stores classified as accessible. However, in terms of store type, consistent with findings from similar work, our results indicated that supermarkets had a higher availability of both healthy and regular food and beverage compared to convenience stores.[28] We also observed a strong and positive relationship between healthy food availability scores and regular food availability scores, as demonstrated through the correlation statistic (0.88). These findings support those observed in similar studies; Olendski and colleagues found that healthy food availability was highly correlated with unhealthy food with a correlation coefficient of 0.90. [28] In other words, stores that are able to stock more food, do so over a wide range of product lines, and thus supply a higher quantity of both heathier and less healthy foods. Together, these results illustrate that it may be presumptuous to define a retailer as a "healthy food source" based on the assessment of healthy food availability alone.

However, there are aspects of our analysis that demonstrate why it may be appealing for some researchers to use healthy food availability as a proxy for total (or relative) food availability when ranking or comparing retailers. When comparing total food availability (regular food availability scores subtracted from healthy food availability scores) we observed that despite having a higher regular food availability score, supermarkets maintained a higher total food availability scores. It is possible that these results can be explained in part by the pervasive availability of regular food items and a more scarce and dispersed availability of healthy food. Although supermarkets earned a higher overall regular food availability score, the point discrepancy was modest (8 points) and observing individual food categories it was evident that almost all stores, both supermarkets and

convenience stores, offered most regular items. There were only three individual regular categories (processed meat, processed cheese and sugary cereals) in which supermarkets earned higher scores than convenience stores; in the remaining 9 categories, we did not detect any difference among convenience stores and supermarkets. Conversely, examining healthy food availability, the magnitude of difference between supermarkets and convenience stores was greater; supermarkets scored 23 points higher in overall healthy food availability and earned higher scores in 10 out of the 19 individual healthy categories compared to convenience stores.

Although few have reported on overall food availability using a checklist measure, we are not the first to observe this tendency. [28,30] These findings echo those observed in a similar study by Zenk and colleagues who examined the absolute and relative availability of 14 indicator items (7 healthy and 7 unhealthy) using a checklist measure.[30] Consistent with our findings, absolute healthy, unhealthy and relative food availability was higher in supermarkets compared to limited service stores. Others have also observed a greater variability in healthy food availability while the variability in less healthy food was more narrow. Oldenski et al. used both healthy and unhealthy food availability indices (scores) to evaluate healthfulness in small and large stores. In this case, healthy food availability scores were almost four times higher in large stores compared to small stores (30.1 vs 7.0) while the difference in unhealthy food availability was only half that (13.0 vs 26). [28]

A common argument for the assessment of unhealthy food and beverages in stores is the concept of the food swamp and the widespread availability of less nutritious items,

however, the predominance of unhealthy foods could also be a relevant counter-argument for the assessment of healthy foods only. Because less nutritious food such as chips, soft drinks and other energy dense snack foods are so readily available in most stores, it is not likely that will we gain much insight or observe much variability in incremental differences in store healthfulness through assessing the availability of these items with a checklist. For those surveying a large sample of stores and/or with limited time or resources, it may not be efficient to conduct consumer food environment measures or collect data on both healthy and regular options, especially considering the large number of varieties of snack foods and sugar sweetened beverages. Collectively, our results and literature with similar findings, demonstrates why it might be appealing to assess healthy items only when evaluating store healthfulness, specifically when ranking or comparing a group of stores using a checklist measure.

However, our research has illustrated that defining stores as "healthy" based on healthy food availability or total food availability is inadequate without reporting on potential unhealthy food exposure. As demonstrated through the positive correlation between healthy and regular food exposure, a store with a higher availability of healthy items cannot be presumed to be an overall" healthy" retailer. Using language such as "greater exposure to healthy foods" or "healthier" may be a more appropriate description for stores that have a higher availability of healthy foods.

It should be emphasized that the intention of these conclusions is not to suggest unhealthy food is an irrelevant component of food environment research. In fact, our study

acknowledges that unhealthy food and beverages have become the most dominant component of the food environment- so much so that the availability of these items is often implied or assumed through existing measurement methods. Our research has demonstrated that rural communities face similar challenges to their urban counterparts in regards to disproportionate and excessive exposure to unhealthy foods and the need to refine the sophistication of in-store assessment to contextualize food environment exposures.

These results also have implications for the design of healthier retail food environment interventions-particularly in rural communities. To date, the majority of food environment interventions have been aimed at increasing the availability of healthy foods in convenience stores or improving geographic accessibility to grocery stores and supermarkets.[41,42,43] However, the effectiveness of these strategies have been mixed; where interventions have been effective in improving accessibility to healthy foods, evidence for improvements in health outcomes have often been lacking[41,42], suggesting increasing the accessibility of healthy items is necessary, but not sufficient to make a significant impact on purchasing and diets. It is perhaps not until effort is made to intervene in the overwhelming presence of non-nutritious foods that we can expect to observe any substantial variability in the availability of these items in the retail food environment.

6.7 STRENGTHS & LIMITATIONS

A strength of this work is that we have refined our understanding of scoring within store audit methods and explored some of the assumptions within scoring methods related to the NEMS-S survey. In terms of limitations, the results are based on data collecting using the NEMS-S method in a rural area of Canada, and given the heterogeneity of rural environments may not be generalizable to other jurisdictions, or to those who conduct complete store inventory including extensive variety counts and shelf space measurement. In this case, more variability may be captured within stores. This research was exploratory work; we did not conduct sensitivity analysis of the healthy, regular or total availability score, and this may be considered for future research.

6.8 CONCLUSIONS

In this census of rural stores in Eastern NL, Canada, both supermarkets and convenience stores offered most regular food and beverage options while the availability of healthier items differed between supermarkets and convenience stores with a greater magnitude and were less likely to be available in convenience stores. Although healthy food availability and total food availability are appealing to use as measures in capturing the disparities among stores, they may not represent the overall consumer food environment and the exposures people experience while shopping.

More investigation is needed to strengthen the measurement of the variability among consumer food environments. Regardless of store type, less nutritious foods are readily available to consumers and indeed a meaningful and prevailing component of the retail food environment. When possible, policymakers and other key stakeholders should expand retail food environment interventions to address exposure to both healthy and unhealthy food and beverages.

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APPENDIX 6A

Table 6A-1 NL Remoteness Index

Remoteness Classification	**Access to Goods and Services**
Highly Accessible	Unrestricted
Accessible	Some Restriction
Somewhat Accessible	Considerable Restriction
Moderately Remote	Significant Restriction
Remote	Very Restricted
Very Remote	Little/ No Access

Table 6A-2 North American Industry Classifications for Store Types

North American Industry Classification	**Definition**
Supermarkets and other grocery (except convenience) stores	Establishments primarily engaged in retailing a general line of food such as canned, dry and frozen foods; fresh fruits and prepared meats, fish, poultry, dairy products, baked products and snack foods.
Convenience Stores	Establishments primarily engaged in retailing a limited line of convenience items that generally includes milk, bread, soft drinks, snacks, tobacco products, newspapers and magazines
Gas stations with convenience stores	Establishments primarily engaged in retailing automotive fuels combined with the retail sale of a limited line of merchandise such as milk, bread, soft drinks and snacks in a convenience store setting.

APPENDIX 6B

Table 6B-1 Healthy Food Availability Score

Item	Availability	Total Maximum Score
Fruits	1-3 varieties = 3pts 3-6 varieties= +2pts > 6 varieties = +3pts	6
Vegetables	1-3 varieties = 3pts 3-6 varieties = + 2pts > 6 varieties= + 3pts	6
Baked Goods	Whole Wheat Bagel Or Whole Wheat English Muffin = 3pt	3
Bread	Whole wheat bread available = 3pts	3
Fresh and Frozen Meats	Ground Beef= 2pts Chicken Leg= 2pts Pork Chops= 2pts Cod= 3pts	9
Meat Alternatives	Canned Tuna= 3pts Yellow Split Peas= 3pts Kidney Beans= 3pts	9
Milk	2% /Skim =3pts	3
Eggs	Eggs= 3pts	3
Cheese	Cheddar Cheese =2pts Deli Cheese = 2pts	4
Frozen fruit	1-2 varieties = 3pts 3-6 varieties = + 2pts >6 varieties= + 3pts	6
Frozen vegetables	1-2 varieties = 3pts 3-6 varieties = + 2pts >6 varieties= + 3pts	6
Frozen dinners	Reduced-Fat=1pt Reduced Sodium=1pt	2
Canned Fruit	1-2 varieties = 3 pts 3-5 varieties = + 2pts ≥6 varieties= + 3pts > 1 kind packed in water without water = +1pt	7
Canned Vegetables	1-2 varieties = 3 pts 3-5 varieties = + 2pts ≥6 varieties= + 3pts> 1 kind without salt = +1 pt	7

Table 6B-1 Continued

Item	Availability	Total Maximum Score
Chips	Baked = 1pt Lightly Salted= 1pt	2
Beverages	Diet Pop = 1pt Reduced Sugar Sports Drink=1pt	2
Cereal	Healthier cereal available = 3 pts > 1 kind healthier cereal = + 2 pts	5
Rice and Pasta	Healthier rice available = 3 pts > 1 kind healthier rice = + 2pts Healthier pasta available = 3pts > 1 kind healthier pasta = + 2pts	10
Total: 93		

Table 6B-2 Unhealthy Food Availability Score

Item	Availability	Total Maximum Score
Baked Goods	Muffin OR Tea Bun OR Apple Flip = 3pts	3
Bread	White Bread = 2pts	2
Processed Meat	Hot dogs = 3pts Chicken Nuggets = 3pts Fish Nuggets = 3pts Bologna = 3pts Salt beef =3pts	15
Meat Alternatives	Peanut Butter = 1pt	1
Milk	Whole Milk = 1pt	1
Processed Cheese	Cheese Slices = 2pts	2
Frozen Dinner	Regular Frozen Dinner = 3pts	3
Chips	Regular Chips= 3pts	3
Beverages	Pop = 3pts Sports Drink = 3pts	6
Cereals	Sugar Cereal = 3pts > 1 variety sugar cereal = +2pts	5
Rice and Pasta	White Rice = 2pts > 1 kind white rice = +1 pt White Pasta= 2pts > 1 kind white pasta = +1 pt	6
Total: 47		

APPENDIX 6C

Table 6C-1 Healthy individual measure scores by store type

Measure	Mean Score (SD)		Total Available Points
	Supermarkets	Convenience Stores	
Fresh Fruit	**4.7*** (2.1)	2.4 (2.4)	6
Fresh Vegetable	**5.6*** (1.0)	4.4 (2.1)	6
Healthier Baked Goods	0.71 (1.3)	0.49 (0.38)	3
Whole Wheat Bread	2.65 (1.0)	2.16 (1.4)	3
Healthier Meat	**6.4*** (2.0)	3.8 (2.9)	9
Healthier Meat Alternatives	8.3 (1.7)	7.6 (2.5)	9
Low-Fat Milk	2.7 (1.0)	2.8 (0.8)	3
Eggs	2.8 (0.7)	2.5 (1.1)	3
Healthier Cheese	2.0 (1.0)	1.8 (1.2)	4
Canned Fruit	**6.4*** (1.3)	4.4 (2.4)	7

***Significant at $p<0.01$**

Table 6C-1 Continued

Measure	Mean Score (SD)		Total Available Points
	Supermarkets	Convenience Stores	
Frozen Fruit	**2.0*** (2.2)	0.4 (1.1)	6
Frozen Vegetables	**4.1***(2.4)	1.4 (2.0)	6
Healthier Frozen Dinner	**0.8*** (0.6)	0.3 (0.6)	2
Healthier Chips	1.6 (0.6)	1.6 (0.6)	2
Healthier Beverages	1.6 (0.5)	1.7 (0.5)	2
Low Sugar Cereal	4.1 (2.0)	3.5 (2.1)	5
Whole Wheat Rice	**2.4*** (2.4)	0.3(1.0)	5
Whole Wheat Pasta	**2.5*** (2.5)	0.3 (1.2)	5

***Significant at p <0.01**

Table 6C-2 Regular individual measures by store type

Measure	Mean Score (SD)		Total Available Points
	Supermarket	Convenience Store	
Regular Frozen Dinner	1.9 (1.5)	1.5 (1.5)	3
Regular Chip Score	3.0 (0.0)	3.0 (0.0)	3
Regular Beverage	5.1 (2.1)	5.7 (1.1)	6
Regular Cereal	**4.3*** (1.7)	2.9 (2.3)	6
White Rice	2.6 (1.0)	2.1 (1.2)	5
White Pasta	2.8 (0.7)	2.8 (0.8)	5
Regular Baked Goods	2.7 (1.0)	2.2 (1.3)	3
White Bread	1.8 (0.7)	1.7 (0.7)	2
Processed Meat	**12.5*(**3.0)	8.4 (4.6)	15
Regular Meat Alt	0.9 (0.3)	0.7 (0.4)	1
Processed Cheese Score	**1.9*** (0.5)	1.4 (0.9)	2

***Significant at p<0.0**

CHAPTER 7: Improving Access to Nutritious Food in Rural Newfoundland and Labrador: A Policy Analysis

AUTHORSHIP STATEMENT

TITLE: Improving Access to Nutritious Food in Rural Newfoundland and Labrador: A Policy Analysis

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Contributions

CM and RH proposed the concept for this manuscript. RH devised an implementation plan and framework for the analysis. RH conducted background research, policy analysis and conclusions. All drafts of the manuscript (including all sections) were written by RH. Initial and intermediate versions were sent to CM for edits and suggested revisions.

7.1 ABSTRACT

Rural food environments have been characterized as disadvantaged because of the low accessibility to full service grocers and a greater dependency on small stores that lack the capacity to offer nutritious foods at affordable prices.

The objective of this analytic essay is to identify potential strategies to improve the accessibility of nutritious food in Newfoundland and Labrador (NL). We proposed and critically analyzed two fiscal policy options: 1) offering financial grants to support the development of full service grocers in rural NL and 2) renovation grants and distribution subsidies for small rural retailers to improve their capacity to stock healthy foods.

Both options address fundamental barriers to healthy food access in rural areas. However, grants to increase the capacity of existing rural retailers to offer healthy items requires a smaller upfront investment and more evidence is available on the success in influencing the availability, purchase and consumption of nutritious foods. Implementation of this option has increased feasibility because of a similar pilot program implemented by Food First NL, Memorial University and Eastern Health. Multi-sectoral collaboration will be essential to ensure the success and sustainability of the program.

7.2 INTRODCUTION AND BACKGROUND

With the overwhelming economic, morbidity and mortality related implications of the rising rates of chronic disease, public health officials and policy makers are under added pressure to reduce the "risk behaviors" contributing to non-communicable disease. Risk behaviors include behaviors such as smoking, alcohol abuse, physical inactivity and unhealthy eating, that increase the risk of developing chronic, non-communicable diseases.[1]

Recent social and cultural shifts alongside evolution in the food industry have led to an increase in the marketing, availability and affordability of highly processed, high fat, high sugar foods and a growing dependence and accessibility to energy dense, nutrient poor, items.[2,3] These trends have created food environments that promote the consumption of an unhealthy diet while making it increasingly difficult for consumers to make healthful choices.[2,3] The situation is exaggerated in rural communities where inadequate accessibility to fresh and nutritious foods is compounded by geographic restrictions in remote locations and a lack of public transportation, and increased food costs.[4,5,6,7]

Unlike alcohol and tobacco, the nutrients and energy from food and beverage are essential for life, thus, regulating the consumption of food and beverage is more challenging than for alcohol or tobacco.[8,9] Food is also a significant component of social and cultural well-being and it can be argued that executing authority over dietary behaviors imposes on individual autonomy.[8] Consequently, establishing and enforcing authoritative regulations

over individual consumption of food and beverage is complex and has been largely disregarded.[8] Opportunely, the use of fiscal policy tools including grants, subsidies and tax, offer a proactive but malleable approach to modifying individual dietary behavior; using the power of treasure[10] to incentivize or discourage the consumption of certain foods without infringing on public liberty.

The aim of this paper is to analyze fiscal policy as a population health intervention to improve availability and affordability of nutritious food in Newfoundland and Labrador (NL), where over 40% of the population live in rural or remote areas[11] and over 3/4 of the population is overweight or obese.[12]

We will begin by outlining the issue history of obesity and diet related disease and the main barriers to creating healthy food environments in rural communities. Next, we will provide a brief introduction into the role of fiscal policy in food environments, with an overview of some existing fiscal strategies that have been implemented across other jurisdictions. We will then review some of the action being taking at the federal and provincial level to address to food access and healthy eating in NL. Finally, we will propose and analyze two fiscal policy options aimed at improving equitable access to healthy foods in rural NL, followed by our recommendations for future action.

Problem Statement

Obesity and the Food Environment

Obesity is a national and international public health crisis. Currently in Canada, the number of people who are overweight or obese exceed the number who are of healthy weights, with 61% of the national population classified as overweight or obese.[12] According to the most recent data, NL has the highest prevalence of overweight and obesity in the country where 77.5% of adults classified as overweight or obese.[12]

The prevalence of diet related diseases, including diabetes, cardiovascular disease, cancer, osteoporosis and dental disease, are also approaching epidemic proportions.[1] Newfoundland and Labrador has the highest prevalence of diabetes in Canada with 9.6% of the provinces' adult population facing type 1 or type 2 diabetes.[13]

Together, diet related diseases, including obesity, are the leading cause of death in Canada and place an insurmountable economic burden on the health care system- costing tens of billions of dollars each year.[1] The estimate per capita total health care costs in Newfoundland and Labrador was approximately $7256 in 2016.[14] Although these diseases are primarily preventable through a healthy lifestyle (including a nutritious diet) a number of indicators suggest that diet quality is poor in NL. For example, only 30% of Canadian adults and 18.5% of Newfoundland adults consume the recommended 5 servings of fruit and vegetables per day. [13]

Understanding the complexity of factors influencing food choice is imperative to developing successful policy intervention to modify dietary behavior and reduce the burden of diet related disease. This includes recognition that to observe change in individual behaviors there must be supportive environments in which to make healthy choices.[2,3,15] The food environment is a significant component of the physical environment that influences diet. The food environment is the accessibility, availability and affordability of food and beverage in a defined community or geographic area.[16] It can be investigated through the community food environment: the distance, proximity or density of food retailers within a defined area (i.e. convenience stores, grocery stores or fast food outlets) or through the consumer (retail) food environment: the availability, affordability and quality of food available within food stores.[15, 20] Although the field of food environment research is relatively new, findings have consistently demonstrated that those living more disadvantaged communities, such as low income neighbourhoods or rural and remote communities are disproportionally exposed to unhealthy food environments.[4,5,6,7]

Barriers to Building Healthy Food Environments in Rural Communities

Rural communities face a catalogue of health, demographic and socio-economic disparities compared to those living in urban communities. Rural populations are aging, they may have lower levels of educational attainment, they are more likely to be unemployed, they may have higher prevalence of income from social assistance sources, they may have more limited access to health care services, and have generally poorer health status and higher mortality rates compared to their urban counterparts.[17]

Rural communities differ from even nearby urban areas. They have smaller populations over a larger area of land, they are further from the metropolitan area and residents often have to travel a significant distance for some of their basic necessities.[5,17,18] Public transportation is limited in rural communities therefore residents may have increased reliance on nearby food retailers.[17] As a result, many living in rural communities may be forced to do the majority of their grocery shopping at smaller local stores, such as convenience stores. This is particularly relevant to NL where there is the highest proportion of convenience stores in rural areas (72%) of any province/territory in Canada.[19]

Rural retailers face additional barriers to offering nutritious foods as a result of limited opportunity to apply economies of scale. Many of the stores in rural communities are small because of objective or perceived low consumer demand and lack of profitability for a full-service grocery store.[20,23] It is difficult for the small stores to stock healthier options, such as fresh produce, because unlike larger stores they don't have the benefit of purchasing in bulk, they may face higher purchasing costs, and their rural location adds to increased distribution expenses.[21] Further, because of the small size and limited infrastructure of corner stores, they often do not have the capacity to stock and display fresh or frozen foods which can lead to produce and other perishable items deteriorating quickly. [21,22]

As a consequence of the economic and environmental barriers facing both retailers and consumers, creating healthy retail food environments is a challenge in rural communities.

Access to healthy foods in rural NL is not an issue that is only relevant to a small portion of the province; 41% of Newfoundland's population live in rural communities.[11]

Implementing fiscal policies in the retail food environment is an area of growing interest to population health decision makers. This paper examines whether fiscal policies can relieve some of the specific barriers in rural areas and work to improve both availability and accessibility of nutritious foods, toward improving diet related population health outcomes.

7.3 FISCAL POLICY IN THE FOOD ENVIRONMENT

The relationship between diet and non-communicable diseases has been well established, however, the ethical debate regarding individual or environmental factors' relative contribution to disease and the roles of government and industry in shaping these factors, remains under dispute.[2,23] Although some maintain that over indulgence and poor diet is a personal choice, in which the individual acknowledges and accepts the potential consequences of their behavior, others argue that the recent shifts in the food environment including increased accessibility, availability and marketing of unhealthy food and beverage has obstructed the ability for individuals to make rational and conscious decisions regarding their diet.[2,23] This idea is often framed under the concept of market failure and used as a central argument in the advocacy for public health intervention in the food environment.[24,25] Market failure occurs when there is an inefficient distribution

of resources and the consumption of a good or services is not in the best interest of society, thereby justifying government intervention.[26]

Fiscal policies have gained traction and support from decision makers in recent years because they offer a balance between government stewardship and individual autonomy. This concept which has been referred to as a "soft paternalism" approach by some authors.[25] That said, some fiscal policy can be perceived to be "harder" than others, most notably taxation, while others, such as subsidization, can be perceived as more "soft" or malleable approaches.[25] Some of most common fiscal interventions that have been proposed or implemented in the retail food environment are outlined below.

Unhealthy Food Tax

Taxation on alcohol and tobacco products has been well described as a successful public health intervention [27,28] and has stimulated interest and advocacy for taxation on other products, such as unhealthy food and beverages, in recent years. In the last decade, many countries, including Denmark, France, Hungary, Mexico, among others, have begun implementing taxes on sugar sweetened beverages and foods defined as "unhealthy" by various standards.[27,29,30,31] Evidence regarding the effectiveness of taxes have been mixed, in part because the taxes accomplish different aims. Although many reviews on the topic have concluded taxation is effective in producing modest changes in consumer behavior and health outcomes, they have also demonstrated that price elasticity varies by item and population, and is dependent on the type and amount of tax collected.[27,28,30] Taxation is among the few retail food environment interventions in the literature that target unhealthy

foods, however, a central argument against nutrition-oriented taxes is that they are regressive and disproportionately burden low income individuals who spend a higher proportion of their income on tax and are more likely to purchase taxed foods.[9,27,28,30,31] More research is needed to establish alternative, evidence-based approaches to intervening in consumer exposure to non-nutritious foods that may be more suitable for rural communities and other populations with high proportion of low income residents.

Healthy Food Subsidies

Nutrition subsidies are based on the economic theory that by decreasing the cost of targeted products relative to an alternative, consumers will be more likely to purchase the targeted products.[9] That is, by decreasing the price of nutritious foods relative to the price of energy dense foods high in fat, sugar and sodium, consumers will be more motivated to make nutritious purchases. Food subsidization has been shown to be a successful nutrition intervention; a 2012 review of field experiments in healthy food subsidies reported that all but one of the reviewed studies (19 of 20), found a significant increase in the purchase or consumption of the subsidized foods.[32] Similar to taxation, the success of the subsidy is dependent on the level of discount applied, with more generous discounts demonstrating a greater increase in purchasing and consumption of subsidized items.[32,33] Although effective, subsidies require substantial financial resources to maintain.

Development of Full Service Grocery Stores

Research has demonstrated a positive relationship between the proximity and density of grocery stores and community diet and health patterns.[4,34,35] The concept of building full

service grocery stores in disadvantaged communities is most often with the intent to remove the geographic barrier to accessing quality, healthy foods and/or to decrease the economic burden of purchasing these items in smaller, higher priced stores.[20,36] Introducing a new retailer may also have the added benefit of creating local jobs while increasing the economic vitality of the community.[20,36] Government intervention in bringing full service grocery stores to underserved communities can be operationalized in many ways, including: documenting consumer demand and household spending power, offering tax credits and regulatory incentives (expediting zoning or permit review) or larger financial contributions in the form of non-repayable grants.[20,36] A perceived limitation of grocery store grants as a policy intervention is the significant up front and long term investment which may pose more risk than other alternatives.

Healthy Corner Store Programs

Because of a perception of low consumer demand, the high cost of distribution, small size and limited capacity of small rural stores, offering fresh healthy foods can be challenging.[21] In efforts to help retailers overcome these barriers and increase access to healthy foods in underserved areas, the concept of the "healthy corner store" emerged. Healthy corner store projects are now widespread across the United States and are becoming more prevalent in Canada.[37] Healthy corner store projects are most often supported through government grants and can be small interventions such as merchandising and marketing campaigns to promote healthy eating or larger infrastructural changes and equipment installation that increase a stores' capacity to stock healthy foods.[37,38] Although evaluations of urban healthy corner store programs have been

mostly optimistic, they have been primarily designed for implementation in urban centers and most do not address some of the key barriers to food access in rural communities, such as costly distribution. [22,39]

7.4 LOCAL POLICY

Improving population health outcomes was named as one of the top three priorities in the 2014-2017 Newfoundland and Labrador provincial strategic wellness strategy.[40] Unfortunately, there are currently no direct provincial programs or policies in place aimed at improving equitable access to healthy foods in rural NL. There is however, some direct and indirect action being taking at the federal and provincial level to address to food access and healthy eating. We will review some of these strategies below.

Provincial Action

Provincial Healthy Eating Framework

In response to rising rates of obesity and diabetes, in 2006 the province published "Eating Healthier in Newfoundland and Labrador" a provincial food and nutrition and framework action plan.[41] The action plan was designed to guide government, organizations and other key stakeholders in decisions regarding healthy eating and was intended to be implemented in phases. Phase one was published in 2006 and described goals and strategies that would take place from 2005-2008. The framework vision reads "All residents of Newfoundland and Labrador will have reasonable access to an adequate, nutritious and safe food supply and a supportive, comprehensive network of food and

nutrition services."[41] The goals of the framework include contributing to individual and community well-being by supporting health promotion strategies directed toward healthy eating and physical activity, supporting measures that will allow access to adequate food supply and nutrition services to vulnerable populations, supporting the development, production, marketing and distribution of healthy foods and supporting food and nutrition research.[41]

The development of a framework involves significant investment of time and resources. The framework development involved a multi-sectorial approach and consultation was made with over 140 groups and over 800 recommendations and comments were given.[41] Unfortunately, approximately a decade later, phase one of the framework has been the only one published. Although some of the actions have been implemented, such as the NL school nutrition policy, the majority of the actions, including collaborating with food producers and suppliers on initiatives that support the availability of healthy foods, have not moved forward.

Community Healthy Living Fund

In 2015, the provincial Department of Health and Community Services introduced the community healthy living fund.[42] The community healthy living fund replaced four previous existing grant programs including the senior's recreation grant, provincial health and wellness grant, and the community recreation support program. The community healthy living fund is divided into three categories: capacity building, programs, and supportive environments.

Application for participation in the grant program is competitive but if chosen, applicants can receive up to 20,000 in one-time funding. The 2017 provincial budget has allocated 1.79 million dollars to support initiatives under the community healthy living fund but it is unclear which areas of the program will be given the most priority.[42] In 2016, the funding was distributed across almost 400 organizations and many of the larger grants were allocated to sports and recreation.[43]

Because the scope of the grant program is so broad, it may lead to smaller investments made in a wide range of areas, instead of larger, more impactful change in high priority areas. Unfortunately, minimal to no evaluation appears to have been done to determine the success of the program and it is difficult to determine if investments are being made into sustainable interventions to improve long term health outcomes of the province.

Federal Action

Nutrition North

In 2011, in response to substantial and increasing food insecurity rates in Northern Canada, the federal government announced Nutrition North Canada (NNC).[44] NCC is a Health Canada program that provides subsidies to retailers and suppliers to relieve the high cost of stocking and distributing perishable foods to the North. Retailers must apply to participate and are selected based on eligibility criteria and need; they are then responsible for forwarding the full subsidy on to the consumers. The subsidy is based on current food cost and distribution expenses and only applies to an approved list of foods.[44]

Nutrition North Canada is a significant national investment. The government invests approximately 60 million dollars each year to NNC.[44] The government has promoted the success of the program, stating that since 2011, the cost of food for a family of four has decreased approximately 5% per month despite the 25% increased cost of shipping eligible items to Northern communities.[44]

Despite communication about the program's success and the significant financial contribution made toward the program, NCC has been criticised.[45] A recent Auditor General Report has identified a lack of transparency and retailer accountability as significant issues.[45] In efforts to increase accountability and transparency, the government announced a point of sales system that will show consumers where and when the NCC subsidy has been applied; all NCC retailers were mandated to implement the sales system by 2016.[44]

Unfortunately, according to the program's eligibility criteria, only those communities who have used Food Mail and lack year-round surface transportation can participate.[44] Based on these criteria only a limited number of NL communities are eligible, leaving many rural communities unassisted.

The Way Forward

Public health research has produced evidence of significant disparity between urban and rural food environments.[4,5,6,7] It has also been suggested that limited access and availability to healthy nutritious food is contributing to poor diet quality and the

development of overweight and obesity.[5,18,22,46,47,48] This is of concern for NL where a significant proportion of the population live in rural communities.[11] This concern, in combination with the alarming rates of overweight and obesity and other diet related disease in NL, demonstrate an urgency for action.

The current strategies in place to promote healthy eating and improve the health and well-being of the province are a step in the right direction but have failed to make a significant impact on provincial diet related health outcomes. The province continues to have some of the leading rates of overweight and obesity, diabetes and hypertension in Canada[13] which indicates that what is being done, is ineffective or insufficient. The provincial strategies currently in place have a broad scope and as a result, it is difficult to make an influential impact on multiple target areas. A more direct and prioritized approach toward reducing barriers and challenges to healthy eating in rural NL is needed.

7.5 POLICY ALTERNATIVES

The policy options proposed below present potential fiscal strategies to improve the retail environment in efforts to improve access to healthy affordable food and make healthy choices easier for those living in rural communities across NL.

Option 1: Rural Food Retailer Development Grant

Developing and maintaining a business in any area is associated with significant upfront investments and high operating costs. Due to the low-density populations in rural communities, there is often a perception of low profitability for businesses owners. As a result, the majority of rural communities in NL lack a full-service grocery store.[49] However, unlike small corner stores, full service grocery stores are larger and have greater structural capacity to offer a wider variety of foods, they are able to make larger purchases therefore face lower food costs and often have higher revenue to cover the increased cost of distribution.[20,36,50] By offering a grant for the development of full service grocery stores in rural communities there is potential to attract business owners to expand in underserved rural areas and improve the access to healthy nutritious food.[20,36,50] This proposed program is modeled on the Healthy Food Financing Initiative (HFFI)[51], a retail food environment program implemented in the United States, and is described below incorporating adaptations that will increase suitability for implementation in rural NL.

In this program, prospective food retailers could apply for the grant and would be selected based on priority eligibility criteria, including their ability to demonstrate concern for the health of the community, motivation to improve access to healthy foods, while also presenting a sound and feasible business plan. Because the size of rural communities are small, this program would target small full service grocers which may include cooperative, independent or chain grocers. In order to qualify as a full-service grocer, retailers would need to fall within the definition of supermarket and grocery store as

defined by North American Industry Classification System.[52] This would include offering fresh, frozen and canned foods including fruits, vegetables, meat, poultry, dairy and baked products. In order to be feasible, it would be reasonable for this program to target fewer, higher populated rural communities of 800-1000 residents.

The proposed development grants would be a one-time contribution and would cover up to 20% of development costs. Distributers would be required to sell foods at fair prices, stock a minimum proportion of healthy foods and display healthy foods visibly and attractively. The retailers would be monitored and evaluated on their compliance during annual food safety inspections and would be subject to fines for non-compliance.

Option 2: Healthy Corner Store Program: Small Food Retailer Renovation Grants and Distribution Subsidies

Because of the high cost of distribution, the size and limited capacity of small rural stores, offering fresh healthy foods can be challenging.[21,22,45] A program that offers store renovation grants and food distribution subsidies could help rural food retailers overcome these barriers by decreasing financial risk for rural food retailers and increase their ability to offer healthy, nutritious food to their community. The following proposed program is modeled after existing healthy corner store programs[3853] that have been implemented across North America, and is described below incorporating adaptations and additions that will increase suitability for implementation in rural NL.

In this program, rural retailers would apply to participate based on specific eligibility and could apply for either the food distribution subsidy, the renovation grant, or both. The food distribution subsidy would be given to food retailers to compensate for the high cost of distribution and the retailers would be required to hand the subsidy down to consumers by offering a price that is equivalent to those in larger metropolitan areas. The distribution subsidy would be applied to a list of approved healthy foods, for example, those that are part of the pre-established Newfoundland and Labrador Nutritious Food Basket.[54] Items included in the Nutritious Food Basket are based on Canada's Food Guide recommendations, it also considers provincial purchasing patterns to ensure that the list includes culturally appropriate foods. The subsidy would be calculated using a formula including food weight and current food and distribution costs.

If a retailer wishes to receive a renovation grant they should first participate in the subsidy program for six months in order to demonstrate they would make a good candidate for renovation. The renovation grants would then be given to retailers who require structural or equipment changes to increase their capacity to offer a wider variety of healthy foods. Because public health food inspectors are an existing resource with experience evaluating the retail food environment, they could be a valuable government asset as a practitioner to assess the store to determine the necessary improvements.

Acceptance into the program would be competitive and based on eligibility criteria and willingness to participate. In order to be eligible for participation in the program, for example, it would be reasonable for the retailer to be located preferably in a somewhat

accessible, moderately remote, remote, or very remote area, as defined by the NL Remoteness Index[55] and to hold and existing NL food establishment license. As part of their application, retailer owners could be requested to state their motivations for participating in the program, including: describing their barriers to offering fresh perishable items, demonstrating a sense of concern for the lack of healthy options in their community, and recognizing their role in making a positive impact on the health and well-being of their community.

A set of accompanying program regulations could include: forwarding the full distribution subsidy to the consumer, stocking a minimum proportion of healthy options, displaying healthy foods in a visible and attractive manner, display program marketing materials and monitor the sales of subsidized healthy foods. In this instance, it would be important for retailers to participate in enforcement strategies to monitor and evaluate compliance. Monitoring could be conducted by public health food inspectors who integrate such inspections as part of routine food safety inspections. Retailers would also be required to prepare self-reports, i.e., to submit their sales of subsidized foods and demonstrate that the subsidies have been passed on to consumers. Consequences of non-compliance could include fines, and a dismissal in program participation.

7.6 POLICY ANALYSIS

Analytical Framework

In the following section, we will analyze the policy options in further detail, supplemented by a critical examination of relevant scientific and grey literature. We will use the framework shown in Figure 7-1, from the National Collaborating Centre for Healthy Public Policy (NCCHPP)[52], to analyze the effects and implementation of the proposed programs. NCCHPP's policy analysis framework integrates the decision-making needs from both the public health perspective (effectiveness, unintended effects and equity) and policy maker perspectives (cost, feasibility and acceptability). It offers guidelines within a flexible framework that is adaptable for varying degrees of time resources, making it a logical and suitable framework for this context.[52] A summary of policy option considerations can be found at the end of the analysis, in Table 7-1.

Figure 7-1 The Framework for Analysis of Proposed Policies

Effects	Effectiveness	What effects does the policy have on the targeted health problem?	Durability
	Unintended effects	What are the unintended effects of this policy?	
	Equity	What are the effects of this policy on different groups?	
Implementation	Cost	What is the financial cost of this policy?	
	Feasibility	Is this policy technically feasible?	
	Acceptability	Do the relevant stakeholders view the policy as acceptable?	

Effectiveness

Rural Food Retailer Development Grant

Preliminary research has established a positive relationship between proximity and density of grocery stores with consumer behavior, diet and health outcomes.[4,34,35] In a multi-state U.S study of more than 10,000 adults, adults living in neighborhoods with supermarkets or grocery stores had lowest rates of overweight (60–62%) and obesity (21%) while those living in neighborhoods with no supermarkets and access to only convenience stores and/or smaller grocery stores, had the highest rates (73–78% overweight and 32–40% obesity).[34] These findings provide evidence that supermarkets and access to nutritious food plays a significant role in building healthier food environments.

This evidence has gained the attention of policy makers and decision makers in the U.S and has led to the development of Healthy Food Financing Initiative (HFFI), a program designed to bring grocery stores and other healthy food retailers to underserved communities across the United States. Unfortunately, although HFFI has developed or supported over 1000 grocers since the implementation, there has been little to no evaluation to demonstrate the effectiveness of these efforts.[57]

The few evaluations that have been done were conducted in urban centres and results contradict expected outcomes. In two separate evaluations by each Cummins et al.[57] and Dubowitz et al.[58], the introduction of a HFFI supermarket did not appear to improve

purchasing patterns, dietary consumption or body mass index. A third evaluation, by Ghosh-Dastidar and colleagues[59], evaluated overall community food availability following the introduction of a grocery store in an underserved community; results demonstrated that there was only a moderate and insignificant increase in community availability of fruits, vegetables and other healthy items and it was paired with a moderate increase in unhealthy food.[59]

Unfortunately, evaluations of grocery store development in rural communities are lacking and it is difficult to know if the results from urban centers are generalizable to rural communities. Many communities in NL do not have a grocery store or supermarket[49] and over 70% of stores in rural communities are convenience stores or corner stores.[19] For this reason, we predict this program could potentially have a more powerful effect in rural NL communities but gaps in knowledge surrounding the success for these program in rural and urban areas remain.

Small Food Retailer Renovation Grants and Distribution Subsidies

Because healthy corner stores have become such a prominent food environment intervention, there have been numerous evaluations regarding the effectiveness of this approach in improving food availability, consumer purchasing, and diet.[22,39] Despite the growing number of evaluations, those in rural communities are lacking.[22, 39] Reassuringly, evaluations conducted in urban communities have illustrated positive outcomes. A review by Gittelsohn identified 16 articles and grey literature evaluating small store interventions between 2005 and 2010.[22] The majority of interventions reported an increase in

availability and sale of promoted foods with some trials observing 25 to 50% increase in produce sales.[22] Increases in consumer food and health related knowledge, as well as an increased perceived accessibility and intention to buy healthy foods, were also observed.[22,25]

Subsidies have also been shown to be a successful nutrition intervention; a 2012 review of field experiments in healthy food subsidies reported that all but one of the reviewed studies (19 of 20), found a significant increase in the purchase or consumption of the subsidized foods.[32] The success of the subsidy is dependent on the level of discount applied, with more generous discounts demonstrating a greater increase in purchasing and consumption of subsidized items.[32,33] In school settings, discounts of 50% have demonstrated up to 93% increase in sale of targeted items.[30]

Summary of Considerations

Although research has shown a positive relationship between proximity and density of grocery stores with many outcomes of interest (consumer behavior, diet, health outcomes), there is a lack of evidence that indicates introducing a new grocery store to an underserved area will lead to an improvement in these areas. More evidence is available for the effectiveness of healthy corner store programs and healthy food subsidization in improving availability, purchasing, consumption and perceptions of healthy foods.

Unintended Effects

Rural Food Retailer Development Grant

One of the primary concerns surrounding the development of larger grocery stores in rural or urban food deserts is the potential increase in the availability of unhealthy foods. Although supermarkets have been considered generally "healthful" food retailers, our previous research in NL, as well as similar research in the field, has shown that stores with higher availability of healthy foods also tend to offer a higher exposure to unhealthy foods.[60,61] Consequently, increasing accessibility to unhealthy foods could lead to an unintended increase in the purchasing and consumption of these items. However, accompanying regulations to sell foods at fair prices, stock a minimum proportion of healthy foods, and display healthy foods attractively, could help mitigate the potential effects of an increase in the availability of unhealthy items.

Small Food Retailer Renovation Grants and Distribution Subsidies

Although healthy corner stores do not increase the availability of unhealthy food, there is a chance that consumers may simply add subsidized foods to their diet rather than substituting them in place of less healthful foods.[28] For instance, an intervention based study conducted in Australia placed a 20% subsidy on fruits, vegetables, bottled water and diet drinks and while they observed a 20% increase in the purchase of fruits and vegetables, they also observed a 13% increase in the purchase of unhealthy foods.[62] With that said, it is unclear if this would occur in rural communities where the price elasticity (a measure of consumer response due to change in price) may differ based on overall higher food prices. If the price of unhealthy food items remained unchanged, is possible

that rural consumers would take the opportunity to reduce food spending and therefore substitute (rather than supplement) unhealthy items with subsidized healthy items.

Summary of Considerations

Because the healthy corner store program does not increase exposure to unhealthy foods and because of the high baseline food prices and reduced purchasing power in rural communities, we feel that the increase in unhealthy food purchasing is less likely to occur in this program compared to the retailer development grant.

Equity

Equity is one of the strongest values when implementing a community based policy and it lies at the core of NL's food access issue. As provincial taxpayers, rural and urban residents both have an interest in provincially implemented programs.

Both proposed programs are designed to prioritize rural communities and it is possible that urban residents may be less supportive and view either program as inequitable. However, rural communities face numerous health, demographic, and socio-economic disparities compared to their urban counterparts and rural retailers also face barriers and disadvantages to building and maintaining a successful business that stores in urban centres may not. For this reason, we feel rural prioritization in both proposed programs is justified.

Summary of Considerations

Both programs equally prioritize investment in rural populations. Within rural communities, participation in the programs are competitive and not universal. Both programs take similar steps to ensure the most equitable distribution of the resources by awarding grants based on eligibility criteria, willingness to participate, feasibility and need.

Cost

It was estimated that in 2017 the government would spend approximately $7377 per capita on health care costs in Newfoundland and Labrador.[14] The latest estimate of obesity related health care costs is from 2006 when annual cost of overweight and obesity was $126 million dollars in Newfoundland and Labrador.[41] The prevalence of overweight and obesity has risen steadily since then, therefore, it is expected that the related costs have followed a similar trend. These figures demonstrate that investing in effective and sustainable provincial public health strategies to prevent and reduce overweight and obesity is necessary and justifiable.

Rural Food Retailer Development Grant

Implementing a small full service grocer can be costly and have been estimated to cost up to 1 million dollars for capital costs including, land, building, amenities and equipment.[63] Based on the commitment to cover 20% of development costs, government contribution would be approximately $200,000 per program. This estimate is consistent with contributions made in the Healthy Food Financing Initiative (HFFI) where grants range

from $170,000 to $800,000 depending on the size of the store and community.[64] Based on the estimate of $200,000 contribution from government, the development of 10 small full service grocers would be $2 million dollars. Retailer development grants require larger upfront investments but would only require a one-time contribution and will serve multiple communities.

Small Food Retailer Renovation Grants and Distribution Subsidies

Reports from similar infrastructure corner store renovations have documented an average cost of approximately $1400 depending on the type of renovations or equipment required.[65] The majority of the costs associated with this program would be dedicated to supporting the food subsidy program. These costs will be based on current food and distribution costs so they would vary. In the federal food subsidy program (NCC), cost were documented at approximately $800 per person annually.[44] Based on this estimation, providing subsidization for a community of 300 people would cost roughly $240,000 annually and about $5 million annually to support 20 communities of this size. However, it is important to note that NCC serves very remote northern communities where air and boat distribution is necessary, therefore, we can predict a lower cost for a provincial program serving communities accessibly by land. Further, research on cost effectiveness on similar healthy food subsidy programs in rural areas have been determined to be cost effective based on the annual costs disability adjusted life years saved.[66]

Summary of Considerations

While the investment in either program could be justified, the large up-front investment in grocery store development poses considerably more risk. The healthy corner store program has smaller upfront investments and the investment in subsidies could be adapted depending on program success.

Feasibility

The policy options proposed here would fall generally under the mandate of the Department of Health and Community Services but would require a multi-sectoral approach. Improving access to healthy affordable food and increasing the economic vitality of rural communities aligns with the priorities of several government departments and many provincial organizations including the Department of Tourism, Culture, Industry and Innovation (TCII), Municipalities NL, Food First Newfoundland and Memorial University. Partnering with these organizations will help ensure the programs are feasible and sustainable.

Rural Food Retailer Development Grant

Building rural food retailers would require more upfront investments in time and financial resources. This program also has a significant business and economic component and would require partnering more closely with TCII, particularly the sector of Regional Economic Development.

We would seek to partner with Regional Economic Development for support during outreach to potential retailers and evaluating the strength of retailer applications and business proposals. They could also provide guidance and support regarding site allocation, land and building permits, and provision of funding.

The Department of Health and Community Services would be primarily responsible for developing nutrition parameters surrounding stocking, displaying and pricing. These guidelines could be overseen by a provincial Registered Dietitian and informed by similar strategies implemented in the Healthy Corner Store NL pilot project[19] (outlined in more detail below). Scientific literature and the numerous toolkits, handbooks and implementation guides developed as part of the Healthy Food Financing Initiative, could also be consulted during guideline development.[36] Once implemented, monitoring and evaluation of the required guidelines could be facilitated by Service NL and food establishment inspectors.

Economic support for this program could be provided by The Department of Health and Community Services but could be supplemented by related grants through TCII under the Regional Development Funding.[67]

Small Food Retailer Renovation Grants and Distribution Subsidies

One of the benefits of the healthy corner store program is that it can work with existing retailers, infrastructure, mechanisms, and partnerships. Key partners in the planning and

implementation of this program would be the Food Policy Lab, Eastern Health and Food First NL.

In 2015, The Food Policy Lab at Memorial University received federal funding for the development of a pilot healthy corner store in rural NL.[68] During this initiative, Memorial University partnered with Eastern Health NL, the largest health authority in NL, and Food First NL, a provincial non-profit organization whose motivation is to improve food insecurity through promoting community based solutions to improve access to healthy food across the province. The pilot program was implemented in 2015 and can provide the proposed program with a healthy corner store model and offers a valuable opportunity to expand on what has been already done including community outreach, networking and increased awareness of the importance of food retailers in creating healthy communities. Evaluations of the pilot will help to identify potential barriers and inform improvements to future program implementation. This partnership may also provide an opportunity to conduct program evaluation in an academic capacity, which will enhance the rigour of program evaluations and provide results and that can be disseminated to knowledge users more widely.

The pilot healthy corner store does not have an integrated distribution subsidy program, therefore, support and guidance for this element of the policy could be sought from federal sources involved in Nutrition North Canada as well as from provinces who have implemented similar programs and can provide feedback on key learnings.[69] Working with a provincial registered dietitian to create program guidelines surrounding approved

foods and the advertising, marketing and display of healthy foods, would also help ensure the program is founded on evidence-based practice.

Financial support for the healthy corner store program could come from the Department of Health and Community Services with support for store assessment and adherence evaluation coming from Service NL food establishment inspectors.

Summary of Considerations

Multi-sectoral partnership is essential for success in both proposed programs. Because the healthy corner store program works with existing retailers and infrastructure and could follow in the steps and key learnings from the pilot healthy corner store, this program offers a more feasible implementation.

Acceptability

The proposed policy options use fiscal instruments to create a health promoting environment and encourage consumers to make healthy choices. In contrast to policy instruments that use central authority, these options allow consumers and retailers to maintain their autonomy when making food choices. However, both programs would require a significant investment of public resources, consequently, may represent trade-offs between financial support for new or existing health and wellness programs. Such redistributive considerations have potential political implications as well as affecting stakeholder support for those in decision making roles. This concern is valid but should be offset by support from other key stakeholders in both the public and private sectors

who will recognize the value of a program to improve the both the built environment and the health and wellbeing of the province (a win-win approach). The following section analyzes some of the key interests at play.

Department of Tourism, Culture, Industry and Innovation (TCII) and Municipalities NL

The Department of Tourism, Culture, Industry and Innovation (TCII) is the department responsible for supporting the development of economically sustainable communities[36] and Municipalities NL is an independent advocacy organization for municipalities across the province.[37] These organizations will be key partners in assisting retailers in preparing program applications, developing business plans and other skills essential for implementing an economically successful project.[37] Both organizations have made revitalizing small rural communities a priority for their organization and improving the rural retail environment can help them achieve this. [67,70]

Food First Newfoundland and Eastern Health NL

Food First Newfoundland is a provincial non-profit organization whose mission is to improve food insecurity through promoting community based solutions to ensure access to adequate healthy food across the province. Food First has contributed to many initiatives to improve food access across the province and is one of the key partners in the healthy corner store pilot project.[68] Eastern Health NL is the largest regional health authority in the province, serving over 300,000 individuals across 21,000 km^2.[71] Eastern Health employees over 50 registered dietitians who work in a variety of contexts and work collaboratively with other health professionals and communities using strategies

that promote healthy eating and help prevent diet- related diseases.[72] Eastern Health is also partnering with Food First and Memorial University on the Healthy Corner Store NL project. Both Food First and Eastern Health are already invested in improving food access through the retail food environment and their support will be essential in implementing a successful program at the provincial level.

Rural Food Retailers & Community Members

Depending on the program implemented, acceptance from existing rural retailers will vary. Full service grocers could present a threat to small rural retailers and could potentially cause some stores to close. For example, in an evaluation by Ghosh-Dastidar, the introduction of a full service grocery store actually reduced the availability of healthy foods in surrounding stores, who could not compete with low prices offered in the larger store.[59] Larger grocers could also be seen an effort to urbanize rural communities. This may lead to some opposition from rural business owners and supporting community members.

Summary of Considerations

The objectives of both proposed are similar and therefore could expect to be accepted equally by most stakeholders. However, there are some reason for concern regarding reactions from local retailers and some community members on the introduction of a full-service grocery in the community. The healthy corner store program offers a less invasive intervention and works with existing, local retailers and enables rural dwellers to support their community members.

Table 7-1 Summary of Policy Considerations

		Rural Food Retailer Development Grant	Small Food Retailer Renovation Grants and Distribution Subsidies
Effects	**Effectiveness**	-Lack of evaluation in rural areas -Evaluations in urban communities were only moderately effective	-Lack of evaluation in rural areas -Evaluations in urban areas have demonstrated the effectiveness in improving food availability, consumer purchasing, and diet
	Unintended Effects	-Potential increase in the availability of unhealthy food	- Consumers may add subsidized foods to their diet rather than substituting them in place of less healthful foods
	Equity	-Prioritizes rural communities	-Prioritizes rural communities
Implementation	**Cost**	-Significant upfront cost but no cost to maintain -Lack of evidence for success in rural communities, therefore high risk investment	-Smaller upfront cost but subsidy will require continuous financial support - Evidence of program success and some evidence of cost effectiveness, therefore less risk
	Feasibility	-Requires more upfront investments in time and financial resources, new partnerships	-Works with existing retailers, infrastructure, mechanisms, and partnerships
	Acceptability	-Could pose a threat to small stores, may lead to some opposition from rural business owners	-Less invasive intervention and works with existing, local retailers and enables residents to support community members

7.7 SUMMARY AND RECOMMENDATIONS FOR FUTURE ACTION

It is evident that a solution to equitable food access in rural areas is imperative to improving diet related health outcomes. The policy options proposed present strategies to improve the retail environment in efforts to improve access to healthy affordable food and make healthy choices easier for those living in rural communities. Based on the factors and trade-offs presented in the analysis above, we would argue that the more suitable policy option for NL among the fiscal interventions examined would be the small food retailer renovation grant and distribution subsidy program.

Grants designed to offer incentives for the development of larger, full service grocery stores in underserved communities requires significant upfront investment and evidence on their success is lacking. There is also a chance this approach may not be accepted by rural community members and could unintentionally increase accessibility to unhealthy food.

Alternatively, administering grants to increase the capacity of existing rural retailers to offer healthy items requires a smaller upfront investment and more evidence is available on the success of healthy corner store interventions. This strategy is also predicted to be more accepted by rural dwellers as it builds on existing infrastructure to improve accessibility, while contributing to the economic vitality of the community. The Healthy Corner Store NL pilot can help to improve feasibility and guide implementation of the program.

Nutrition subsidies designed to mitigate the increased cost of nutritious food due to distribution and purchasing expenses address significant barriers to food access in rural communities and have proven to be successful in influencing the purchase and consumption of nutritious foods. Although there are several known challenges with Nutrition North Canada, its implementation offers valuable lessons and can be used as a learning platform for future, smaller scale, more inclusive distribution subsidy programs.

Conclusion

The current strategies in place to promote healthy eating and improve the health and well-being of Canadians have failed to make a significant impact on obesity and diet related health outcomes in NL. The prevalence of diet related chronic disease continue to rise, indicating that what is being done is ineffective or insufficient, calling for more direct and prioritized action. It is clear that reducing barriers and challenges to healthy eating in rural communities is a crucial step, and fiscal policy levers offers an influential and potentially autonomy-preserving approach to achieve this.

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SECTION III

SUMMARY

CHAPTER 8: Summary & Recommendations for Future Research and Policy Directions

8.1 INTRODUCTION

Through a series of manuscripts, this dissertation has critically reviewed, analyzed and discussed the retail food environment in a rural and remote context using the empirical example of the retail food environment in rural NL. The objectives of this thesis were to 1) identify the methods and features used to describe and define the healthfulness of the rural food environment, 2) determine the significance and implications of assessing the consumer food environment using healthy food only (and not unhealthy) and 3) investigate and analyze fiscal intervention strategies to improve access to nutritious foods in rural NL. In this concluding chapter, we will review the key learnings from this series and finish with recommendations for future research and policy direction.

8.2 KEY AREAS OF INVESTIGATION

Rurality

This thesis considered factors in the rural food environment that may be independent and distinct from those in urban food environments because of the geographic, demographic, economic, and epidemiological disparities threatening population health in rural and remote communities. In addition, prevailing disparities including decreased access to public transportation, higher rates of poverty and unemployment, lower levels of education, aging populations and increased burden of disease[1] are all critical factors to consider when measuring and intervening in retail food environments in rural communities. Rural food environments are also particularly significant in the local

context with 41% of the NL population residing in rural areas[2]; a province leading the nation in obesity and diet related disease.[3]

Methodological Approaches

In order to support action, it is necessary to produce evidence that is accessible to knowledge users, guiding them in an appropriate process through which to make change. As said best by Dr. Leia Minaker "There are thousands of food environment features that are measurable, but not all measures are equal in terms of their ability to raise awareness or inform policy priorities."[4] It is for this reason that we dedicated this dissertation to exploring the ways in which the food environment is measured and reported, in efforts to identify approaches to describe rural food environments in a format that is transferable to prioritized policy development and that can lead to more impactful change in rural communities.

To date, the Nutrition Environment Measures Survey for Stores (NEMS-S) has consistently served as the proxy gold standard and is among the most widely used checklist tool in retail food environment assessment.[5,6,7,8] NEMS-S has been found to be a valid and reliable tool and measures the key constructs of the food environment (availability, quality, price) making it a logical focus for our review.[9] Concentrating on the NEMS-S checklist also allowed us to apply methods identified in the scoping review in a local context by conducting empirical investigations using the NEMS-NL data collected through the Healthy Corner Store NL project.

Fiscal Interventions

Finally, this thesis began to examine how fiscal policy can be used in relation to retail food environments and proposed and analyzed two policy options designed to address some of the fundamental barriers to food access in rural NL. It was our goal to initiate a critical discussion surrounding emerging retail food environment strategies, with particular consideration of the suitability of these interventions for rural communities.

As a consequence of their remote location, rural retailers as well as rural consumers face many economic barriers to accessing nutritious foods. Due to the low-density populations in rural communities, low profitability is a perceived and objective barrier for rural businesses owners. The majority of rural communities lack a full-service grocery store and many rural residents may depend on convenience stores and corner stores for food shopping.[10,11] However, because of the high cost of distribution, reduced economic power, and the small size and limited capacity of small rural stores, offering fresh healthy foods can be challenging.[12,13,14] Fiscal policies in the form of grants and subsidization can help alleviate some of these barriers and work to improve availability and affordability of nutritious foods in rural areas.

8.3 KEY LEARNINGS

A Scoping Review of NEMS-S Research in Rural Communities

Our review of the literature surrounding Nutrition Environment Measures Surveys in rural communities provided us with a greater understanding of the methods and measures

being used to evaluate the rural and remote communities. Among our key findings were that just over half of articles included for review explicitly defined and operationalized the variable of rurality and even fewer provided definitions for store types. This was concerning because of the numerous ways in which a rural community and store types have been be defined. Without defining these key variables transparently, it makes the research less accessible and less meaningful to knowledge users who are unable to interpret the findings with context. We also learned that rural researchers are predominately using the NEMS to report on healthy food and beverages only (and not unhealthy) and about 35% of researchers are reporting on availability only (and not quality and price).

Availability, quality, and price, are all important features in measuring the foodscape, especially in rural areas where quality[15,16,17] and price[11,18,17] have been reported as key barriers to following a healthy diet. Reporting on healthy food only may not capture the entire consumer experience and is potentially contributing to a gap in intervening in consumer exposure to non-nutritious foods. We encourage greater transparency in reporting methodology; and providing explicit definitions and rationales so that findings are more accessible to knowledge users and can be used to guide future research and policy direction. Future researchers should consider elaborating upon all features of the consumer food environment. In order to inform prioritized action and decision making, it is critical to have a comprehensive understanding of consumer experience. Measuring and acting on only one element of the food environment, such as availability, may be rendered

ineffective if consumers are unable to afford these items or the items available are of poor quality or unsafe to consume.

Empirical Investigation into Healthy and Unhealthy Food Assessment

Through secondary analysis of data from the HCSNL project, this thesis further investigated the significance of evaluating the food environment with healthy food availability only (compared to considering both healthy and unhealthy food). Our results indicated many stores offered most unhealthy food and beverage while healthy food availability was less common and therefore was more varied between store types, demonstrating why it may be appealing to for those with limited recourses to measure discrepancies in store healthfulness using healthy food availability only.

However, our results also demonstrated that healthy food availability and unhealthy food availability are highly correlated, suggesting stores who offer a large variety of healthy foods also offer a high variety of unhealthy foods. These findings corroborate that we cannot define store healthfulness or consumer experience based on healthy food availability alone. Further, unhealthy food availability scores were high in both store types (both supermarkets and convenience stores), with many stores offering most of the unhealthy items. To date, most retail food environment interventions have been aimed at increasing the availability of healthy items[13,19,20] and it is plausible that the lack of unhealthy food assessment is contributing to a subsequent gap in intervention strategies targeted toward reducing the availability of unhealthy items.

Policy Analysis- Fiscal Strategies to Improve Food Access in Rural Newfoundland

The objective of the final paper in the manuscript series was to analyze fiscal policy options to improve the availability and affordability of nutritious foods in rural NL. We focused our policy analysis on two proposed options 1) Rural Food Retailer Development Grant and 2) Small Food Retailer Renovation Grants and Distribution Subsidies. This was a policy option analysis for the NL context supplemented by a critical examination of relevant scientific and grey literature.

Both proposed options address some of the fundamental challenges to creating healthy retail food environments in rural communities. Rural food retailer development grants increase access to healthy foods by removing the geographic barrier to shopping at larger, full service grocers, who have the capacity to stock a variety of healthy foods at affordable prices. Small food retailer renovation grants and distribution subsidies increase the structural capacity of existing rural retailers to stock healthy foods while the subsidy alleviates the high cost of distribution and allows retailers to offer nutritious foods at affordable prices.

Although there has been evidence demonstrating the relationship between proximity and density of grocery stores and improved diet and health outcomes, there have been minimal evaluations surrounding the effectiveness of improving diet and health outcomes by introducing a new grocery store into an undeserved area, especially in rural communities. There is a chance this option could increase the accessibility to unhealthy foods and potentially lead to an unintended increase in the purchasing and consumption

of these items. Further, this option also requires considerable upfront investment and may pose more economic risk for the province than the renovation grant and subsidization program.

Small retail renovation grants work with existing infrastructure and existing retailers and has lower upfront costs. This option has the added benefit of following in the footsteps of a pilot healthy corner store implemented in rural NL by Memorial University, Food First NL and Eastern Health. Both healthy corner store programs and subsidization programs have been successful in increase the availability, consumption and perceptions surrounding healthy food.

Based on our analysis, we recommended decision makers consider the second option, small retailer renovation grants and distribution subsidy. This policy will require a multi-sectoral approach involving the Department of Health and Community Services with support from Food First NL, Eastern Health, Regional Economic Development and Service NL, and most importantly rural retailers and rural community members.

8.4 RECOMMENDATIONS FOR FURTURE RESEARCH & POLICY DIRECTION

Our series of investigations identified several gaps in measuring, reporting and intervening in the rural retail food environment. The section below will outline a selection of the gaps that we feel are among the most significant in terms of producing evidence

that will work to identify priority areas for action and should be considered for future research and policy development

Increase Transparency in Defining and Operationalizing Variables

Our review of the Nutrition Environment Measures survey raised concerns surrounding the transparency and accessibility of retail food environment research. These concerns stem from the heterogeneity in the methods used define key variables of interest including rurality and store type.

Defining Rurality

Discrepancy in operationalizing rurality is not exclusive to food environment research; the use of non-congruent definitions within and across health-related disciplines is common.[21,22,23] Depending on what elements of rural exposure are most relevant to the variables of interest, definitions of rurality have been based on population size, density, proximity, contiguous urban areas, commuting trends, economic activity or the social and cultural aspects associated with rurality.[21, 22,23]

Fluctuating definitions for rural and remoteness is methodologically problematic as well as challenging for decision makers, as it as it often creates a barrier to aggregating and summarizing findings.[23,22] Although a standardized definition for rurality would be advantageous, rurality is multifaceted and how it is measured and defined will depend on the context and scope of the research. [21,22,23] Rural demography is complex and a single definition is not able to justifiably capture all aspects.[21, 22,23] Dichotomous definitions are

limited in their ability to capture the heterogeneity among degrees of rurality and remoteness which can mask issues at a local level[21,22]; experts in rural taxonomy in health research agree that when possible, hierarchical or multilevel definitions should be applied.[21,22,23] Hart, an expert in rural health and rural taxonomy, describes five elements of an appropriate rural taxonomy: (1) Measures something explicit and meaningful (2) Replicable (3) Derived from available, high-quality data (4) Quantifiable and not subjective and (5) Has on the ground validity.[23]

How rural is defined will have significant implication on findings and subsequent policy and decision making, and has potential to bias conclusions if applied inappropriately.[21, 22,23] Therefore, rural classification should be applied judiciously, based on the context of the research question[21,22,23], and ideally with consultation from geographic professionals[23]. Researchers should explicitly indicate how they chose to define rurality accompanied with a clear rationale so that evidence users can interpret the findings in an appropriate context.[22] When making comparisons across studies, researchers should be aware of discrepancies in rurality and definition revision over time, and avoid aggregating data with dissimilar geographic units.[22]

Defining Store Types

The foundation of much of food environment research has been the investigation into the disparities in food accessibility within and among differing store types.[25,26,27] This evidence often informs conclusions regarding the healthfulness of certain store types and is ultimately used to define individual and community level exposure to healthy or

unhealthy food environments.[28] If or how a store type is classified, can significantly impact investigation outcomes, evidence interpretation, future research, decision making and policy development.[29]

To date, evidence regarding the healthfulness of differing store types has been conflicting and lack of explicit store classifications have acted as a barrier to the advancement and refinement of food environment literature.[27] An increasing number of retail food outlets have begun to carry food and beverage, making classifying store types particularly difficult in rural communities, where the retail presence is often comprised of these non-traditional or "hybrid" food outlets (e.g. general stores, pharmacies)[30,31] Methods of classification in the literature have included store size, annual sales, number of cash registers, number of employees, variety of foods offered, owner interpretation and federally established industry classification codes.[10,27,32]

Despite efforts within the field[33,34], there is yet to be a standardized classification system recognized as the gold standard. However, the North American Industry Classification System (NAICS) is among the most widely used classification systems in nutrition environment literature.[10,27,35] A strength of NAICS codes is that they offer refined definitions for a range of food retailers and facilitates comparability across Canada and the United States. Although NAICS codes are standardized definitions, they are still applied with user discretion which can lead to discrepancies within the literature. Some secondary databases used for store classification will come with pre-assigned NAICS codes and the accuracy of these classifications have been questioned in previous

literature. [36,29] Secondary databases have been shown to misclassify retailers, assign more than one code or merge NAICS codes, all of which have potential to bias findings in research relying on these sources alone. [27,36,29]

Consumer food environment researchers should continue to work toward establishing standardized definitions or guidelines for defining retail food outlets that include a wide variety of stores that may sell food.[27,32] Until then, NAICS codes offer recognized, detailed definitions for classifying most outlets that sell food and beverage and when used correctly require minimal subjective interpretation. However, to maintain the integrity of the NAICS codes it is critical to assign them in a standardized way. When using datasets with preassigned NAICS codes it is recommended that researchers confirm coding either manually or through predetermined algorithms[29], or through other confirmatory methods such as ground-truthing. If it is necessary to merge NAICS code categories for statistical or investigative purposes, it should be best practice to provide sufficient detail for any modifications made so that knowledge users may consider this when interpreting results and comparing and using findings.

Comprehensive Assessments and Interventions

Quality and Price

Despite the evidence from qualitative and perceived food environment assessment indicating that quality and price impacts food accessibility for rural dwellers[15,17,37,38, 39], there has been a considerable lack of research reporting on direct field observation of quality and price in rural retail stores.[26,40]

Quality

Offering and maintaining high quality supplies of fresh food is often a challenge for small rural stores due to remote location, access to suppliers, limited turnover, and other infrastructural limitations.[12,39,41] Many fresh and frozen wholesalers have minimum purchasing requirements that are often too large for small rural retailers to manage and not all offer delivery to remote areas. [12,39,41] Distribution to rural and remote areas can be costly and lengthy; if not delivered with appropriate refrigeration equipment, produce can deteriorate before it reaches the store, reducing the shelf life significantly.[12] Infrastructure within small rural stores may also act as a barrier to quality food storage. A deficiency of adequate refrigeration and freezer equipment due to reduced store size or high cost, combined with a lack of knowledge regarding appropriate food handling practices by store employees can also contribute to a shorter shelf life for both fresh and frozen produce.[12,41] Further, the barriers to quality food distribution and storage can contribute to a cycle of poor supply and demand: Consumers are less likely to purchase produce if the quality is poor and due to reduce sales, owners perceive a lack of demand and profitability and are less motivated to increase availability and quality of these items.[12]

The original NEMS-S survey evaluates the quality of fresh fruits and vegetables only. However, research conducted six remote communities in Northern Labrador NL indicate that the quality of fresh and frozen meats may also be of concern in remote communities.[15] Survey results from a report published by Indian and Northern Affairs Canada in 2002, revealed that 77% of community members classified frozen meat as poor (41%) or fair (36%) quality.[15] Fresh and frozen meat were the most likely items to be

classified as poor, while the majority of fresh and frozen fruit and vegetables were classified as fair or good, indicating that although the quality of produce is perceived as generally fair in these communities, the quality of meat is perceived to be particularly poor.[15] These findings come from isolated communities serviced by food mail where they face a higher level of distribution barriers and therefore may not be generalizable to all rural communities but findings should be considered in future research. The NEMS-NL researchers have also communicated that during data collection the majority of meat offered in the rural foodscape was frozen, not fresh, indicating that frozen meats are a fundamental aspect of the rural consumer experience.

Quality is a significant element of the consumer shopping experience and decision making process and should not be overlooked during food environment assessment or intervention, especially in rural and remote communities where shelf life can be reduced. Researchers may also want to expand quality assessment to include fresh and frozen meats.

Price

Having healthy options available can be beneficial only if consumers have the power to make healthy choices. Research has consistently demonstrated that rural areas have limited geographic access to supermarkets and large grocery stores and have a higher density of convenience stores and corner stores.[10,11,18,37,42,43] Evidence also suggests the cost of healthy items (when available) including fresh produce, eggs, low-fat/fat free milk and whole grains, is substantially higher at convenience stores than at supermarkets and

grocery stores.[11,18,42] Because many larger supermarkets are chain stores, it may be more feasible for them to offer lower prices than smaller convenience stores or independent, locally owned stores.[41] It can be difficult for small rural stores to offer healthy produce at an affordable price because unlike larger stores they don't have the benefit of purchasing in bulk which can result in higher purchasing costs and remote locations add to increased distribution expenses.[12,41] The lack of retail competition can also negatively affect food affordability for rural consumers. In many rural communities, there is only one food retailer and access to transportation is limited, therefore, consumers do not have the option to shop for lower prices and store owners are less motivated to offer competitive prices.[41]

Socioeconomic disparities, higher rates of unemployment and reliance on social assistance make rural communities even more vulnerable to the burden of increased food prices and food insecurity.[9,10,11]. Even more concerning is extremely remote northern communities who receive food by air or boat, where the barriers and burden of food costs and the associated implications, are exponentially exaggerated. Food cost contributes to other food system issues, prominently, household food insecurity. According to the most recent data, one in eight households in Canada, encompassing over 4 million adults and children, are food insecure.[44]

The methods used to measure and evaluate price will influence the data captured and how it will be reported and interpreted. Among the articles in the scoping review, price was measured and evaluated in various ways: the price of the healthy option relative (higher

or lower) to the price of the regular option, the price of an item relative (higher or lower) to the median price of that item in other store types or communities and/or the absolute price or mean price of an item by store type or community.

Analyzing relative price disparities between healthy and unhealthy items within a store is effective in examining whether the retail food environment offers health-promoting environmental features and incentivizes consumers to make healthful choices, but it does not capture overall price, nor does it allow for comparisons among stores or geographic areas. For example, if a rural store sells a loaf of white bread for $6.00 and a loaf of whole grain bread for $6.50 and an urban store sells white bread for $3.50 and whole grain bread for $4.00, both stores would be scored equally and the overall price discrepancy between the jurisdictions is not captured. In this case, the price of food and beverages in the rural community could be overlooked as an area for potential intervention.

Analyzing price relative to other stores or absolute prices allows researchers to capture price discrepancies among store types and community characteristics, which is particularly valuable when evaluating stores and or geographic areas which are known to have higher absolute food costs. Both relative (internal and external) and absolute measures are valuable and pertinent measures when it comes to evaluating price, so depending on study objectives, researchers may want to consider using both measures.

Measuring and Intervening in the Exposure to Unhealthy Food and Beverage

A consistent theme throughout the manuscript series was the relative paucity of evidence for measuring, reporting and intervening in consumer exposure to non-nutritious food. Through our investigation into the significance of measuring the food environment with healthy foods only, we learned that unhealthy food is widely available in both supermarkets and convenience stores and is an important feature when characterizing the healthfulness of food stores.

Despite the widespread exposure to non-nutritious foods, the majority of retail food environment interventions target healthy food accessibility only.[13,19,20] Although many of these approaches have been proven to be successful in improving the availability, purchase, consumption and perceptions of healthy foods, evidence of their impact on obesity and other diet related health outcomes is less prevalent.[13,19] This suggests that targeting healthy food access is necessary, but potentially insufficient if non-nutritious foods remain highly available.

Unhealthy food taxation is among the few interventions aimed toward reducing the purchase and consumption of unhealthy foods. However, many have argued this approach is regressive and disproportionally burdens low income populations.[45,46,47,48,49] Further, an unhealthy food tax does not actually reduce consumer exposure to non-nutritious foods but rather reduces accessibility. In contrast to a restrictive policy approach to reducing the availability of unhealthy food, taxation is in theory a more permissive policy approach to discourage consumers from purchasing unhealthy foods. Restrictive policy approaches

targeted toward decreasing the availability of unhealthy foods has been most prevalent in other organizational food environments, most notably school and sport and recreational facilities.[50,51] These strategies include restricting the type of food that can be serve and sold to children and adolescents in school lunch programs, canteens and vending machines.[50,51] Similar efforts have expanded to hospital and other health-care settings.[52]

Despite the evidence of success in other institutions[53], these practices have not yet translated into the broader retail food environment. Within the literature, one of the only retail based interventions aimed toward reducing the availability of unhealthy foods in retail food stores was conducted in Nova Scotia, Canada.[20] Researchers removed sugar-sweetened beverages (SSBs) from a pharmacy over a 123-week period to assess the impact on the overall community sales of carbonated soft drinks.[20] Although the removal of SSBs did lead to a decrease in the overall community sales of soft drinks, the decline was statistically insignificant.[20] However, encouragingly, the removal of sugar sweetened beverages did not lead to an increase in the sales of these items in surrounding stores, suggesting removing sugar sweetened beverages from pharmacies could reduce impulse purchasing of these items.[20]

The most evident barrier to implementing regulations surrounding the sales of unhealthy food and beverage in retail environments is the much-anticipated push back from the food industry due to the perceived threat to their revenue. This threat may be perceived as even greater in rural communities where operating costs are higher and profitability margins are much tighter.[54] We have witnessed the power of this push back in 2014 when industry

lobbyist successfully repealed the proposed limit of soft drink sizes sold at New York City restaurants and similar food service establishments.[55]

Although the power of industry may intimidate advocates for healthy public policy, we can reflect on similar reactions from the tobacco industry when regulations surrounding the sale, tax and marketing of tobacco products were introduced.[56] Researchers, health practitioners, public health officials and policy makers must learn from the efforts made when establishing tobacco regulations and continue to display the detrimental long term health and economic impacts of diets high sugar, salt and fat and the critical role obesogenic food environments play in contributing to this epidemic.

Measuring and reporting on accessibility of unhealthy food and beverages in the retail food environment is the first step to earning support and moving toward acting on limiting the amount and type of non-nutritious food and beverage sold in our communities. Evidence that is more accessible to knowledge users can help to guide change. Conducting formative research and working with retailers to implement small changes such as those demonstrated by Minaker et. al[20], are critical to establishing evidence based practice while holding stakeholders accountable and maintaining policy interest and support.

8.5 CONCLUSION

The overarching aim for this research was to identify and discuss the contextual factors that are significant to measuring and intervening in the rural retail food environment.

In order to encourage action and influence change, it is most effective to produce evidence that is accessible to policymakers, retail owners and other key stakeholders, guiding them in prioritized and informed decision making. To do this, we need to promote greater transparency in reporting methodology; and providing explicit definitions and rationales so that findings are more accessible to knowledge users and can be used to guide future research and policy direction. Reporting on all aspects of the food environment including availability, quality and price as well as the exposure to nutritious and non-nutritious foods are critical to capturing barriers and potential areas for intervention in rural communities.

Improving food access in rural communities will require a comprehensive and multi-sectoral effort. In NL, existing strategies are broad and relatively abstract. A more direct and prioritized approach that address the fundamental barriers to food access in rural communities is essential to make impactful improvements in population health. By collaborating government, food retailers and communities to make equitable access to healthy, nutritious food a provincial priority, the province can take the necessary steps toward improving the health and vitality of rural communities across Newfoundland and Labrador.

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