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# MEASURING THE FOOD ENVIRONMENT *in Canada*

Canada

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***Measuring the Food Environment in Canada***
is available on the Internet at the following address:
**www.hc-sc.gc.ca/fn-an/nutrition/pol/index-eng.php**

Également disponible en français sous le titre :
***Mesure de l'environnement alimentaire au Canada***

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Contact:

Publications
Health Canada
AL 0900C2
Ottawa, Ontario  K1A 0K9
Tel.: 613-957-2991
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**PDF** Cat.: H164-155/2012E-PDF
ISBN: 978-1-100-20974-6
Pub.: 120182

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# ACKNOWLEDGEMENTS

This paper was prepared for the Office of Nutrition Policy and Promotion, Health Canada, in collaboration with a working group of the Federal, Provincial, Territorial Group on Nutrition. The British Columbia Ministry of Health, the Government of the Northwest Territories, Manitoba Health and Healthy Living, and Aboriginal Affairs and Northern Development Canada were represented on the working group.

Health Canada and members of the working group helped to create the broad vision for the report and provided input throughout the project.

## *Key informants*

The following people took part in telephone interviews or surveys. They explained the ways in which Canadian researchers and practitioners are conceptualizing and assessing food environments and using food environment data. Their varied experience and the diverse locales and communities in which they conducted food environment research helped to paint a comprehensive picture of food environment research in Canada. The key informants were:

- Jill Aussant, Public Health Nutritionist, Health Promotion Department, Saskatoon Health Region
- Jennifer Black, Assistant Professor, Food Nutrition and Health, Faculty of Land and Food Systems, University of British Columbia
- Elsie DeRoose, Territorial Nutritionist, Prevention Services, Child and Family Services Division, Northwest Territories
- Rachel Engler-Stringer, Assistant Professor, Department of Community Health and Epidemiology, University of Saskatchewan
- Stefan Epp-Koop, Community Food Assessments Coordinator, Food Matters Manitoba
- Pat Fisher, Public Health Planner, Region of Waterloo Public Health Department
- Chris Furgal, Associate Professor, Indigenous Environmental Studies Program and Co-Director, Nasivvik Centre for Inuit Health and Changing Environments, Trent University
- Rachael Goodmurphy, Public Health Dietitian, Kingston Frontenac Lennox & Addington Public Health Department
- Yvonne Hanson, Researcher and Diversity Education Coordinator, Prairie Women's Health Centre of Excellence
- Kristie Jameson, Executive Director, Food Security Network, Newfoundland and Labrador
- Ellen Lo, Project Manager, Healthy Families B.C., British Columbia

- Catherine Mah, Scientist at the Centre for Addiction and Mental Health and Head of the Food Policy Research Initiative, Ontario Tobacco Research Unit; Assistant Professor, Dalla Lana School of Public Health, University of Toronto; Member, Toronto Food Policy Council
- Deborah McPhail, ISER Postdoctoral Fellow in Community Health and Humanities, Faculty of Medicine, Memorial University of Newfoundland
- Suzie Pellerin, Director, Québec Coalition on Weight-Related Problems (Coalition québécoise sur la problématique du poids)
- Tarra Penney, PhD candidate, Dalhousie University; Research Associate, Applied Research Collaborations for Health, Nova Scotia
- Valerie Tarasuk, Professor, Department of Nutritional Sciences, Faculty of Medicine, University of Toronto
- Katie Temple, Research Assistant, Sustainable Food Systems Project, Environmental Policy Institute, Grenfell Campus, Memorial University of Newfoundland
- Shirley Thompson, Associate Professor, Natural Resources Institute, University of Manitoba
- Jennifer Wakegijig, Territorial Public Health Nutritionist, Department of Health and Social Services, Government of Nunavut

# SUMMARY

Healthy eating is central to overall health and reduces the risk of nutrition-related chronic diseases and obesity. To maintain healthy eating patterns, Canadians must have access to safe, acceptable, affordable, and nutritious foods. In 2010, the Federal, Provincial, and Territorial (FPT) Ministers of Health and of Health Promotion/Healthy Living endorsed a *Declaration on Prevention and Promotion* and ***Curbing Childhood Obesity: A Federal, Provincial and Territorial Framework for Action to Promote Healthy Weights*** *(Framework).*

One of the policy priorities that the *Framework* identified is to increase the availability and accessibility of nutritious foods, particularly for vulnerable populations. The food environment plays an important role in influencing the availability of nutritious foods.

The food environment includes features of the community, such as the number and kinds of food outlets in people's neighbourhoods, which is often referred to as geographic food access. It also features the consumer experience, such as the kinds of foods that are available, affordable, and of good quality. Many jurisdictions in Canada have begun to act on food environments. Some have restricted geographic access to certain kinds of food outlets (such as fast-food outlets or convenience stores) where non-nutritious foods are readily available. Others have created incentives for food outlets where nutritious foods are readily available, such as farmers' markets and grocery stores.

Research on the food environment is relatively new, and the conflicting evidence to date dictates caution when implementing policies or programs that aim to improve food environments. That said, the field of research is promising and deserves attention and investment from a public policy perspective. Environmental factors have the potential for a more sustained impact on health outcomes than programmatic strategies. More research in this area will help to inform the creation of effective, sustainable solutions to improve healthy eating in Canada.

By means of a literature synthesis, this report discusses the conceptual models and measurement approaches currently in use in research on food environments. It examines their application to the Canadian context and the evidence available to date on the association of food environments with diet-related outcomes. The report points out unresolved issues and gaps in the existing research methodology, with an emphasis on research approaches needed to address uniquely Canadian food environments, such as in the North.

The report then takes a closer look at the Canadian context, with a review of 19 Canadian community food assessments. Through interviews with key informants across Canada, the report highlights the experiences and analysis of food researchers in communities across the country. It examines in detail three case studies of notable food environment measurement initiatives within different Canadian contexts.

Here are the report's key findings:

- Most of the Canadian literature published to date shows associations between features of the food environment and residents' diet-related outcomes, even after adjusting for important confounding variables.
- In the academic literature, there is not much evidence for the widespread existence of food deserts in Canada—areas where vulnerable populations have poor geographic access to nutritious food. But there *is* evidence for the existence of food swamps—areas of low socioeconomic status with high geographic access to non-nutritious food sources.
- The review of Canadian community food assessments and the key informant interviews showed that food deserts may be more common than has yet been identified in the academic literature. This reveals the importance of collecting evidence from a variety of sources.
- Food swamps—neighbourhoods where sources of high-fat, high-calorie foods were plentiful, were fairly consistently identified in the community food assessments, and may be more important than food deserts in influencing residents' diets.
- There is not enough information about food environments in remote northern communities. This is a significant research gap, because rates of food insecurity and diet-related chronic diseases are much higher in these communities than elsewhere in Canada.
- There are many food environment assessments underway in Canada. Community-university partnerships can be an ideal way to conduct research that can be used for policy and program development.

# 1. INTRODUCTION

Healthy eating is central to overall health and reduces the risk of nutrition-related chronic diseases and obesity. To maintain healthy eating patterns, Canadians must have access to safe, acceptable, affordable, and nutritious foods. In 2010, the Federal, Provincial, and Territorial (FPT) Ministers of Health and of Health Promotion/Healthy Living endorsed a *Declaration on Prevention and Promotion* and ***Curbing Childhood Obesity: A Federal, Provincial and Territorial Framework for Action to Promote Healthy Weights*** *(Framework)*.

One of the policy priorities that the *Framework* identified is to increase the availability and accessibility of nutritious foods, particularly for vulnerable populations. The food environment plays an important role in influencing the availability of nutritious foods. For the purposes of this report, we consider the food environment to be retail outlets where people can purchase foods, such as grocery stores and restaurants, as well as environments where people acquire food in traditional ways, such as hunting and fishing. This report does not examine the particular food environments created in homes, schools, workplaces, childcare centres, and recreation facilities. However, while the food environments *within* schools are out of scope for this report, community or consumer food environments *around* schools are the topic of much food environment research and are within the scope of this report.

The subject of food retail environments is increasing in popularity among both researchers and policy makers. Research has generally focused on differences in food environments based on socio-economic and demographic factors, such as research on food deserts,[1–4] or on associations between food environments and diet-related outcomes, such as dietary behaviours, food purchasing, weight status, or diet-related disease outcomes.[5–12]

Policy makers, acknowledging the role of diet in supporting healthy communities, have begun to take action on food environments through zoning regulations, mandatory menu labeling, or incentives for grocery stores in underserved areas.[13–16] The evidence base for such policies has

yet to be solidified. This is in part due to inconsistent methodology in assessing food environments, different definitions of place, and the different contexts in which food environment studies have been conducted.

The purpose of this report is fivefold:

1. Describe current Canadian evidence on geographical access to nutritious food.
2. Look at the evidence of associations between food environments and diet-related health outcomes.
3. Highlight the limitations and gaps in current research.
4. Explore current research aimed at measuring the food environment in Canada.
5. Describe how food environment assessment methods are being used in Canada.

To fulfil objectives 1, 2, and 3, we conducted a literature synthesis, relying on evidence published in academic journals up to February 2012 (See Sections 2 and 3). Using the results of the literature synthesis and with guidance from a working group of the Federal, Provincial, Territorial Group on Nutrition, we conducted an environmental scan and interviews with key informants to meet objectives 4 and 5 (See Sections 4, 5, and 6). Key point summaries appear throughout the report.

# 2. LITERATURE SYNTHESIS

## 2.1 METHODOLOGY

We limited the literature review to studies conducted in developed countries (as defined by the World Bank). The review included studies conducted among all age groups, both sexes, and all ethnicities. Several systematic literature reviews relevant to the food environment have emerged over the past year. [11, 12, 17–19] Two of the recent reviews examined food environment literature published up until 2008. [11, 17] One reviewed literature published up until 2009. [12] One, which examined built environment links with childhood obesity, reviewed literature published up until 2010. [19] The existence of these recent studies meant that the literature review for this report could be restricted to literature published since 2008. We also relied on 19 literature reviews published since 2000. [3–12, 17–25]

Four databases were searched for articles related to the food environment: Web of Science, Scopus, Urban Studies & Planning: A SAGE Full-Text Collection, and PubMed (Medline). Searches were conducted using the following key words alone or in combination:

- food environment; food scape; food retail
- grocery store*; supermarket*
- local environment; neighbourhood OR neighborhood; area; community
- nutrition; diet; food; eating; obesogenic; overweight; obes*
- food access; food availability; food quality; food affordability OR food cost OR food pric*.

(Asterisks represent a wild card. For instance, "obes*" would search for the terms "obese" or "obesity"; "pric*" would search for the terms "price" or "pricing".)

The search strings returned the following hits:

| | |
|---|---|
| Scopus: | 873 |
| Web of Science: | 684 |
| Sage returned: | 150 |
| PubMed: | 347 |

Articles were kept for inclusion in the literature synthesis if deemed relevant to one or more of our five objectives listed in the Introduction. After title and abstract scans, 81 relevant articles were retained. The discussions in this report are informed by these findings, as well as the 19 literature reviews published since 2000. Articles related to the broader field of obesity also inform the discussion, but were not examined systematically.

## 2.2 AN ECOLOGICAL APPROACH TO FOOD ENVIRONMENTS

In the past, theories in the nutrition field about food choice have tended to emphasize factors that influence individual decisions. The idea was that, with enough knowledge about healthy eating, individuals would choose nutritious diets to prevent future illness.[26] However, psychosocial predictors such as beliefs and attitudes only explain a fraction of the differences in dietary patterns.[27] An exclusive focus on this approach "ignores what is known about human behaviour and minimizes the importance of evidence about the environmental assault on health." [28] (p. 256)

Obesity levels have continued to rise, despite the many individual-level interventions.[29] Researchers and policy makers have come to recognize that there are complex influences on individual dietary patterns, including factors such as the social and built environments.[30] These are best viewed through the lens of an ecological approach—"a way of approaching issues that accounts for interrelationships between persons and settings." [31] (p. 308) Many ecological models have been developed to try to explain the relationships between food environments and diet-related outcomes. [32] The key feature of an ecological approach is recognizing that a number of factors and contexts influence behaviour, namely: intrapersonal factors such as feelings, interpersonal factors such as relationships, community and organizational contexts, and public policies.[31, 33–35]

The ecological perspective has gained momentum over the past two decades. [31, 36–42] Our understanding of food choices has shifted from being purely a matter of 'personal responsibility' to a more complex analysis, embedded within various contexts.

### KEY POINTS

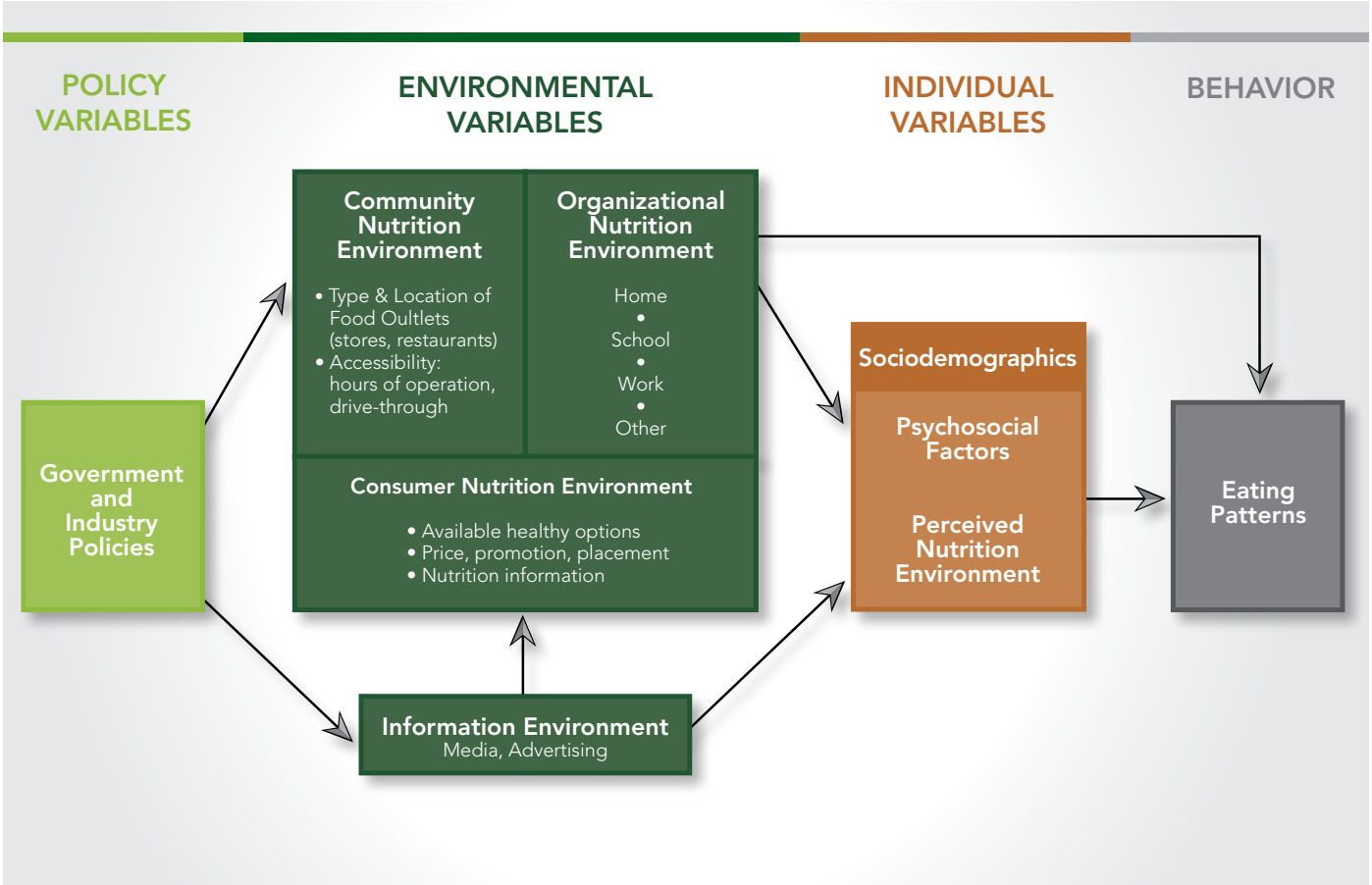
- Dietary behaviour is best understood through an ecological perspective—one that takes into account many determinants at a number of levels, including individual, social, environmental, organizational, and public policies.

## CONCEPTUAL MODELS OF THE FOOD ENVIRONMENT

The *Framework* presents a conceptual model of food availability, access, and utilization in the context of food security. The model is comprehensive, with many determinants of healthy eating. Here, we discuss two complementary conceptual models that have been developed to specifically address the food environment, which is the focus of this report.

The first model, by Glanz and colleagues,[30] incorporates features of the food environment thought to be related to eating patterns (Figure 1).

Figure 1. Model of Community Nutrition Environments[30]

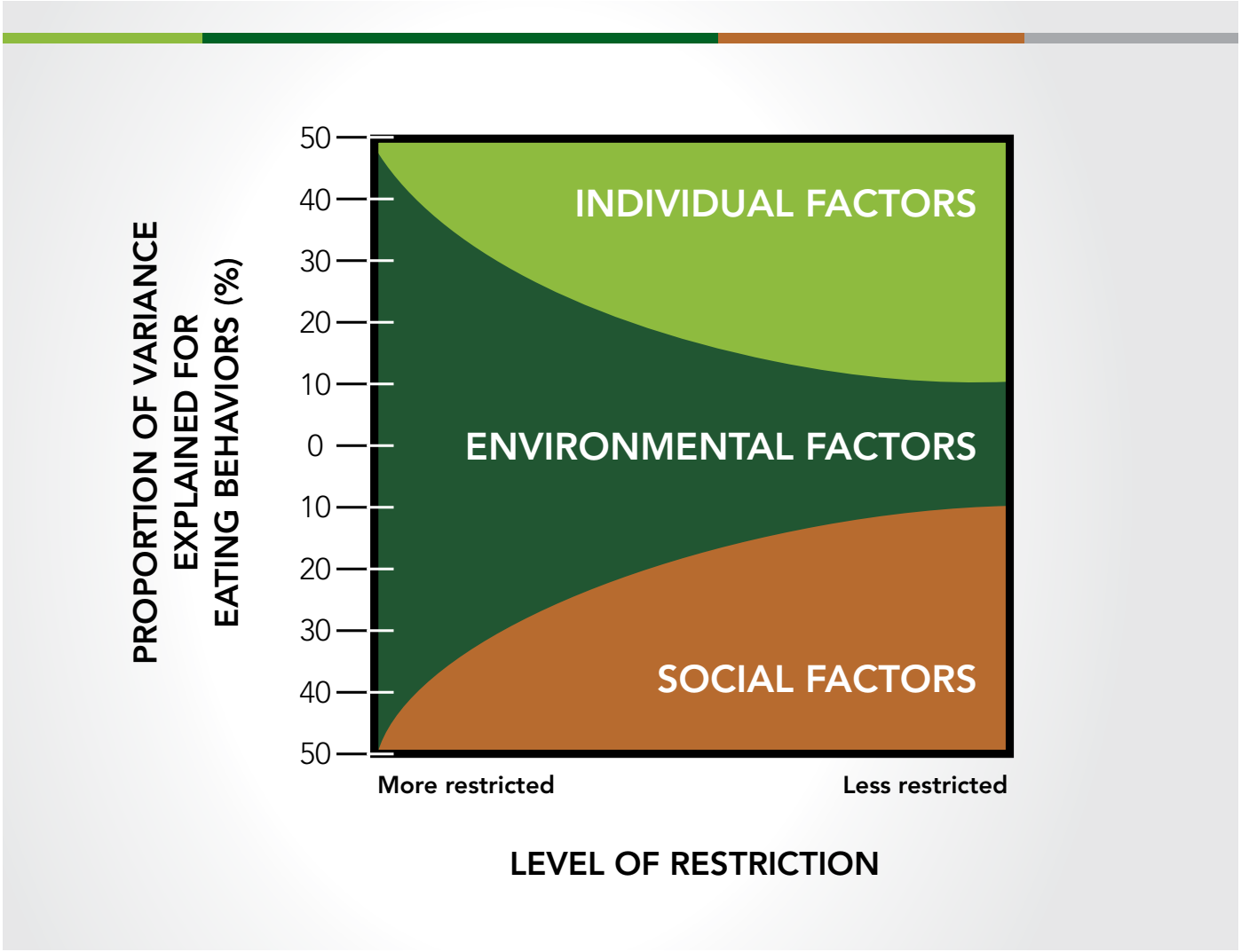



In this model, *Community* nutrition environments are reflected in measures of geographic food access. They are distinguished from *consumer* nutrition environments, which represent characteristics of the food environment important to consumers who have already reached their food store or restaurant destinations. For example, in a consumer nutrition environment, we might ask: what types of foods are being promoted? And what is the relative cost of nutritious foods compared to less nutritious foods?

Social and demographic factors such as income and age are seen as mediating or moderating the impact of food environment variables on eating patterns. In this report, we look at features of the community and consumer nutrition environments. *Organizational* nutrition environments, such as those found in homes, schools, and workplaces, are beyond the scope of this report.

The second conceptual model, developed by Lytle,[43] considers how individual, environmental, and social factors explain differences in eating behaviours. This model proposes that the more people are restricted by things like low-income, physical disability, or lack of access to a vehicle or transit, the more the food environment explains about their eating behaviour.

Figure 2. The relationship among individual, environmental, and social factors[43]



For example, a low-income person with no access to a vehicle, living in a neighbourhood with poor public transit, may be more reliant on food sources within walking distance in his/her neighbourhood, and those sources may offer fewer nutritious options. This model suggests that eating behaviours of people who are socially or economically disadvantaged would be more strongly associated with the quality of their food environment, whereas other factors may be more at play for people who are free to leave their immediate food environments to access desirable retail food.

**KEY POINTS**

- Conceptual models can help organize how we think about different dietary influences and can help us consider the differences in how food environment affects various populations.
- Glanz and colleagues' model organizes food environment features into *community* (geographic food access) and *consumer* (foods available in local food outlets, the cost of foods in local food outlets, and the quality of foods in local food outlets). Lytle's model hypothesizes that local food environments more strongly determine eating patterns for people who are more restricted to staying in their neighbourhoods relative to those who can easily leave.
- Together, these two models provide a comprehensive view of food environments and their interactions with other variables to affect population dietary behaviours.

## 2.3 FOUR RELEVANT FEATURES OF THE FOOD ENVIRONMENT

Because this field is young, the terminology used to describe the features of the food environment varies. In this report, we use the terminology often used in the literature, and this may vary from the language used in the *Framework*. For example, the *Framework* defines availability of nutritious foods to mean the supply of food to a region or community. In this literature review, that concept is expressed as *geographic food access*. The *Framework* defines accessibility as the ability of an individual or household to acquire nutritious foods. In this report, that feature is expressed as *food affordability*.

Four features of the food environment have been identified in the literature, although terminology can vary. For the purposes of this report, we define these features as follows:

1. ***Geographic food access*** refers to the geographic availability of different types of food stores and restaurants. There are various ways to measure geographic access. For example, one can measure the proximity of homes to specific outlet types, such as grocery stores or fast food outlets. Another measure is to count the number of convenience stores or fast food outlets within a given geographic area.

2. ***Food availability*** refers to the actual foods that are available in someone's neighbourhood. For example, studies examining food availability have looked at whether or not fresh fruits and vegetables are within a certain distance of peoples' homes, or the amount of shelf-space dedicated to energy-dense snack foods in someone's neighbourhood.
3. ***Food affordability*** refers to the cost of foods within a defined area. It can be measured using an absolute method such as a nutritious food basket, for instance – "How much does it cost to eat a healthy diet in Toronto for a family of four?" It can also be measured using a relative or comparative method, such as "How much does whole grain bread cost compared to white bread in grocery stores in a given neighbourhood?"
4. ***Food quality*** measures subjective assessments of food quality – for instance, whether fruits and vegetables appear withered or bruised. Food quality measurement can gauge residents' satisfaction with the quality of foods in their neighbourhoods. Bruised or withered fresh vegetables or expired foods can act as a deterrent of purchasing. In the context of this report, food quality does not mean nutritional quality.

Each of the food environment features mentioned above *assume* nutritional quality in their measurement. For example, researchers might measure the availability in stores of 'nutritious' foods, such as fruits, vegetables, and low fat milk or 'non-nutritious' foods, such as sugar-sweetened beverages or high-fat snack foods. Assumptions about what constitutes a nutritious food are most often implicit; although most assessments do not explicitly reference national dietary guidelines. Food environments considered unsupportive of healthy diet or body weight include those where there is high availability and large portion sizes of energy-dense, non-nutritious foods, at low cost.[44] Whether stated or not, the research assumes that improved food environments will be tied to improved population-level dietary behaviour and weight status.[25]

Food environment research is complex, in part because no particular field or stakeholder group dominates either the research or the proposed policy solutions. Features of food environments have been studied within academic disciplines that include public health,[43] economics,[45, 46] urban planning,[47] health geography,[48] and health promotion.[30] As a result, there is little consistency in terminology, assessment methods, or actual outcomes among studies.

Different levels of government, as well as players in other sectors, may undertake actions that impact the food environment. For example, action could be taken to affect *geographic food access* through land-use planning.[14, 15] Subsidizing nutritious foods can affect *food affordability* in remote northern communities.[49] Guidelines on the provision and procurement of nutritious foods can affect *food availability* in a range of settings.

We found 19 literature reviews on aspects of food environments to date, and of these, 14 address specific aspects of food environments in relation to diet-related health outcomes.[5–12, 17, 19–23] See Appendix A for a description of each review's purpose, perspective, subjects, and main findings.

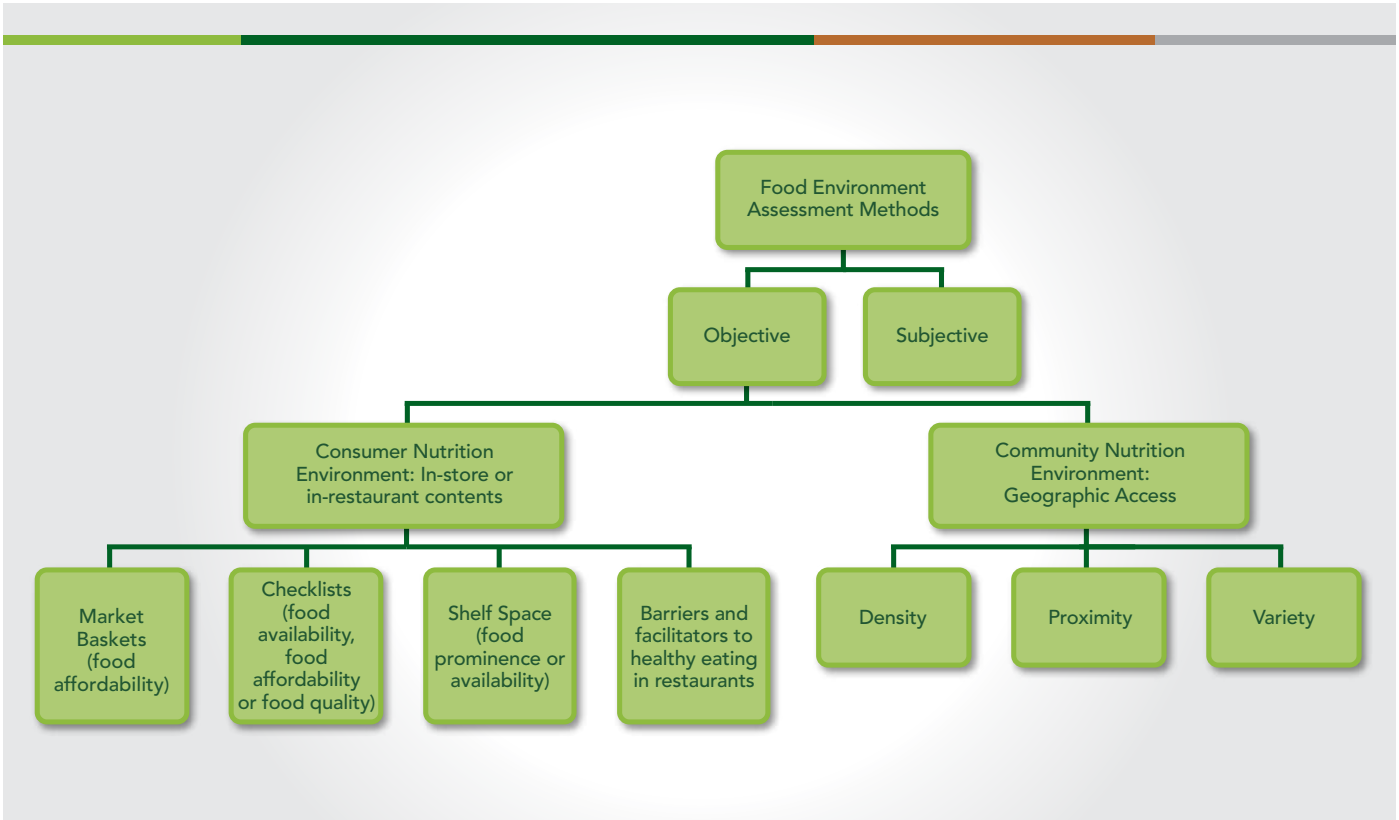
## FOOD ENVIRONMENT ASSESSMENT METHODS

Over the past few decades, hundreds of food environment assessment methods have been developed. Figure 3 shows how food environment assessment methods can be classified.

Food environment characteristics have been measured both objectively and subjectively. Objective food environment assessment methods tend to fall within one of two categories: in-outlet examinations and GIS-derived (geographic information system) food access measures. In-store or in-restaurant measures assess the "consumer nutrition environment."[25, 30] They include checklists that may include items on availability of specific foods, prices, and quality, as well as measures of shelf-space for particular food items.[50, 51] GIS methods measure distances in the food environment to places of interest from a nutrition perspective.

Over 500 food environment measures have been compiled in a database maintained by the National Cancer Institute, part of the United States National Institutes of Health at **https://riskfactor.cancer.gov/mfe/**. The website categorizes measures by setting, including workplaces, schools, homes, food stores, and restaurants. The sheer number of existing assessment methods, plus the fact that only a few comparative studies have been done,[52–56] means that the field is full of inconsistent operational definitions and findings.[32]

Figure 3. Classifying typical food environment assessment methods



Another reason for the proliferation of measures may be that researchers, public health practitioners, and community organizations have different information needs and different capacities to undertake assessments of food environments. Because no short-form, or gold-standard assessment methods have been developed to date, there is a trade-off between simplicity and low-cost on one hand and detail and accuracy on the other. [57]

It is also true that there may be no universal standard. Measures that might accurately and comprehensively describe food environments in one city or country may not be useful in another context. And while researchers may be more interested in sensitive measures to detect relationships between food environment characteristics and diet-related health outcomes, community organizations may be more interested in simply identifying areas or groups in their community with reduced food access, so that action can be taken. [57]

Ohri-Vachaspati and Leviton [57] published a guide to available instruments and describe, in detail, the different needs of groups interested in assessing food environments. The authors note that collaborations between researchers and practitioners are a promising way to rigorously assess food environments for practical purposes. A collaborative food environment assessment of this kind was completed in the Region of Waterloo, Ontario in 2010. [15]

**KEY POINTS**

- The four relevant features of the food environment are often referred to in the literature as: geographic food access, food availability, food affordability, and food quality.
- Over 500 methods for measuring the food environment exist. There is no 'gold standard'.
- Choosing the appropriate measure depends on the user's needs.

# 2.4 A CLOSER LOOK AT OBJECTIVELY MEASURED FEATURES OF THE FOOD ENVIRONMENT

## GEOGRAPHIC FOOD ACCESS

Geographic food access is the most frequently studied of the four features, perhaps because the data are relatively simple to obtain and assessment methods are relatively easy to use. Keeping Glanz's conceptual model in mind, geographic access can be considered as a measure of the *community nutrition environment.* [25] Objective measures of geographic food access include:

- Geographic proximity, for instance, distance between a person's home and the nearest grocery store; [58–61]
- Density, such as concentration of fast food outlets within a defined geographic area; [52, 62–64] and
- Variety, for example, measuring the degree to which different types of food outlets exist within a specified area. [60, 65, 66]

Researchers often categorize food retailers as 'healthy' (meaning places like grocery stores or fruit and vegetable markets) or 'unhealthy' (fast food outlets and convenience stores). Several studies have demonstrated that nutritious foods are more available in grocery stores than convenience stores. [67–69] So food access measures are considered a proxy for the availability of nutritious food.

Researchers who measure geographic food access use GIS software. Four data sources are most frequently tapped:

- Fieldwork or 'ground-truthing' to document whether an identified food store actually exists, and if so, what type of food store it is.
- Land use and parcel data, often available in municipal GIS databases.
- Health and agriculture departments' licensing data: This might be collected at the municipal, county, regional, or the provincial level. These data reflect public concerns such as food safety.
- Commercial business data, such as telephone or business directories and company websites. Data may be categorized using standardized industrial classification codes. [70]

Relying solely on geographic data is limiting. That is because there are differences in food availability in a neighbourhood, even after accounting for store type. [50, 61, 71, 72] For instance, the shelf-space for fruits and vegetables might vary. Also, the exclusive use of food access measures ignores individual and social restrictions, such as physical disability, lack of access to a vehicle or transit, and inadequate family income. [73–75]

## FINDINGS

Literature reviews that examine the relationship between geographic food access and diet, health outcomes, or both, have shown mixed results. Some found stronger relationships [2, 3, 6, 9, 76] than others. [8, 10, 20] The studies vary in the measures of food access they use and the results vary by country. For example, one review found that children's weight was most consistently related to geographic access to convenience stores rather than other measures of geographic food access. [19] American research more frequently reports inequalities in geographic food access related to socio-economic status than does research in other countries. [11, 73] Specifically, United States studies more often show that low-income families have decreased access to grocery stores [1, 64, 67, 77] and increased access to fast food outlets. [17]

A prospective cohort study is a type of longitudinal study. Five such studies related to geographic food access and weight status were published in 2011 or 2012. All indicate that, despite the promise of this method of characterising food environments, geographic food access has a limited impact on diet-related health outcomes.

The first prospective cohort study reviewed reported that fast food consumption was related to the number of fast food outlets within three kilometres of home for low-income, male respondents. However, supermarket availability was generally unrelated to diet quality and fruit and vegetable intake. [78] The study's authors noted that the lack of measures related to the *consumer* nutrition environment may have caused gaps in the findings. They suggest that previous evidence of the health benefits of nearby supermarkets may be due to a third factor that determines both diet behaviours and neighbourhood selection. [78]

A second prospective study showed no relationship between fast food access and consumption, in both urban and rural settings, in a large, national sample of young American adults. [79] A third study found that the only type of food access measure that had a significant, positive relationship with weight among urban residents was the neighbourhood density of small grocery stores. [80]

The fourth study assessed the relationship between BMI (body mass index) and nearness to fast food outlets over a 30-year period. Results indicated that each one kilometre increase in distance from the closest outlet was associated with a 0.11 unit decrease in BMI, but only for women. Other urban food environment characteristics were either inconsistently associated or not associated with BMI. [81]

The fifth study, conducted among children, found that different exposures to food outlets did not independently explain weight gain over time. [82]

## KEY POINTS

- Community and consumer nutrition environments are related: geographic food access is most often used as a proxy for measuring food availability, but may also capture aspects of food affordability, and food quality.

- The relationship between geographic food access and diet-related outcomes is inconsistent and evidence for the existence of food deserts is stronger in the United States than elsewhere.

## FOOD AVAILABILITY

Food availability can be categorized in Glanz's conceptual model as part of the consumer *nutrition* environment. [25, 30] Measuring food availability overcomes some of the limitations of relying solely on geographic food access to define a healthy food environment. There is no need to assume that store type is an adequate proxy for the availability of nutritious foods when availability is directly measured. However, even this measure may be limited, because social concerns such as neighbourhood disorder, lack of safety, and food quality issues may impede residents' use of local food stores, even though vegetables, fruit, and other nutritious foods might be available there. [83, 84]

### FINDINGS

In Canada and the United States, food availability has increased over the past few decades. In Canada, there were up to 530 more calories available in the food supply per capita in 2002 than there were in 1985. These new calories were mainly in the form of salad oils, wheat flour, soft drinks, and shortening. [85] At the local level in the United States, studies have found that the availability of nutritious foods is associated with higher neighbourhood income. [86–88] However one study found that poorer food availability was not significantly associated with poorer dietary patterns after adjusting for race. [89]

Another United States study found that neighbourhood availability of dark green and orange vegetables was associated with the residents' consumption of these vegetables. [90] Yet another found an association between higher availability of nutritious foods and higher BMI among urban residents of predominantly white neighbourhoods, but lower BMI among urban residents of predominantly black neighbourhoods with low socio-economic status. [91]

The pathways by which nutritious food availability impacts diet-related health outcomes are still unclear. The limited number of studies and the inconsistent methods used to measure exposures and outcomes in these studies represent a significant research gap. It is not possible to come to strong conclusions about the impact of neighbourhood availability of nutritious foods on diet-related outcomes.

### KEY POINTS

- There is good evidence that indicates overall food availability has increased over the past few decades in Canada.
- Evidence on whether food availability differs by geographic locale mainly comes out of the United States. It suggests that disadvantaged areas have poorer food availability.

## FOOD AFFORDABILITY

Food affordability is traditionally understood as the cost of food *relative to* an individual's or household's income or purchasing power. This makes sense, given that individuals who lack adequate income are frequently unable to afford a nutritious diet. [46] In fact, Canadian data suggest that food price is the most important determinant of food purchasing for low-income, food-insecure families. [92]

In food environment literature, however, food affordability is considered to be food costs within a defined geographic area. By aggregating food costs to an area level, researchers are able to determine:

- whether food costs are higher or lower in neighbourhoods of different socio-economic status; and
- whether food affordability predicts health outcomes among residents of different neighbourhoods.

Food prices are significantly related to food consumption and disease risk. Specifically, increases in food prices are associated with decreased consumption, decreased weight status and decreased insulin resistance. [46] The inverse relationship between energy density and energy cost has been well-documented. In other words, the more calories in food products of a given weight, the cheaper they tend to be. [46, 93, 94] However, recent evidence suggests that other metrics of food cost show nutritious food to be less expensive than non-nutritious foods. [95] Such metrics include the price of edible weight ($ per 100 edible grams) and the price of an average portion ($ per average portion).

Human Resources Development Canada has developed a comprehensive review of the market basket measure (MBM). [96] This measure includes a food component, and compares prices in rural and urban areas. The 2010 review acknowledged that the costs of food are often very different in northern regions, and their exclusion from the review was a limitation. In the near future, the Nutrition North Canada program will calculate the cost of the Revised Northern Food Program in isolated northern communities that are eligible for the program's retail food subsidy. The plan is to post this information on the program's website regularly. [49]

### FINDINGS

The MBM food basket was cheaper in at least one urban centre than it was in rural Newfoundland and Labrador, Nova Scotia, New Brunswick, Ontario, Manitoba, Saskatchewan, and Alberta. The food basket was more expensive in urban areas in Quebec and British Columbia. There was no difference in Prince Edward Island, but that was due to survey methods being inconsistent with other provinces. Recent data from the United States suggest that the relative cost of nutritious foods vs. non-nutritious foods varies by geographic locale, and that there is no clear pattern regarding whether nutritious or non-nutritious foods are more expensive. [97]

Food affordability is amenable to policy change, through subsidization. In a number of studies conducted in settings such as workplace and school cafeterias, decreasing the cost of nutritious foods consistently resulted in increased consumption, regardless of visual promotion. [37, 98–101]

Researchers have examined the impact of food affordability in neighbourhood settings as well, although findings are again inconsistent on whether nutritious foods are cheaper in more advantaged neighbourhoods. Measures of food affordability, like other measures of food environment constructs, vary widely, which may partly explain inconsistent findings. Several United States studies have found retail prices for the same foods to be higher in deprived areas.[102, 103] Others, conducted in the United States,[104, 88] United Kingdom,[105] and Australia[106] have found no differences in food cost. Deprived areas have been found to have less expensive food than more affluent areas in the United States[107] and Australia[108] when comparing the same food items.

Longitudinal data suggest that area-level prices of fruits and vegetables (relative to other costs of living) are indeed associated with excess weight gain among children, with higher prices linked to higher weight gain.[109] Other findings from a nationally representative survey of children and adolescents in the United States indicated that as area-level fast-food prices increase, so too does diet quality for children aged 2–9 years. Higher fruit and vegetable prices were linked to higher BMI and lower fibre intake.[110] Higher community-level fast food prices were also associated with decreased fast-food intake among adults, especially among males.[111]

**KEY POINTS**

- In the field of food environment research, food affordability refers to comparative costs in different areas, not to the percentage of income spent on food.
- In Canada, food costs are not systematically measured in the northern territories or in northern parts of provinces. Yet food costs can be substantially higher there.
- Neighbourhood food environments might be more or less important in determining people's dietary behaviours, depending on certain individual and social factors. For instance, food price seems to be the most important determinant of purchasing for food-insecure families. But food prices might have very little influence on the food purchasing habits of higher-income families.
- There is a significant gap in the research on how families respond to food prices across the socio-economic spectrum.

## FOOD QUALITY

Few studies have assessed neighbourhood food quality.[112] It is generally accepted that people do not like to buy withered or bruised produce, or meat or canned foods past their best before date.[113] Ideally, food safety inspections should ensure that poor quality and potentially dangerous foods are not sold. Yet qualitative data from Chicago indicates that foods of extremely poor quality are available for sale, particularly in corner stores.[113] Data from Canada are not available.

While still considered an objective measure, food quality tends to be more subjective than measuring geographic food access. Despite training, raters can disagree about the degree of bruising on fruits or whether vegetables have wilted. Like availability and affordability, food quality is most often subsumed

under food access measures. And food quality has indeed been found to vary by store type, with convenience stores generally selling fresh produce of lower quality than grocery stores do. [104, 48] For that reason, store type is often used as a proxy for food quality.

The availability of high-quality food has been linked to socio-economic status, with more disadvantaged areas selling foods of lower quality. [104, 112–115]

**KEY POINTS**

- Poor overall quality of nutritious foods acts as a deterrent to buying them.
- Measuring food quality is a more subjective task than measuring geographic food access.
- No systematic food quality examinations exist in Canada.

### SOME CONCLUSIONS ABOUT OBJECTIVELY MEASURED FEATURES OF THE FOOD ENVIRONMENT

- Many objective measures of the food environment exist. This makes it hard to compare findings when simply considering the food environment.
- The features of availability, affordability, and quality are often subsumed under the measure of geographic food access, because this measure is easier and less resource-intensive to create and use. Because the field is still in its infancy, the validity of subsuming other features under this measure is unknown.
- Research on links between food environments and diet-related outcomes has produced inconsistent results. This might reflect inconsistent measures, or it might be that residents in different areas respond differently to food environments.

## 2.5 A CLOSER LOOK AT SUBJECTIVELY MEASURED FEATURES OF THE FOOD ENVIRONMENT

People's perceptions of their food environments have also been recognized as a valid step in helping to better understand the complex nature of the environments in which people make food choices. [43] Objective measures of the food environment, such as geographic food access, do not necessarily reflect how people think about their neighbourhood food environments. [52, 116] In the literature, perceptions of food environment have been shown to be more strongly correlated to food-related behaviours such as food purchasing [53] and diet quality [77, 117] than objective food environment measures. Questions about how people interact with their environments to buy food and eat food have not been adequately addressed in the current literature. [118–120] Interventions based on an over-simplified understanding of food environments will likely not meet their public health potential. [120]

Several studies have examined whether people's perceptions about their local food environment line up with objective food environment measures.[53– 56, 121, 122] Perceptions can differ from objective food environment measures, depending on the food environment feature in question. For example, correlations between objective and perceived *geographic food access*[55, 123, 124] seem to be more consistent than correlations between objective and perceived *food availability*, with some studies finding no correlations,[122–124] and others finding some correlation.[54, 56]

Similarly, perceptions of neighbourhood *food quality* are not strongly associated with objectively measured quality.[106] Nor are perceptions of *affordability* strongly associated with objectively measured affordability.[121, 123]

Research in this field has also examined how socio-economic position might moderate or mediate the association between objective measures and perceptions. Several studies have found that socio-economic position moderates, or changes the strength of, the relationship between objective and perceived food *availability*.[53, 54, 125] Socio-economic position also moderated the relationship between objective and perceived food *access*.[123] Studies that looked at whether socio-economic position mediated, or explained, the relationship between perceptions and dietary outcomes had mixed results.[116, 117]

A final thread of research has examined the extent to which perceptions of the food environment are associated with body weight and dietary or food purchasing behaviours.[53, 55, 122, 126–128] This avenue of inquiry is particularly important for policy makers. If people's perceptions predict diet-related health outcomes more strongly than objective measures, policy and program responses might be different than if objective measures were the strongest predictors. In the first scenario, policy efforts might focus more on increasing residents' awareness of nutritious, affordable foods in their neighbourhoods. The second scenario might lead to strategies that would increase access to nutritious, affordable foods, perhaps through zoning regulations or promoting community gardens.

To date, much of this research has focussed on particular populations, such as low-income people,[56, 122, 125] women,[117, 123] or convenience samples.[126] The lack of research within a more general population raises the question of whether policies and programs should target only the sub-groups identified. Other research limitations include:

- inconsistent assessment methods, such as incongruent geographic scales between perceived measures and objective measures, contributing to inconsistent findings in the literature;[123]
- using only one objective measure to operationalize each food environment feature;[54, 122] and
- examining only specific dietary behaviours such as fruit and vegetable intake[122, 126, 127] or specific food purchasing behaviours,[53, 128] rather than overall diet quality.

**KEY POINTS**

- Using subjective measures to characterise food environments can complement objectively-measured characteristics. Subjective measures may inform the choice of objective measures, and also contribute to an ecological understanding of food environments.
- People's perceptions of their food environments do not always match up with objective measurements, such as geographic food access or food costs in their neighbourhoods.
- It is still not clear to what extent objective or perceptual measures predict dietary outcomes. This is important since different findings have different policy implications. Therefore, researchers should attempt to compare residents' perceptions with objective measures.
- The relationships between food environment characteristics and diet-related outcomes are still uncertain. This may reflect inconsistencies in the research, or it may be that food environment features are more important in determining residents' diet-related outcomes in some communities relative to other communities.

## 2.6 CANADIAN FOOD ENVIRONMENTS

### GEOGRAPHIC AREAS AND SOCIO-ECONOMIC STATUS

People with lower socio-economic status (SES) have poorer dietary quality on average than more socio-economically advantaged people. [129] Research that shows people with lower SES having less access to nutritious foods supports the deprivation-amplification hypothesis. This is defined as a process "by which disadvantages arising from poorer quality environments … amplify individual disadvantages in ways which are detrimental to health." [130] (p. 33) There is robust evidence to suggest that food deserts exist in the United States. [3, 4] These are defined as low-income areas where nutritious food sources are lacking. Such studies most often assess disparities in access to nutritious and affordable foods between high and low SES areas. [4]

In Canada, there is little published evidence to support the deprivation-amplification hypothesis. In one study of 12 high-poverty neighbourhoods in Toronto, the authors concluded that there was no association between distance to the nearest discount supermarkets and food insecurity. [131] They suggest that interventions addressing poverty would be more effective than interventions to improve geographic food access. Indeed, a recent commentary argued that adequate access to nutritious foods (for example by placing a supermarket in an underserved area) may be a necessary but not sufficient condition to improve dietary quality. There must also be efforts to ensure that nutritious foods are of high quality and priced affordably. [132]

Three studies (in Hamilton, Ontario,[133] London, Ontario,[58] and Saskatoon, Saskatchewan[134]) found that disadvantaged areas have poorer access to supermarkets or grocery stores relative to more advantaged areas. Ten other studies, which were not consistent in the way that they defined low socio-economic status, found that:

- there was no difference between disadvantaged and advantaged areas (in Montreal, Quebec[135–137] and Quebec City, Quebec[138]); and
- disadvantaged areas actually had better food access than advantaged areas (in Edmonton, Alberta,[139, 140] metropolitan areas in British Columbia,[141] Middlesex County, Ontario,[142] and Montreal, Quebec[60, 143]).

Only two of the studies published to date have been conducted in non-urban settings. Some evidence from Quebec suggests that access to nutritious foods is poorer in rural and suburban areas.[137, 138]

Appendix B provides summaries of this research. The little Canadian evidence that exists suggests that *food availability*[133, 136] and *food affordability*, defined as the cost of nutritious food baskets[133, 144] were similar between more and less disadvantaged areas.

Although there is no evidence for the widespread existence of food deserts in Canada, evidence is stronger for the existence of food swamps. These have been defined as disadvantaged areas "… with a plethora of fast food; convenience stores selling calorie-dense packaged foods, super-sized sodas, and other sugar-loaded beverages; and other non-food retail venues selling junk food as a side activity."[132 (p. 1171)] Disadvantaged neighbourhoods with greater access to fast food or convenience stores than more advantaged neighbourhoods have been found in Edmonton, Alberta,[140, 145] Hamilton, Ontario,[133] Middlesex County, Ontario,[142] Montreal, Quebec,[143] and the province of Nova Scotia.[146]

## KEY POINTS

- There is no evidence of widespread food deserts in Canada, although a few have been identified in the literature (in Hamilton, London, and Saskatoon). Three studies found evidence of food deserts, whereas 10 studies found lower SES areas to have as good or better geographic access to nutritious foods than higher SES areas.
- The vast majority of food access research in Canada has taken place in urban areas. There is a significant gap in knowledge of food environments in rural and remote northern communities. More work needs to be done to examine whether food deserts exist there.

## CANADA'S CHALLENGES IN RURAL, REMOTE, AND NORTHERN COMMUNITIES

Due to its geography, Canada may face unique challenges in creating or supporting healthy food environments. From this arise opportunities for community-level solutions.

In 2006, about 80% of Canadians lived in urban areas. The three largest (Toronto, Vancouver, and Montreal) made up 34.4% of Canada's entire population. However the urban-rural distribution is uneven across the provinces and territories. Quebec, Ontario, British Columbia, and Alberta had higher urban proportions than the national average. The Atlantic provinces, Saskatchewan, Manitoba, and the Territories had significantly higher rural proportions than the national average. [147]

Urban-rural population distribution is an important issue. While features such as geographic food access have not been found to differ much by area-level socio-economic indicators in Canada, some evidence indicates that food environments may differ between urban and rural environments. Different measures of the food environment may be better suited to the rural or northern context. [142] Food environments may have different impacts on diet-related health outcomes in urban and rural settings. [148]

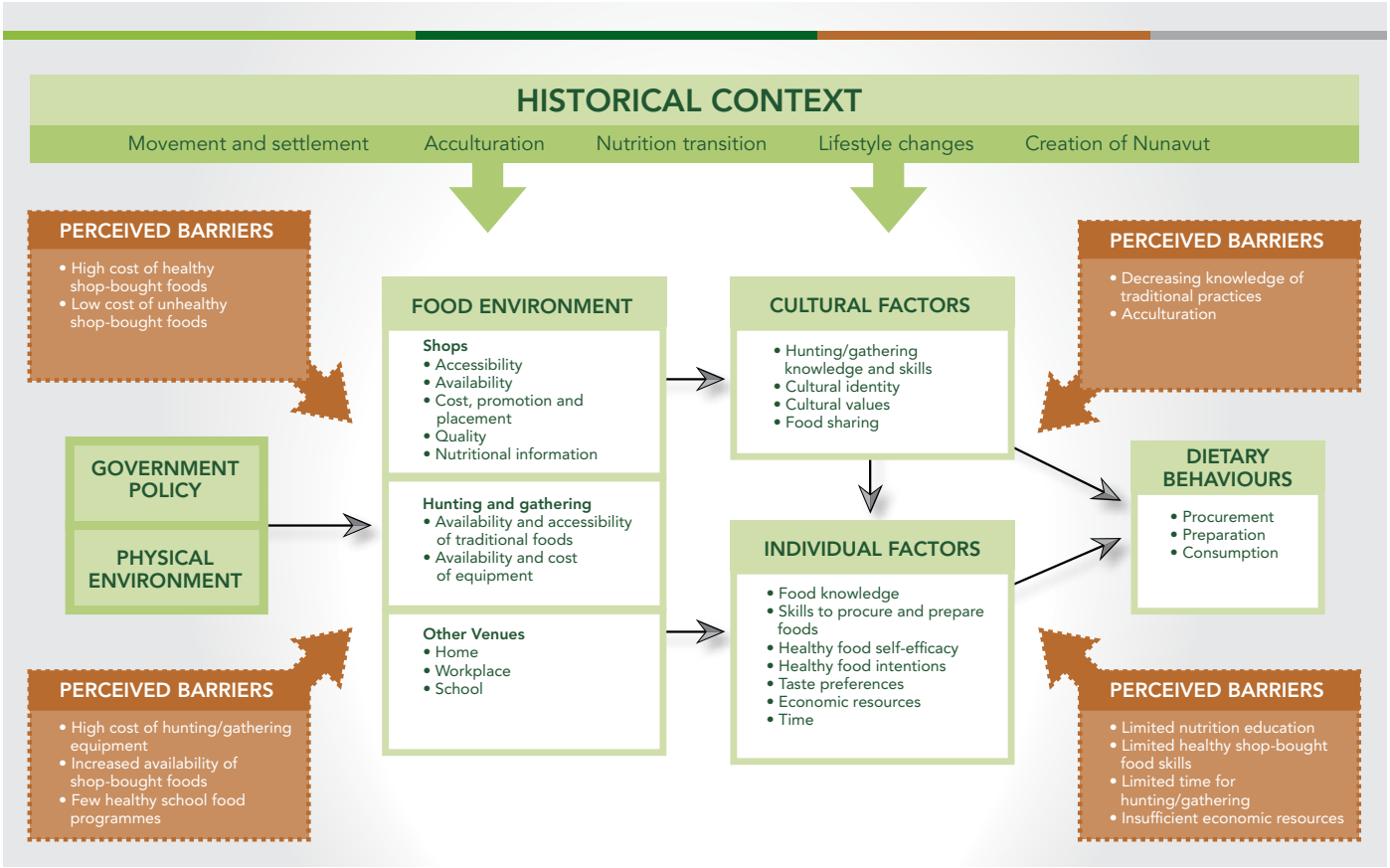
Rural and especially remote, northern communities have higher prices than more central areas [144, 149, 150] and poorer availability of nutritious foods. [144] They have fewer grocery stores and supermarkets. The small populations in these communities may not support the development of new stores. [150–152] Thirty percent of Déne/Métis, 44% of Yukon First Nations, and 60% of Inuit women reported that their families could not afford to buy all the foods they needed from the store. [153]

Inuit, Yukon First Nations, and Déne/Métis populations also consume traditional foods, which are shared at no cost among community members. [151, 153, 154] But climate change may overwhelm the capacity of many communities to access sufficient traditional foods, making store-bought foods an increasingly important factor in food security in the North. [155]

Inuit people have identified a number of barriers to the availability of nutritious foods in stores, most of which have to do with transportation and storage of food from the south:

- Profitable foods tend to have a long shelf-life and be light-weight (for instance, dry soup mixes, chips, and candy). These may displace nutritious foods.
- There is often not enough storage space for non-perishable foods in northern grocery stores. These foods are often brought in by ice road or ship. Because of ice conditions, food shipments may not arrive when anticipated, creating food shortages. [151, 152]
- Transporting perishable foods from the south is difficult and affects food quality and price. [152] It is hard to control temperature throughout transit to avoid freezing of fruits and vegetables and thawing-refreezing of frozen foods. Appropriate packaging practices are not always followed.

Figure 4. Conceptual model for factors influencing dietary behaviours and the perceived barriers to consuming a healthy diet amongst Inuit adults in Nunavut, Canada [152]




## KEY POINTS

- Evidence is limited, but it seems as though unique issues in remote, northern communities create a context in which food environments are less supportive of healthy eating. This is important because populations living in remote, northern communities are already more at risk of diet-related diseases than other Canadians.
- Addressing food insecurity is another major priority for remote, northern communities, with 70% of Inuit preschoolers living in food insecure households. [156] Food insecurity often exists alongside chronic diseases in remote, northern communities.

# 2.7 CANADIAN EVIDENCE FOR THE ASSOCIATION OF FOOD ENVIRONMENT WITH DIET-RELATED OUTCOMES

## CANADIAN EVIDENCE ON COMMUNITY NUTRITION ENVIRONMENTS

The published Canadian evidence to date has focused on geographic food access in Glanz's model of nutrition environments. Thirteen Canadian studies have examined food access (either objective or perceived) in relation to diet-related health outcomes (Table 1). Eleven of the 13 studies, or 85%, found some association between the food environment and diet-related outcomes.

Four studies were conducted among children and youth. Perceived high-quality food environments were associated with better diet quality,[157] lower probability of being overweight or obese,[157] and higher health-related quality of life.[158] In terms of geographic food access, one study found that students at schools with higher exposure to food retailers had lower risk of being overweight[159] while another found increased risk of overweight with more fast-food retailers around schools.[160]

Five studies examined weight and food access in adults. Four of these found a relationship between increased geographic access to non-nutritious food sources and overweight or obesity in Ontario and Alberta.[63, 161, 162, 163] The fifth found no such association in urban Ontario and British Columbia.[164]

Two studies assessed the relationship between food access and cardiovascular outcomes. In one cross-sectional study, cardiovascular deaths among adults in Montreal, Quebec, were not found to be associated with the density of stores selling fruits and vegetables. However, overall mortality was associated with higher fast food restaurant density, even after accounting for socio-demographic variables.[165] The second study, conducted in Ontario, found that mortality and hospital admissions for acute coronary syndrome were higher in regions with a higher density of fast food chains compared with regions of lower density.[166] In this study, outcomes were adjusted for age, gender, and socio-economic status.

Only one of the eight studies among adults examined food environments and associations with diet quality. It found no significant associations.[162]

Although physical activity is not traditionally understood to be an outcome associated with food environments, one of the studies conducted in Ottawa, Ontario, examined the relationship between geographic food access and physical activity. It found that each additional store in a neighbourhood doubled the likelihood of men (but not women) being physically active.[163]

Food access seems to have differential associations for men and women, with women being more likely than men to have their weight status significantly associated with a less supportive food environment.[161, 163] In addition, perceived food access seems to have differential associations for urban and rural children, with diet and weight outcomes more strongly related to perceived food access among urban rather than rural settings.[157]

## CANADIAN EVIDENCE FOR OR AGAINST LYTLE'S HYPOTHESIS

Lytle hypothesized that food environment characteristics are more strongly associated with diet-related health outcomes among individuals who are more restricted by things like low-income, disability, or lack of access to a vehicle or transit. [43] To find the extent to which Canadian evidence supports this, the author assessed the 13 identified studies' methods to see if individual restrictions were analysed as moderators of the relationship between food access and outcomes of interest.

Of the 13 associations assessed in Table 1, only one examined socioeconomic status as a potential effect modifier and results do not support Lytle's hypothesis. [166] The lack of significant interaction between food access and cardiovascular outcome, however, could be due to the area-level income status used in the study (each area represented 28,371 people on average) rather than using individual-level income. Using area-level income, particularly in areas representing a large population, masks whether or not a socioeconomically disadvantaged individual is more reliant on his or her immediate environment for food.

Seven other studies examined how different socio-demographic groups (based on sex, age, or urbanicity) might relate differently to food environments. In sex-specific models, men were found to be more physically active than women with each additional local convenience store. [163] Women were more likely to be overweight or obese with increased access to specialty food stores, convenience stores, and fast food outlets. [161, 163] In urban and rural children, both diet quality and overweight/obesity were positively associated with perceived food access, but this finding was more pronounced among urban children. [157] One study among youth found that there was a significant interaction between grade and the number of fast food retailers and grocery stores within one kilometre of a student's school. An increased risk for overweight was observed for grade five students compared to grade six to eight students. [160]

There is a need to further examine the hypothesis that diet-related outcomes of more "restricted" individuals are more strongly related to their environments, since exploring this question has implications for policy development. For example, if low-income people or people with limited mobility are more restricted to their immediate neighbourhoods to access food, neighbourhoods with high proportions of low-income or less-mobile individuals could be identified as priority neighbourhoods for improving access to nutritious foods.

### KEY POINTS

- The majority of published Canadian evidence indicates that a significant relationship exists between geographic food access (the only food environment characteristic yet assessed in the Canadian context) and diet-related health outcomes.
- There is a research gap in examining whether food environments are more important determinants of dietary outcomes in low-income populations rather than high-income populations.

Table 1. Canadian evidence for associations between food environment characteristics and diet-related health outcomes

| Outcome | Population | Locale | Main finding | Evidence supporting Glanz and colleagues' model | Evidence supporting Lytle's model |
|---|---|---|---|---|---|
| **Cardiovascular outcomes** | Adults | Montreal, Quebec | Density of stores selling fruits and vegetables were not associated with cardiovascular (CV) mortality or non-CV mortality; higher fast food restaurant density was associated with mortality after accounting for socio-demographic covariates. [165] | + | n/a |
| **Cardiovascular outcomes** | Adults | Ontario | Mortality and hospital admissions for acute coronary syndrome were higher in regions with more fast food chains after adjusting for risk. The relationship between outcomes and fast food intensity was not moderated by area-level socio-economic status. [166] | + | - |
| **Physical activity** | Adults | Ottawa, Ontario | For every additional convenience store in the neighbourhood, men (but not women) were twice as likely to be physically active. [163] | + | n/a |
| **Weight status** | Adults | Edmonton, Alberta | A lower ratio of fast food restaurants and convenience stores to grocery stores and produce vendors near people's homes was associated with lower odds of being obese. [63] | + | n/a |
| **Weight status** | Adults | Ottawa, Ontario | For every additional specialty food store, women (but not men) were almost twice as likely to be overweight or obese. [163] | + | n/a |
| **Weight status** | Adults | Ottawa, Ontario | Greater neighborhood density of convenience stores and fast food outlets were associated with increased odds of women (but not men) being overweight/obese. [161] | + | n/a |
| **Weight status** | Adults | Waterloo, Ontario | Several measures of geographic food access predicted BMI and waist circumference in a population-based sample. Diet quality was generally unrelated to the food environment, although findings differed between males and females. [162] | + | n/a |
| **Weight status** | Adults | Toronto, Ontario; Vancouver, British Columbia | Density of fast food restaurants, convenience stores, and grocery stores within 1km of individuals' homes were not significantly associated with BMI in Toronto or Vancouver. [164] | - | n/a |

Table 1. Continued

| Outcome | Population | Locale | Main finding | Evidence supporting Glanz and colleagues' model | Evidence supporting Lytle's model |
|---|---|---|---|---|---|
| **Diet Quality** | Youth | Nova Scotia | Children (aged 10 to 11 years old) in neighbourhoods with the highest perceived access to stores selling healthy foods had better diet quality than those in other neighbourhoods. This finding was more pronounced in urban relative to rural settings. [157] | + | n/a |
| **Health Related Quality of Life** | Youth | Alberta | Perceived access to stores selling fruits and vegetables was one component of a neighbourhood satisfaction score. Children residing in neighbourhoods characterized as providing good satisfaction reported higher health-related quality of life. [158] | + | n/a |
| **Weight status** | Youth | Canada: National sample | Increased exposure to food retailers around schools was not associated with increased odds of overweight or obesity in school-aged youth across all food retailer types. Using 1km buffer zones, students attending schools with at least one food retailer had lower relative odds of overweight; at 5km buffer zones, students at schools with the highest exposure to food retailers had a lower relative odds of overweight compared with students attending schools with no exposure. [159] | - | n/a |
| **Weight status** | Youth | Nova Scotia | The probability of being overweight or obese was 26% and 33% less, respectively, for children living in neighbourhoods with good perceived access to stores selling healthy foods than children in neighbourhoods with poor perceived access. This finding was more pronounced in urban than rural settings. [157] | + | n/a |
| **Weight status** | Youth | Ontario | More fast food restaurants and grocery stores around schools were positively associated with students' likelihood of being overweight, particularly for grade five students. [160] | + | n/a |

(-) No significant relationship observed (+) Significant relationship observed (n/a) Relationship was not assessed (BMI) Body Mass Index

# 3. UNRESOLVED ISSUES AND RESEARCH GAPS FOUND IN THE LITERATURE

Thirteen of the 14 reviews published to date that examine at least one aspect of the food environment and diet-related health outcomes note inconsistent findings. Ten of them attribute this at least in part to the inconsistent methods used to assess the food environment.

Twelve of the 14 reviews mention the high prevalence of cross-sectional studies as a weakness in the current body of research, since a full understanding of how food environments affect diet-related outcomes cannot be inferred from cross sectional study designs.

Seven of the reviews document the lack of a sound theoretical basis in the literature reviewed, particularly in defining food environment characteristics and in the definitions of place or neighbourhood.

Two reviews identified the common use of secondary data and researchers' reliance on administrative boundaries to define place as symptoms of insufficient theoretical consideration and limited data availability.

## 3.1 MEASURING GEOGRAPHIC AREAS

Many researchers do not explicitly define the neighbourhood food environment. However, the measures they use represent unstated assumptions and theories about how food environment features affect diet-related outcomes.[120] For instance, in one study,[65] the authors measured the number of food stores within census tracts. Measuring store proximity and relating it to residents' BMI reflects an underlying assumption that people will shop more at a closer grocery store. Other assumptions follow this one, for example, nutritious foods are available in grocery stores, which will increase people's consumption of nutritious foods, and therefore people who live closer to a

grocery store will eventually weigh less than people who live further from a grocery store. When these assumptions are spelled out, it becomes clear that some (or all) are over-simplistic.

Zenk and colleagues, on the other hand, [167] explicitly defined the neighbourhood food environment as "a group of factors including the types of retail food outlets and the availability, quality, and price of different kinds of foods, such as prepared foods, fresh produce, and other groceries, in a given geographical area." [167 p. 61] In this definition, the authors summarize in one sentence the characteristics of the food environment most frequently assessed in the literature.

Geographic metrics used vary widely. [6, 10] For the most part, the literature measures the neighbourhood food environment in one of three ways: administrative boundaries, buffer zones, and activity spaces. There is no 'gold standard' when it comes to which geographic scale captures food environments most meaningfully. Future research should provide explicit rationales to make it easier to compare studies and to clarify the meaning of different boundaries and measures. [8]

## ADMINISTRATIVE BOUNDARIES

Administrative boundaries are lines drawn by government, usually census tracts. They are small, relatively stable geographic areas that usually have a population of 2,500 to 8,000. [168] Relevant data exist at the census tract level, such as neighbourhood income, proportion of renters, proportion of immigrants, and proportion of unemployed. Moreover, defining neighbourhoods as census tracts is relatively quick and easy to do, because the data are publicly available. Individual survey data can be easily aggregated to the area level. Finally, using administrative boundaries is also useful for policy applications, because governments can easily see how the research connects to the area over which they have jurisdiction.

There is one serious drawback: census tracts and other administrative boundaries do not necessarily represent neighbourhoods as experienced by residents. [169]

## BUFFER ZONES

Buffer zones are defined areas around relevant places such as people's homes, schools, or workplaces. They can be either Euclidean distance (as the crow flies) buffer zones, or street-network-distance buffer zones (taking into account how far a person could walk or drive based on the street network). Using buffer zones to define neighbourhoods is more complicated than relying on previously-established administrative boundaries because buffer-zones must be created for each respondent. In addition, it is impossible to aggregate individual data to the area-level because buffer zones are specific to each residence.

Acknowledging these difficulties, however, it may be more theoretically justified to use buffer zones than administrative boundaries because it is likely that residents would perceive neighbourhoods as including their home and the surrounding area, which a buffer zone captures. There is currently no consensus around what buffer zone scale is most associated with residents' weight or diet quality. This method has also been criticized because most people are not restricted to buying food in their own neighbourhoods. [170]

## ACTIVITY SPACES

The most recent stream of food environment research examines activity spaces related to foods, or foodscapes.[171–173] The idea of activity spaces is to look at where people actually go throughout the day, because we know that most people are not restricted to their neighbourhoods. Some researchers have looked at activity spaces by giving people GPS devices, creating a map of where they went, and then looking at food environments around their activity spaces. Others have developed maps of where people usually go for activities relevant to food intake, such as a restaurant, a grocery store, or a convenience store.

Activity space research fits within a socio-ecological framework, in that it can examine how people interact with their environments to procure food. This can be done on a larger scale than qualitative studies would allow. Activity space research could provide a more solid evidence base for policies related to supporting healthy food systems than the current state of the evidence, which mainly examines residential neighbourhoods.[170]

To date, research on activity spaces has been limited to defining exposure in terms of different food store or restaurant types, rather than examining the foods available, or food cost within outlets. Outcome data have been limited to self-reported BMI[172] and dietary variables based on food frequency questionnaires.[173] Activity spaces have been found to vary by both individual and socio-demographic characteristics (employed people and people with access to private vehicles may have larger activity spaces than non-employed people and those with no access to private vehicles).[173]

## CHALLENGES IN DEFINING NEIGHBOURHOOD FOOD ENVIRONMENTS

Defining the appropriate geographic scale for a neighbourhood depends on the research question.[174] Hypotheses about how environmental exposures act on outcomes can help research determine the relevant geographic scale.[174] For example, of the few people in a study sample who walked to purchase food, all walked less than one mile.[175] Only close proximity predicts people's patronage of food outlets.[176] This hypothesis has been confirmed by evidence from Edmonton, Alberta indicating that food environment features within 800m (but not 1600m) of someone's home are associated with weight status.[63]

But people often travel more than one kilometre from home to purchase food.[48, 175, 177] People live and work in multiple geographic areas. At the same time, influential environments are often nested within a single neighbourhood. A single neighbourhood can contain different physical, social, cultural, and policy environments.[108]

**KEY POINTS**

- Administrative boundaries, buffer zones, and activity spaces are the most common ways that place has been defined in the food environment literature. Defining food environments as administrative boundaries or buffer zones oversimplifies the way that people move about and interact with their food environment.
- Defining the appropriate geographic scale depends on the research question.
- There is no gold standard when it comes to which geographic scale captures food environments most meaningfully. Future research should provide explicit rationales to make it easier to compare studies and to clarify the meaning of different boundaries and measures.
- Much needs to be done to determine how people actually interact with their environments to procure and eat food.

## 3.2 SUGGESTED STUDY DESIGN AND MEASUREMENT STRATEGIES FOR FUTURE RESEARCH

### PSYCHOMETRIC MEASUREMENT APPROACHES

Psychometrics is a field of study concerned with measurement theory and methods, including reliability and validity. For example, construct validity is described as "the extent to which the measure 'behaves' in a way consistent with theoretical hypotheses." [43] (p. S136) Several reviews have called for increased psychometric testing of food environment assessment methods [2, 17, 23, 24, 70, 57]. Future research should explore whether traditional psychometric methods could be applied to, or adapted for, food environment constructs.

### MIXED-METHODS STUDY DESIGNS

Most studies have used either quantitative or qualitative methods to assess food environment characteristics, but not both. How people feel and think about their food environments with respect to access, availability, affordability, and quality can complement objective food environment data, making mixed-method study design a suitable approach from an ecological perspective. [3, 43] Several questions could be assessed with mixed-method designs, including, "How well do objective assessment methods capture residents' lived experiences?" and "Do objective or perceptive characteristics differentially predict diet-related outcomes?" The answers to these questions have policy and programming ramifications.

## LONGITUDINAL STUDY DESIGNS

Several reviews have noted the prevalence of cross-sectional study designs in the field.[5, 9, 10, 12, 20, 23] Because such studies gather data at only one moment in time, they limit our full understanding of how food environments affect diet-related outcomes. Causal mechanisms are far from understood. Five longitudinal studies examining food access and diet-related outcomes have been published recently. Three found limited effects of food access on outcomes[78, 80, 81] and two found no effect.[79, 82] Despite the lack of longitudinal designs, policies affecting food environments have already been undertaken in some jurisdictions.

## CONSISTENCY AND VALIDITY OF MEASURES

The food environment literature is full of inconsistent measures. One recent systematic review noted the wide range of methods by which researchers classify food outlets.[25] Another noted that most studies used their own definition of fast food in fast food access studies.[17] This lack of consistency makes it difficult to compare studies. Because measures are inconsistent, it is unclear whether differences in findings are due to real differences in food environment features or in the extent to which food environment features influence behaviours or health outcomes.

A gold standard (or standards) for food environment assessment methodology has yet to be described. Little is known about how well the methods for assessing different constructs predict outcomes. Moreover, methods for measuring some constructs, such as food availability and food affordability, are more time- and resource-intensive than those that measure food access. It is still unclear whether investing the time and resources into using food environment checklists or shelf-space measurements rather than GIS-derived food access measures are worth the extra investment in terms of better predicting outcomes of interest.

As with any public health research area, detail and completeness of data are not uniform across regions or research questions. Different food environment data are available from different data sources, with corresponding implications for study findings.[70] Selection of data sources should be explicitly outlined in methods sections, along with details about data quality.

Complex data structures require complex statistical models and reporting. Researchers must consider the benefits and drawbacks to using aggregate data for different measures. For example, the presentation of responses from individuals might be different for people living within a census block group as opposed buffer zone data or activity space data.

The large amount of data collected in some studies may lead researchers to test associations that are not theoretically-based. This may lead to statistically significant findings due to chance and, thus, inappropriate conclusions.

## COMMUNITY CONTEXTS

Features of the food environment may not influence individual behaviour the same way in all community contexts. Community characteristics include predominant culture, area-level income, social capital, and built and natural environments in which the neighbourhoods are situated. For example, a predominantly upper-class neighbourhood with high rates of vehicle ownership might be far less dependent on their immediate environments for food than an area in which very few residents own cars. Reviews have identified the need to:

- examine where people actually buy and eat food; [70]
- explore whether the features of the immediate food environment have more of an impact when individual-level factors are at play, such as when someone stays home during the day to care for children, or is elderly, or has reduced mobility; [8]
- examine the influence of the food environment on cultural, racial, and other minorities as well as children; [2, 9, 12] and
- seek a broader understanding of historical, political, and cultural underpinnings of socioeconomic characteristics and racial segregation in an area as determinants of the food environment. [17]

In Canada, there is not enough research about food environments in northern and remote regions—a significant gap, given that food environment issues, especially in remote Aboriginal communities, are different to those in the south and equally complex.

### KEY POINTS

- Research gaps related to measurement and study design include inconsistent food environment assessment methods, inconsistent definitions of geographic scale, lack of mixed-method study designs, and the lack of food environment assessment validity or reliability testing.
- The detail and completeness of data are not uniform, and the data are complex.
- The inconsistent findings that characterize the literature could reflect actual differences in how people respond to food environments rather than simply inconsistent methods or study designs. If aspects of the food environment are a more important determinant for some populations than others, this could be an important policy or program consideration.
- Not enough food environment research has been conducted in northern and remote communities. This is concerning because residents of northern and remote communities are often people who are at increased risk of diet-related diseases.




# 4. CANADIAN COMMUNITY FOOD ASSESSMENTS

Community food assessments, or CFAs, are intended to "bring together people from across the food system to develop a participatory, evidence-based strategic action plan on food for a particular area. Food assessments identify existing food assets, as well as community priorities for future work. Community food assessments have been used as a tool by professional planners in Canada and the United States, and have been seen as a first step in planning for community food security". [178] (¶ 1)

Although the specifics of each CFA are different, "most have an environmental scan that looks at the socioeconomic, health, and demography of the participating community. Community resources are identified, and often mapped or charted. Assessments also look at access to and the affordability of food, food production opportunities, social and cultural food diversity, or other issues identified by participating communities". [178] (¶ 2)

At least 22 community food assessments have been completed in Canada, although this list may not be exhaustive, since there is no central registry and much of the literature is unpublished. Figure 5 shows the locations of known CFAs that have been completed or are underway. Appendix D lists the year of completion and location of the CFAs.

While the literature synthesis revealed that food deserts were not widespread in Canada, in many of the CFAs, at least a few neighbourhoods were identified as food deserts, with low access to grocery stores and higher-than-average proportions of low-income families. They were found in Saskatoon, [179] Winnipeg, [180] Toronto, [181, 182] and many northern and remote communities (see Table 2). This discrepancy between the academic literature and CFA results may be explained by the different geographic areas studied. Another possibility is that practitioners engaged in CFAs may have been able to identify small pockets of the community that could not be adequately

captured by administrative boundaries like census tracts. Still another possibility is that food deserts identified by CFAs truly exist, but that findings from CFAs are not published in the academic literature.

Often, in the CFAs, food deserts were identified as especially problematic for people with limited mobility, seniors, and those with no access to a vehicle. Moreover, even in CFAs where overall, objective grocery store access was good, some of the focus group findings revealed that certain residents still struggled to access nutritious foods. While some of the food environment assessments only evaluated grocery store access, others also looked at access to fast foods and convenience stores, and found that many high-school students have high access to these kinds of outlets

Food costing studies have also been done across the country. In general, it appears that northern and remote communities in particular pay more than their southern counterparts for the same foods. [183, 184]

While some evidence suggests that increasing the number of stores in northern and remote communities might help ameliorate food insecurity, there are practical considerations that might get in the way. These considerations include:

- the long travel time for food to be shipped to the communities (time during which the quality of foods may deteriorate);
- small populations that may not make a grocery store economically viable;
- the cost of doing business in the North, such as shipping costs, equipment maintenance and repair costs, utility rates; and
- the fact that making foods available does not guarantee that residents will purchase them.

Table 2. Evidence for the existence of food deserts in Canada collected through community food assessments (CFAs)

| Type | Location | Evidence |
|---|---|---|
| **CFA** | Thunder Bay, Ontario | In focus groups, low-income families identified lack of transportation to and from the grocery store and distance to the grocery store as factors contributing to food insecurity. Although the CFA found that grocery store access was generally good throughout the city, a couple of lower income neighbourhoods lack a grocery store. |
| **CFA** | Vancouver, British Columbia | The cost of the National Nutritious Food Basket was highest in high-income neighbourhoods and lowest in lower-income neighbourhoods. In most neighbourhoods, including the downtown east side, there is good access to grocery stores, although there are a number of neighbourhoods with low grocery store density but higher-than-average populations of people who are at risk of food insecurity, indicating that there might be pockets that could be considered to be food deserts. |
| **Program evaluation** | Northern Manitoba | Northern Manitobans pay 60% more than Southern Manitobans for the National Nutritious Food Basket. Remote communities pay 1/3 more than non-remote northern communities. Several northern, remote communities in Manitoba have no food stores (Thicket Portage, Ilford, War Lake First Nation, Granville Lake),[185] indicating that a number of northern Manitoba communities fit the definition of food desert. |
| **CFA** | St. Vital, Manitoba | Distance to a grocery store is shorter in lower-income neighbourhoods, but the food balance (ratio of the distance to the nearest fast food or convenience store to distance to the nearest grocery store) is higher for higher income neighbourhoods than lower-income neighbourhoods. This means that lower-income neighbourhoods have increased access to fast food outlets. While this finding does not in itself suggest food deserts, it does suggest that people in poorer neighbourhoods have less healthy food environments. |
| **GIS mapping** | Toronto, Ontario | 93 Dissemination areas in Toronto are high-poverty and are located at a greater distance to a grocery store (more than 1km), indicating support for the existence of food deserts.[181, 182] |
| **CFA** | Burin Peninsula, Newfoundland and Labrador | People living outside of Burin/Marystown had to travel between 40 and over 250 kilometres (round-trip) to do grocery shopping, since several of the smaller communities had no grocery stores. Participants in the CFA indicated that quality and selection of fresh foods is a provincial concern. Similar to other remote communities in Canada, remote communities in Newfoundland appear to be food deserts. |
| **CFA** | Labrador West, Newfoundland and Labrador | All grocery stores are located in Labrador City, although convenience stores exist in several smaller communities. In Wabush, two convenience stores are the only sources of retail food. |

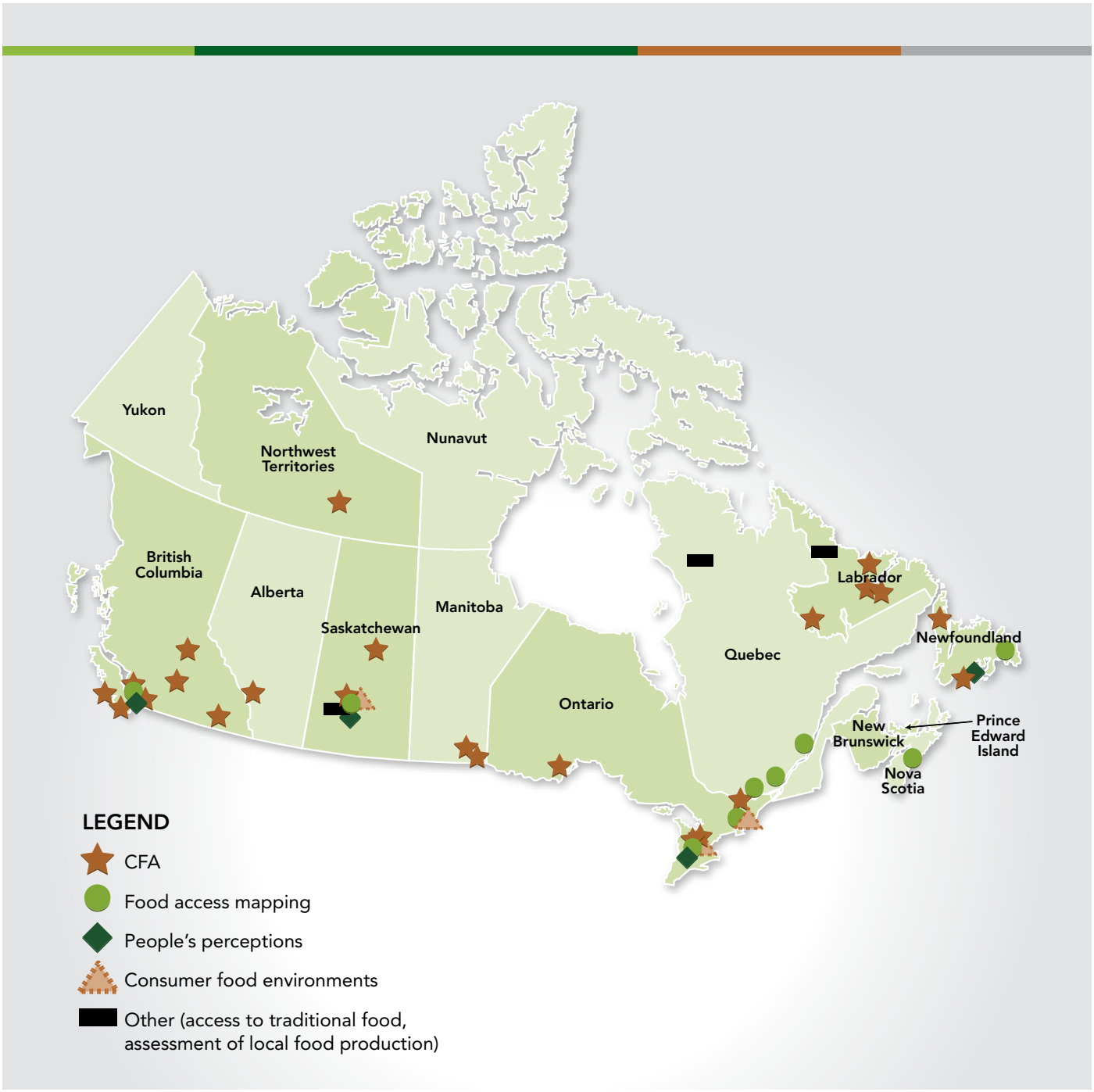
| Type | Location | Evidence |
|---|---|---|
| **CFA** | Upper Lake Melville, Newfoundland and Labrador | There are two grocery stores in Happy Valley Goose Bay, and 11 convenience stores. There are convenience stores in Goose Bay located close to the low-income housing developments, and they are heavily used by residents, since they are within walking distance (while the grocery stores are not), and many residents do not have cars. Taxis are very expensive, and there is no local transit system. In winter, road conditions can be poor, and if one delivery is missed, there is little fresh produce to be found for up to a week. |
| **CFA** | Hopedale, Newfoundland and Labrador | Because of the long travel distance, food is often past its best before date or of poor quality (bruised, withered) once it arrives in Hopedale. This indicates that, even with a grocery store, food availability and food quality can still be an issue. |
| **CFA** | North Shore, British Columbia | Participants in the consultations identified grocery accessibility as a challenge for people on the North Shore, particularly seniors and those with mobility issues. These perceptions were not followed up with a food access map. |
| **CFA** | La Ronge, Saskatchewan | The majority of grocery stores are clustered in one area of the town, leaving many areas without easy access to nutritious foods, particularly for those without a vehicle. Groceries are more expensive in northern Saskatchewan than southern Saskatchewan. |
| **CFA** | Halton, Ontario | There appear to be several lower-income neighbourhoods without good access to grocery stores. Many high schools are within walkable distance to convenience stores and fast food outlets. |
| **CFA** | Yellowknife, Ndilo, Dettah, Northwest Territories | There are no grocery stores in Ndilo or Dettah. Dettah is 27 kilometres from Yellowknife by all-weather road and 6.5 kilometres by ice road, making grocery stores difficult to access for those without vehicles. |
| **CFA** | Victoria, British Columbia | Most large grocery stores are on public transit routes. While some neighbourhoods have many grocery stores within a small radius, others have none. |
| **GIS mapping** | Saskatoon, Saskatchewan | Food deserts exist in Saskatoon, situated in some of the most deprived areas. |
| **GIS mapping** | Waterloo, Ontario | 94% of urban residents live within walking distance of a public transit route to access groceries. However, 71% of the urban population does not live within a walkable distance (450 metres) of a large grocery store. |

## KEY POINTS

- Food deserts were more commonly identified in community food assessments than they were in the academic literature synthesis.
- Even if food deserts are not widespread in Canada, challenges in accessing nutritious foods still represent a problem in many locales, especially for people with mobility issues and lower-income individuals.

- Food deserts, traditionally defined, appear to be common in northern, remote communities, especially since some communities have no grocery stores. Despite this, urban-focused definition of, and solutions for, food deserts may not be relevant for these communities.

Figure 5: Locations of known community food assessments (CFAs) in Canada



# 5. INTERVIEWS WITH KEY INFORMANTS

Nineteen key informant interviews were completed: nine with researchers and 10 with practitioners. All key informants had been involved with conducting food environment assessments. Key informants from the research sector were associated with a Canadian university or research institution. Practitioner key informants included public health planners, public health nutritionists (regional, provincial or territorial), and employees of non-governmental organizations that had mandates relevant to food environments.

The author of this report selected key informants from her contacts in Saskatchewan, Ontario, Quebec, and Nova Scotia. The Federal, Provincial, Territorial Group on Nutrition members and Health Canada also nominated key informants to ensure regional representation for the interviews. Appendix C summarizes the food environment assessment projects described by the key informants.

## WHAT PRIMARY PURPOSE DID YOU HAVE FOR ASSESSING THE FOOD ENVIRONMENT?

Most practitioners saw the primary purpose of food environment assessment as informing policies and program development, while about one in five mentioned the evaluation of existing policies or programs the main purpose. As one practitioner put it, "The overarching goal of this research is to inform municipalities and encourage local interventions/policy changes related to zoning bylaws and land use."

Researchers, on the other hand, most commonly cited improving our understanding of environmental determinants of food choice, food security, or other diet-related outcomes as the primary purpose of food environment assessment. About a third identified informing policies and program development as an important purpose. One researcher, who alluded to both purposes in her statement, said, "Broadly, the purpose is to get a better understanding of the determinants of

dietary practices and related chronic diseases … Ultimately our goal is to inform policies, programs and strategies to help create changes to improve and impact population health."

Only three key informants identified "describing food access within a community" as a main purpose of food environment assessments.

### KEY POINTS

- Most practitioners wanted to use food environment assessments to inform policies and programs.
- Most researchers wanted to better understand environmental determinants of diet-related outcomes.

## WHAT TYPES OF FOOD ENVIRONMENT ASSESSMENT METHODS DID YOU USE?

The key informants identified five methods they were using to assess food environments:

1. **Community food assessments (CFAs):** Although CFAs most often employ geographic food access mapping, they do so with the specific purpose of engaging and informing key stakeholders who want to take action on food security or local food systems. Four of the practitioners, but none of the researchers, had completed community food assessments.
2. **Food access mapping:** Mapping the locations of different types of outlets was the most commonly-used type of food environment assessment, with four practitioners and most of the researchers using this method.
3. **Within-outlet audits:** These are audits of stores and restaurants to assess features such as food availability, food quality, and food cost. Four practitioners and two researchers had used within-outlet audits to evaluate consumer experiences.
4. **Community residents' perceptions of their food environments:** One of the practitioners and more than half of the researchers, evaluated residents' perceptions of their food environments.
5. **Assessments of traditional or local food production:** One researcher was examining wildlife population models of traditional or country foods in Inuit communities. One practitioner was examining local food production and local food demand in a Prairie community.

### KEY POINTS

- Geographic food access mapping is the most commonly-used type of food environment assessment, although a substantial number of practitioners and researchers are beginning to examine consumer food environments within stores and restaurants as well.

- CFAs were used by two-fifths of practitioners but no researchers. This might reflect differences in priorities, since researchers more commonly identified understanding food environments as the main purpose, whereas practitioners more commonly identified informing policies and programs as the main purpose.

## WHAT GEOGRAPHIC SCALE OR AREA DID YOU CONSIDER MOST RELEVANT?

The community level was the most common geographic scale considered relevant by half of the practitioners and a little more than half of the researchers. Community was most often defined as a specific town, city, or region. Of the practitioners who conducted community food assessments, all considered the community level to be the relevant geographic scale.

A third of the practitioners and one-fifth of the researchers found buffer zones around places of interest, such as schools or homes, to be relevant. One of the practitioners and a little more than half of the researchers, used administrative boundaries, such as census tracts, census dissemination areas, and forward sortation areas. One practitioner used provincial boundaries.

### KEY POINTS

- Key informants were most likely to consider communities as a relevant geographic scale, followed by administratively-bound areas and then buffer zones.
- The published literature suggests that the use of administratively-bound areas and buffer zones are the most common conceptualizations of relevant geographic scale.

## WHAT OUTCOMES DID YOU CONSIDER RELEVANT?

Five of the practitioners and three of the researchers were examining food environments in relation to food security. This is not an outcome commonly considered in the academic literature on food environments. Diet-related health outcomes, the traditional outcomes of interest in the academic literature, were considered relevant by three of the practitioners and four of the researchers.

Four of the practitioners considered the act of mapping or describing the food environment as a relevant outcome in itself, as did one of the researchers. One practitioner was additionally considering food production as a relevant outcome.

One researcher was focused on the level of engagement with traditional means of procuring food among Inuit, such as hunting, fishing, and gathering. One researcher sought to find the reasons for traditional eating patterns and body image concerns among people living in the Maritimes.

**KEY POINTS**

- Unlike the academic literature, which generally focuses on diet-related outcomes or on social and economic patterns in the features of food environments, much of the work being done by the key informants focuses on food security as a relevant outcome.
- Mapping or describing the food environment was more commonly considered an outcome among practitioners (four out of ten), than among researchers (one out of nine).

## WHAT POPULATIONS DID YOU CONSIDER RELEVANT?

Six of the practitioners focused their data collection on the general population. Three identified Aboriginal populations. One focussed on low-income populations, and one on policy-makers. Among researchers, relevant populations were fairly evenly split among the general population (two), low-income people (two), Aboriginal (two), youth (two), and women (one).

One practitioner, who had conducted a community food assessment, noted:

> One challenge was how to engage middle-class communities around a food assessment. With lower-income populations, you have organizations from those communities working with you, but there are not as many people or groups who do that in middle-income communities. We found a few places who had looked at this, but it was different than what we had seen in the past—people who do not have high rates of food insecurity.

**KEY POINTS**

- A substantial amount of food environment research identified by the key informants is being undertaken with vulnerable or disadvantaged populations, including Aboriginal communities and low-income families.

## WHAT ARE THE IMPORTANT CONSIDERATIONS AND REMAINING QUESTIONS?

Practitioners and researchers spoke frankly about the challenges of conducting food environment assessments and the questions that remain. They noted, for example:

- the context and complexity of dietary behaviours and food security;
- considerations of purchasing power;
- the contrasts between remote, northern communities and urban centres;

- the idea that food environments might not affect all populations in the same way;
- measurement issues;
- data limitations; and
- the necessity of community-university partnerships to address food environments.

## *The risks of oversimplification*

One researcher highlighted the importance of connecting data on socio-economic status to data on food cost. She referred to a study with which she was involved that looked at food access and food security in a major urban centre:

> The bigger question in regards to assessing food environments is assessing access to affordable food, which is relative to purchasing power. If we just look at food cost, we get away from the actual ability of people to purchase healthy foods. The starkest example of that problem was in the work that we did, in the neighbourhood that we were looking at, everyone had to be in rental accommodations to be eligible, but they were stratified by subsidized housing vs. not subsidized. Subsidized apartments in one location were right on top of a [large discount grocery store]. The levels of food insecurity in that building were as high or higher than anywhere else. My feeling is that the conversation about geographic access only works as long as you keep purchasing power out of the equation. As soon as you bring it in, it changes the whole picture… Food access doesn't really matter if people can't buy the foods, even if they live on top of the grocery store.

Another key informant, working in the same large city, noted the limitations of food access mapping in light of the complexity of dietary behaviours:

> Even though GIS would tell us one thing, how people interact with their environments may be a different thing.

It seems as though access to nutritious foods is important, but only in the context of adequate purchasing power. "Food environment research in general seems to be oversimplified," bluntly stated another key informant.

Key informants also pointed out the need to examine food charity in addition to retail food environment features. By focusing only on access to grocery stores, fast food, and convenience stores, we miss the important contributions (both negative and positive) that food charities make to the diets of lower-income Canadians.

## The differences in northern, rural, and remote communities

Despite this, one key informant's recent research experience paints a different picture for rural populations in northern and remote communities, where increasing the number of grocery stores could, in fact, help to ameliorate food insecurity. This is significant, since food insecurity affects 75% of these households. [185]

Another key informant working with northern Inuit communities made this observation: methods for assessing food environments in relation to food security that are relevant for urban areas are likely not relevant in remote, northern communities. "In addition to capturing food access or availability measures, non-monetary food sources [food sharing practices] coming into the household need to be considered. We need to generate or validate methods for this context."

## Finding the right measurement methods

Defining the relevant geographic scale was a challenge for several key informants. One summed it up this way:

> Spatial scale has not been defined … We need to figure out where youth actually go, and what the relevant "place" is to measure—we tend to focus on a residential context or a school food context, but I don't have a good sense of which places are the most relevant. How do we account for all of those exposures, when the food environment is not static, people move, and other geographic life environments may be very important? I think we need to continue to validate measures, and create meaningful measures.

Another key informant challenged defining a relevant spatial scale "… around definitions of neighbourhoods—we are assuming that people walk, but people don't necessarily walk, and they don't necessarily go to the closest grocery store. We are taking a fairly simplistic view of access."

The differences in measuring rural vs. urban food environments were also identified as a challenge: "One of the limitations is the lack of information about the best way to assess food environments in rural areas. For example, is GIS a valuable tool or what are the challenges? What is the best suited method for looking in rural environments?"

A final measurement issue, that of the large number of food environment assessment methods currently available, was also identified, "… it can be difficult to know what measures to use to study the environment. There has been limited research done to compare different measurement tools and their effectiveness in predicting diet outcomes. It could be overcome by completing more research in this area."

## Data limitations

Two data limitations were identified by several key informants: access to data sets with appropriate information included, and the lack of linkages between relevant data sets. "The greatest limitation of this research is access to large data sets with the appropriate measures. In addition, the food environment is not static and keeping up with the constant changing landscape can be very costly." Another key informant added "At this moment, there are a lot of separate studies and pieces of information—it would be helpful for them to be linked. There is quite a lot of rich data that has been collected. I'm quite pleased that the data are there, the big issue is my capacity to use and analyze the data."

## Community-university partnerships

Several key informants noted the importance of community-university partnerships. One researcher who is very engaged in inter-sectoral research, noted two challenges:

> This kind of research is very time-consuming and takes a lot of effort to cultivate relationships—it's a whole other area of research activities. The other limitation is the feeling of, "Is the research question being too shaped by a policy direction?" The critique is that the policy is made, and then they need the research to back it up. We need to be careful to do rigorous research that is useful and will have an impact.

Two other key informants argued that these partnerships are needed, in part, so that research findings can support taking action. One said:

> [Research] does not necessarily lead to meaningful policy solutions, such as lobbying municipal governments to create healthy eating contexts, or lobbying provincial and federal governments such as the old age pension and social assistance, so that people can afford healthy foods. With respect to Northern and Aboriginal contexts, the focus should be on negotiating land claims so that people can have their land and access traditional foods in traditional ways.

Another noted that the research findings have implications beyond simply informing the academic literature or even describing food environments. "More collaborative research between academics and health departments is needed, but the most important thing is influencing the food industry. Food choice is complicated and not only an individual's decision. Municipalities could also create more equitable neighbourhoods."

**KEY POINTS**

- Key informants all recognized that food choices are complicated decisions, affected by individual, social, and environmental factors, and that food environments were just one piece of the puzzle.
- Examining food charity in addition to retail food environment features would help create a more comprehensive picture. By focusing only on access to grocery stores, fast food, and convenience stores, we miss important contributions (both negative and positive) that food charities make to the diets of lower-income Canadians.
- Access to nutritious foods is only relevant in the context of adequate purchasing power. For people who lack the income to purchase food, geographic access is irrelevant.
- Context is important, and assessment methods should be refined to reflect context. Specific examples include urban vs. rural food environment assessments, and food environment assessments in northern and remote communities.
- Food environment research should entail collaboration between researchers and community-based practitioners, to maximize both the scientific rigour of the research and the usability of the findings for policy and program development.

## WHAT ARE YOUR STRATEGIES FOR KNOWLEDGE TRANSFER AND EXCHANGE?

### *Relevant stakeholders*

Most of the practitioners considered health regions and public health departments to be relevant stakeholders in food environment assessments. Two thirds identified municipal and regional governments (including food safety, transportation, and urban planning departments) as stakeholders. Half identified non-governmental organizations with a poverty or food security mandate. Three of the practitioners identified food retailers or producers. Researchers most often identified municipal and regional governments and health regions or public health departments (56%). A third identified non-governmental organizations and school boards as key stakeholders.

**KEY POINTS**

- The two most commonly-identified stakeholders in food environment assessment research were health regions or public health departments, and various departments within municipal or regional governments.

## *Using the results of food environment assessments*

The two most commonly-identified uses of food environment assessment findings were policies and programming (six of the practitioners and eight of the researchers). Four practitioners and three researchers identified priorities for action for populations or areas at risk of inadequate food access. Other uses of the assessments included informing city planning practices (two practitioners and one researcher), advocacy (one practitioner and one researcher), informing future research (two practitioners and one researcher), and surveillance or monitoring of food environments (three practitioners).

One researcher suggested taking a political approach to using food environment assessment findings:

> When we think about interventions, it might be important to look at a city councillor—what's their neighbourhood (electoral districts, wards, etc.), what's important to them, how to get them to buy in to what you are doing.

In terms of identifying populations or areas at risk, another key informant noted that her research:

> ... has the ability to directly inform potential programming, identifying communities with a lack of food environment assets or poor dietary behaviour and further contributing the evidence base that the food environment is an important aspect of healthy eating and maintaining health.

Although few researchers and practitioners explicitly identified policy solutions that could result from their work, one practitioner had an explicit outcome in mind:

> The results will be used to inform the municipality to consider food in their planning decisions. It will also inform the [regional] Healthy Eating Working Group of the current situation in [the city], and direct their future work. I would foresee the following: food environment assessment methods used to determine areas of need (e.g., those with poor food access) with continued surveillance over time; determine ratios of healthy food locations (grocery) vs. less healthy food locations (restaurants) and have local government set standards for ratios; programming on how to improve the food environment in retail (e.g., recommendations for best practice); policies relating to zoning bylaws and land use planning (zoning around schools, playgrounds etc.); amend municipal official plans to ensure that healthy food access is included.

Practitioners who reported on community food assessments also tended to report explicit outcomes, although most often the outcomes were not municipal policies. For example, one practitioner reported:

> We're seeing in working with our partners that the findings from the food assessment can be a guide for the actions that they can take on food-related actions, and

> also put together an information base for people who are interested in doing more research or programs. It lends support if they have evidence to back them up. In the [community] assessment: corner stores started stocking healthier food items; there was a grocery shuttle for underserved areas; and a variety of other things are coming out – health standards of foods served in an organizational setting are being developed. We're still working out how we can use the findings in [the other community]…

**KEY POINTS**

- Improving the evidence base for developing policies and programming, and identifying areas or populations at risk of inadequate food access were the most commonly-identified intended uses of the food environment assessments.
- Several researchers and practitioners gave vague responses in terms of the types of programs or policies food environment assessments could facilitate, although some were able to provide explicit anticipated outcomes.
- No key informants identified municipal or regional policies developed as a result of food environment assessments, although several community programs have been developed to facilitate residents' access to nutritious foods.

## *Knowledge translation outputs*

In addition to traditional academic outputs, such as presentations and publications, other knowledge translation outputs were identified by the key informants, including:

- reports (four practitioners and three researchers);
- websites (one practitioner and one researcher);
- meetings with or presentations to stakeholder groups (two practitioners and two researchers);
- peer or community education (three practitioners and five researchers);
- documentary films or media coverage (one practitioner and two researchers); and
- learning guides (three practitioners).

**KEY POINTS**

- Many kinds of knowledge translation strategies are being employed, including some non-traditional ones, such as media coverage and documentary film making.
- All researchers noted at least one type of knowledge translation output other than traditional academic presentations and publications.

## 5.1 SUMMARY OF KEY INFORMANT INTERVIEW FINDINGS

Research linking food environment features to diet and health outcomes increases our understanding of environmental determinants of food choice and dietary behaviours. Although researchers and practitioners generally identified different primary purposes of their food environment assessments, increasing our understanding of how food environments work and in what contexts can help to guide policy-makers who are ready to act on food environments, and help to refine those policies and programs that already exist. There are many interventions already underway, and research should be done to evaluate their impact, which can be done through community-university partnerships. Context-specific evaluations can help to tailor policies and programs for different communities and different population groups within communities. Refining food environment assessment methods is important both for research as well as surveillance, since surveillance is an important part of policy and program evaluation.

# 6. CASE STUDIES

Here we look at three studies of communities with contrasting characteristics: an English-speaking urban area; French-speaking urban and rural areas; and northern and remote communities. In each case, the communities are using innovative approaches to assess and monitor food environments in order to develop or sustain healthy food systems.

## 6.1 REGION OF WATERLOO: THE IMPORTANCE OF A COMMUNITY-UNIVERSITY PARTNERSHIP

The Region of Waterloo is a mid-sized, mainly urban municipality in southern Ontario. The region has a population of 543,900 and includes three urban centres: Kitchener, Cambridge, and Waterloo. It is surrounded by four rural townships. [186]

According to our key informant, a public health planner in the Region:

> [We have] been working on food systems issues for a number of years. We have conducted several baseline research projects including: assessing for existence of food deserts, assessing changes needed in local food production to meet the nutritional needs of our residents, assessment of access to locally produced foods and more. This work has been done to guide our food systems work as a whole. The previous work has also helped us to develop relationships with local food producers, food processors, food retailers, consumers, and land use policy makers.

In 2009, the Regional Council adopted a Regional Official Plan (ROP). This provides a framework for planning in the region. One of the goals of the regional plan is to help create a healthy food

system, one in which "all residents have access to, and can afford to buy, safe, nutritious, and culturally-acceptable food that has been produced in an environmentally sustainable way and that sustains our rural communities." [187] The ROP further aims to provide a mix of land uses (including food outlets) within close proximity to each other to facilitate residents' access to nutritious foods.

While the Regional Council endorsed policies related to supporting healthy food environments, there was a lack of consensus on how to best assess food environments. This presented a challenge to planners, developers, and policymakers. The key informant noted that:

> Locally, there is interest and support from a land use planning and policy perspective to focus on creating good accessibility to healthy foods. If the research can demonstrate a solid link between the quality of food environment and food consumption patterns, there will be greater credibility and more options open to policy development. The specific food assessment measures can then also be included in a food access policy.

In response to this challenge, the NEWPATH project was created. NEWPATH stands for Neighbourhood Environments in Waterloo Region: Patterns of Transportation and Health. [188] It was a multi-disciplinary study led by researchers at the Universities of British Columbia, Alberta, and Waterloo and the Region of Waterloo Public Health Department. The study aimed to characterize associations between objective and subjective aspects of built environments including walkability, transportation patterns (using a 2-day travel diary), physical activity, dietary behaviours, food insecurity, and health outcomes in a population-based sample of just over 4,800 residents.

A separate but related project used nine different food environment measures to comprehensively evaluate geographical food *access*. [15, 121, 162] These were of four types: proximity measures, density measures, diversity measures, and the retail food environment index. The index is a ratio of the number of fast food outlets and convenience stores to the number of grocery stores and specialty stores. Shelf space measures evaluated food *availability* in stores (n=421). [50, 51] The NEMS-S [104] evaluated food *availability*, *quality*, and *affordability* in stores (n=421). The NEMS-R evaluated food *availability*, *affordability*, and barriers and facilitators to healthy eating in restaurants (n=912). Residents' perceptions of their neighbourhood food environments were also collected.

In addition, the NEWPATH project collected diet records over a two-day travel survey as well as self-reported weight, height, and waist circumference. Because the NEWPATH project contains many datasets that are relevant to both diet and physical activity, analyses will go on for the next several years.

Three papers with implications for food environment policy are currently under development. The first examines the construct validity of the food environment measures employed. This will help health practitioners and planners gain a better understanding of how to concretely measure the relevant policies of the Regional Official Plan. [121] The second examines how different features of the food environment are

related to diet quality, BMI, and waist circumference, and whether these associations differ by sex. [162] This will allow public health practitioners to select the food environment assessment tools that best predict the health outcomes of the population. The third examines pathways by which food environment features are associated with diet-related outcomes. This is done by looking at whether food purchasing frequency at different outlet types explains the relationship between food environment features and outcomes of interest. [189] The paper aims to identify possible settings or behaviours that might be amenable to food environment interventions.

The NEWPATH partnership between the region's Public Health Department and academics from a variety of institutions has resulted in public health practitioners having access to comprehensive and nuanced data on both food environments and diet-related outcomes. Researchers believe the NEWPATH data will answer questions pertinent to policy development in the region, including these:

- How does the quality of the food environment around workplaces impact food purchasing and dietary behaviours?
- The region plans to build a rapid transit system over the next few years. [190] Are there different shopping patterns for those who use transit rather than driving? For example, do they make more frequent, smaller shopping trips? If so, what types of food stores are needed in the area to help make public transportation more appealing?
- What are food environments like around schools?

**LESSONS LEARNED:**

- Food environment policies are being adopted in many jurisdictions, regardless of the state of the evidence. Policy makers are increasingly adopting and implementing policies related to food environments ahead of the evidence. This is an important opportunity to evaluate these programs and policies.
- There is a strong need for close partnerships between researchers who are able to measure and analyse food environment features in relation to diet-related outcomes, and practitioners who are able to use the information to help create, refine, or enforce policies that support healthy food environments.

## 6.2 ZONING REGULATIONS IN QUEBEC: THE IMPORTANCE OF CHAMPIONS

The Coalition Québécoise Sur la Problématique du Poids (Quebec Coalition on Weight-Related Problems) is a provincial advocacy group with a mandate "to obtain the required support to make demands for changing legislation, regulations, and public policy in three strategic areas (Agri-Food, Industry, Sociocultural, Built Environment) in order to encourage the development of environments that help in making healthy choices and will contribute to preventing weight-related issues." [191]

In 2009, the Institut national de santé publique du Québec (Public Health Institute of Quebec) published a report, "Le zonage municipal: un outil contribuant à créer un environnement bâti favorable aux saines habitudes alimentaires." [192] The report reviewed zoning regulations in 41 municipalities across Quebec in order to identify elements that can promote access to a healthier food supply. The report found that zoning regulations are neither consistently applied nor specified across municipalities. While zoning regulations are not necessarily intended to improve public health, they could be considered to create a more conducive healthy eating environment. The report recommended improving the nomenclature of food-related land uses to establish an understanding of optimal locations for food shops across Quebec.

A second report by Institute, published in 2010, summarized evidence on the impact of built environment features on body weight. [193] The report recommended ensuring access to food outlets offering a good selection of nutritious, affordable foods, particularly in under-served areas. It also recommended further examination of the location of fast food outlets and other food stores around schools and the ability of regulatory tools to establish a healthier food environment.

A third report from the Institute found that Quebec students had fairly high access to fast food during the school day, and that the proximity of fast food outlets and convenience stores to schools might counter the Province's efforts to implement healthy school food policies. [194]

In this context of support from a provincial public health authority, Coalition Poids has been involved with the Association pour la santé publique du Québec (ASPQ) to work with three municipalities (Baie-Saint-Paul, Lavaltrie, and Gatineau) to identify whether fast food outlets clustered around schools were a cause for concern for decision makers. Maps were developed in each city, and for each school, to determine the number of restaurants accessible to students during their school day. An additional survey was conducted with students in the three cities. The studies sought to identify reasons why students ate at restaurants for lunch during the school day, and to gather their perceptions of fast food access. In each municipality, steering committees were established to provide local leadership, and were comprised of concerned community members.

Although the ultimate goal of the projects in each city was to analyze the feasibility on a legal and political point of view to reduce access to restaurants for school children, the director of Coalition Poids identified the need to work with elected officials to accomplish the project's goals. She observed:

> Our first target was the elected officials, the ones with the power to put zoning in place. If we don't have any public support, they won't put the measures in place. So we had to involve business people, education people, public health people, Quebec En Forme, and community leaders. They were all invited to be part of the committee. A survey was conducted before and after, and it showed that public support was raised.

One of the major challenges identified was the potential legal ramifications for the municipalities of zoning restrictions against fast food outlets, for example. In response, Coalition Poids worked with a municipal lawyer to ensure that all aspects of categorizing very specific land-uses (in order to restrict certain land uses or to create incentives for other land uses) fell within a legal framework. In addition, they conducted a legal review of a number of countries where municipalities have used zoning regulations to change food environments. The review found that municipalities vary in terms of reasons for restricting fast food: most did so to protect their heritage or to promote local economic diversity. Only a handful did so explicitly for public health reasons. Actual zoning regulations implemented also varied. Some municipalities explicitly prohibited drive-thrus, or prohibited land use categories of restaurant or fast-food by zone. Some imposed quotas for a maximum area, or by distance from a school or park. The report concluded that defining and then restricting unhealthy food outlets was both legal and a potentially effective public health initiative.

The director of Coalition Poids also noted the importance of having a community leader as a champion of the zoning regulation in order to keep moving the policies forward as staff turns over. She cited the example of a clear champion from one of the municipalities who changed jobs mid-project and moved to another city. The previous champion's replacement was less supportive, so another champion was sought. In another municipality, a city staff member was able to influence newly elected councillors to see the value of the project, which helped created buy-in. In the third municipality, "… the mayor was the champion from the beginning. During a municipal conference in Quebec City, the mayor … was in the media more than anyone else. He became a real champion for the project." These experiences serve to illustrate the point that with staff turnover come new people who may not see the same value in the work. It is important to make connections with potential champions, to present the benefits of the work, and to be flexible.

The process of adopting regulations is a long one, and although the process is underway in several jurisdictions, zoning regulations restricting access to fast food or convenience stores around schools have not yet been adopted. The director and her colleagues from ASPQ have been disseminating their findings through presentations at academic conferences, through their website, through a Chronic Disease Prevention Alliance of Canada webinar, and through presentations to the Municipal Affairs Minister, municipal organizations and various municipalities. A guide, "The school zone and nutrition: courses of action for the municipal sector" has been published in both English and French. It makes the case for municipal zoning regulations and provides guidance on how to begin the process. [195]

As regulations are adopted, the director identified several questions that still remain:

- How do the zoning regulations change students' behaviour at lunch time? Do these regulations actually result in healthier diets throughout the school day?
- How will municipal leaders' support for zoning regulations change over time?

**LESSONS LEARNED:**

- It is important to use research to understand the context of the municipalities where zoning regulations are being proposed, and to determine the public support for such regulations.
- Zoning regulations for fast food and convenience stores can be adopted under several mandates, including family policies, improving economic diversity, healthy living, and community wellness. Public health is not the only mandate under which zoning regulations can fall.
- Legal implications of zoning interventions to improve food environments (by either creating incentives for healthy food outlets or restricting unhealthy food outlets) need to be carefully considered.
- Champions matter: community leaders' support of zoning regulations can make or break the success of the implementation.

## 6.3 FOOD ACCESS IN NUNAVUT: THE IMPORTANCE OF CONTEXT

Nunavut is Canada's geographically largest and least-populated territory. It is home to about 32,000 people in 25 fly-in only communities. [196] There are very high rates of food insecurity among Inuit, with 70% of Inuit preschoolers living in food-insecure households. [156] This has been identified as a major priority for the Department of Health and Social Services, the federal government, and Nunavut Tunngavik Inc (NTI), an organization that coordinates and manages Inuit and federal and territorial government responsibilities set out in the Nunavut Land Claims Agreement. [197]

Nutrition North Canada seeks to improve access to perishable nutritious foods in isolated northern communities by providing a subsidy for healthy fresh and frozen foods that need to be flown into communities. [49] Nutrition North collects information on the types and amounts of products that receive a subsidy under the program. The information comes from retailers and suppliers who are registered with the program and is available at **www.nutritionnorthcanada.gc.ca**.

One key informant was a Territorial Public Health Nutritionist working in the Department of Health and Social Services in Nunavut. She is responsible for nutrition policy and programming in the territory. She and her colleagues have developed a project in partnership with stores in Nunavut to promote 10 recipes

for culturally acceptable, nutritious meals throughout the year. During the promotions, ingredients in the recipes will go on sale, the recipes will be promoted, and recipe cards will be available in the stores. These will show very explicitly how to prepare the recipes.

According to our key informant, for Inuit, changing food environments by increasing nutritious food availability or by reducing the cost, will only help to support healthy diets if food skills are also addressed. She observed:

> The big issue here is that there isn't a cultural heritage regarding how to prepare store-bought foods. People have developed huge preference for things that are easy to prepare because they do not have a sense of preparing basic foods.

She explained the complexity of food security and the relevance of food environment features to food security:

> I am thinking about food security, compared to other Canadian and cultural environments, where you assume that everyone knows food-related skills. It's an underlying assumption that we make. I don't know how to measure food-related skills here, but it's not the case that people in Nunavut have the same food skills that people in the rest of the country have. In Nunavut, people assume that the dietary habits are a problem because of the high cost. But I don't think that's the case. I think it's because the food-skills are so low. With the food mail pilot project, for example, they made a list of healthy foods cheaper, but did not find any differences in the outcomes. They repeated the project for nine years, and the average woman consumed $93 worth of food, $30 worth of pop, and less than $5 on promoted foods. Everyone assumes that people just need more access. But it seems to me to be more related to food skills than cost or access. This is why we are trying to work with retailers in a way that is related to skills, but include cost and availability considerations. Knowing how to do something and the frequency of exercising that ability are both important. I also think cultural values are important. People aren't necessarily focused on optimizing nutrition intake. People are dealing with a lot of other social issues, they are focused on surviving and are not necessarily coping that well. Crowded housing also doesn't help. Buying in bulk is a disincentive because so many people live in the same house, so buying healthy foods in bulk doesn't necessarily mean that you will increase your own fruit and vegetable intake. People make choices differently in this environment. The cost alone doesn't determine people's food choices.

She also observed that several potentially relevant food environment interventions are not being evaluated. "Currently, we have more interventions rather than evaluations." One example is country food markets, which are markets where hunters can generate income by selling country foods, and communities can have increased access to nutritious country foods. Because country food initiatives are funded by Economic Development and Transportation department, initiatives are not being rigorously assessed with respect to health outcomes, because improving health outcomes is not one of their mandates.

The key informant and her colleagues are in the process of developing a Food Security Strategy that will include a comprehensive evaluation framework, including food skills, access to country foods, and whether food security changes as a result of the interventions identified. While she recognized obesity and chronic diseases as common among Inuit, she maintained that addressing food security was the first priority.

Another key informant, an Associate Professor in the Indigenous Environmental Studies Program and Co-Director of the Nasivvik Centre for Inuit Health and Changing Environments at Trent University, agreed that food security should be the main priority of food environment assessments and interventions in Inuit communities. He stressed the complexity of food insecurity, and noted, "Just putting good food in communities and making it cheap is not going to change people's diets."

The key informant works in Inuit communities in Northern Labrador and Northern Quebec, and his main focus is on understanding food security in the context of Inuit communities, both in terms of country foods and in terms of coping with food insecurity in Inuit communities. Engaging in research related to availability of traditional foods has required him to partner with wildlife researchers to understand population models of traditional food sources, such as caribou herds and schools of Arctic char. He is also learning about wildlife health issues such as zoonotic diseases or parasite loads. He has conducted qualitative interviews with hunters and elders in the communities to find out about the distribution of country foods and about perceptions of accessibility and availability of wildlife. The key informant is interested in food sharing practices among Inuit households and in the use of community freezers.

**LESSONS LEARNED:**

- Programs that could improve food environments are not necessarily being evaluated with respect to health outcomes, since evaluations depend on the funders' mandates.
- In the context of northern and remote communities, the population may not have the same level of food skills, and other priorities may trump eating a healthy diet.
- Food environment measures that may be valid in urban areas may not be valid in northern and remote communities.

# REFERENCES


1 Powell LM, Slater S, Mirtcheva D, Bao Y, Chaloupka FJ. Food store availability and neighborhood characteristics in the United States. Preventive Medicine. 2007;44(3):189–195.

2 Larson NI, Story MT, Nelson MC. Neighborhood environments: disparities in access to healthy foods in the U.S. American Journal of Preventive Medicine. 2009;36(1):74–81.

3 Walker RE, Keane CR, Burke JG. Disparities and access to healthy food in the United States: a review of food deserts literature. Health & Place. 2010;16(5):876–884.

4 Beaulac J, Kristjansson E, Cummins S. A systematic review of food deserts, 1996–2007. Preventing Chronic Disease. 2009;6(3):A105.

5 Kamphuis CBM, Giskes K, de Bruijn GJ, Wendel-Vos W, Brug J, van Lenthe FJ. Environmental determinants of fruit and vegetable consumption among adults: a systematic review. British Journal of Nutrition. 2006;96(4):620–635.

6 Papas MA, Alberg AJ, Ewing R, Helzlsouer KJ, Gary TL, Klassen AC. The built environment and obesity. Epidemiological Reviews. 2007;29:129–143.

7 Van der Horst K, Oenema A, Ferreira I, Wendel-Vos W, Giskes K, van Lenthe F, et al. A systematic review of environmental correlates of obesity-related dietary behaviors in youth. Health Education Research. 2007;22(2):203–226.

8 Black JL, Macinko J. Neighborhoods and obesity. Nutrition Reviews. 2008;66(1):2–20.

9 Holsten JE. Obesity and the community food environment: a systematic review. Public Health Nutrition. 2009;12:1–9.

10 Feng J, Glass TA, Curriero FC, Stewart WF, Schwartz BS. The built environment and obesity: a systematic review of the epidemiologic evidence. Health & Place. 2010;16:175–190.

11 Giskes K, van Lenthe F, Avendano-Pabon M, Brug J. A systematic review of environmental factors and obesogenic dietary intakes among adults: are we getting closer to understanding obesogenic environments? Obesity Reviews. 2011;12:e95–e106.

12 de Vet E, de Ridder DTD, de Wit JBF. Environmental correlates of physical activity and dietary behaviours among young people: a systematic review of reviews. Obesity Reviews. 2011;12(e130–e142).

13 Sturm R, Cohen DA. Zoning for health? The year-old ban on new fast-food restaurants in south LA. Health Affairs. 2009;28(6):W1088–W1097.

14 Desjardins E, Lubczynski J, Xuereb M. Incorporating policies for a healthy food system into land use planning: the case of Waterloo region, Canada. Journal of Agriculture, Food Systems, and Community Development. 2011;2(1):127–140.

[15] Minaker L, Fisher P, Raine KD, Frank LD. Measuring the food environment: from theory to planning practice. Journal of Agriculture, Food Systems, and Community Development. 2011;2(1):1–18.

[16] Brambila-Macias J, Shankar B, Capacci S, Mazzocchi M, Perez-Cueto FJA, Verbeke W, et al. Policy interventions to promote healthy eating: a review of what works, what does not, and what is promising. Food and Nutrition Bulletin. 2011;32(4):365–375.

[17] Fleischhacker SE, Evenson KR, Rodriguez A, Ammerman AS. A systematic review of fast food access studies. Obesity Reviews. 2011;12:e460–e471.

[18] Casey R, Oppert JM, Weber C, Charreire H, Salze P, Badariotti D, et al. Objective measurements of built environment and weight status of children and adolescents: a review of literature. Cahiers de Nutrition et de Diététique. 2011;46(3):120–129.

[19] Casey R, Oppert JM, Weber C, Charreire H, Salze P, Badariotti D, et al. Determinants of childhood obesity: what can we learn from built environment studies? Food Quality and Preference. 2011;In Press. Available from **www.sciencedirect.com/science/article/pii/S0950329311000991**

[20] White M. Food access and obesity. Obesity Reviews. 2007;8:99–107.

[21] Raine K, Spence JC, Church J, Boule N, Slater L, Marko J, et al. State of the evidence review on urban health and healthy weights. Ottawa: Canadian Institute for Health Information (CIHI); 2008.

[22] Larson N, Story M. A review of environmental influences on food choices. Annals of Behavioral Medicine. 2009;38:S56–S73.

[23] Richter KP, Harris KJ, Paine-Andrews A, Fawcett SB, Schmid TL, Lankenau B, et al. Measuring the health environment for physical activity and nutrition among youth: a review of the literature and applications for community initiatives. Preventive Medicine. 2000;31:S98–S111.

[24] McKinnon RA, Reedy J, Morrisette MA, Lytle LA, Yaroch AL. Measures of the food environment: a compilation of the literature,1990–2007. American Journal of Preventive Medicine.2009;36(4S):S124–S133.

[25] Kelly B, Flood VM, Yeatman H. Measuring local food environments: an overview of available methods and measures. Health & Place. 2011;17:1284–1293.

[26] Nestle M, Wing R, Birch L, DiSogra L, Drewnowski A, Middleton S, et al. Behavioral and social influences on food choice. Nutrition Reviews. 1998;56(S50–S74).

[27] Baranowski T, Cullen KW, Baranowski J. Psychosocial correlates of dietary intake: advancing dietary intervention. Annual Review of Nutrition. 1999;19:17–40.

[28] Crawford R. Individual responsibility and health politics in the 1970s. In: Reverby S, Rosner D, editors. Health Care in America: Essays in Social History. Philadelphia: Temple University Press; 1979.

[29] Garner DM, Wooley SC. Confronting the failure of behavioral and dietary treatments for obesity. Clinical Psychology Review. 1991;11(6):729–780.

[30] Glanz K, Sallis JF, Saelens BE, Frank LD. Healthy nutrition environments: concepts and measures. American Journal of Health Promotion. 2005;19(5):330–333.

[31] Richard L, Gauvin L, Raine KD. Ecological models revisited: their uses and evolution in health promotion over two decades. Annual Review of Public Health. 2011;32:307–326.

[32] Minaker L, Raine K, Wild C, Nykiforuk CIJ. Food environments: theory, evidence, and future directions. Obesity Reviews. Submitted.

[33] Robinson T. Applying the socio-ecological model to improving fruit and vegetable intake among low-income African Americans. Journal of Community Health. 2008;33:395–406.

[34] Green L, Richard L, Potvin L. Ecological foundations for health promotion. American Journal of Health Promotion. 1996;10:270–281.

[35] McLeroy K, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. Health Education Quarterly. 1988;15(4):351–377.

[36] Booth SL, Sallis JF, Ritenbaugh C, Hill JO, Birch LL, Frank LD, et al. Environmental and societal factors affect food choice and physical activity: rationale, influences, and leverage points. Nutrition Reviews. 2001;59:S21–S39.

[37] French SA, Story M, Jeffery RW. Environmental influences on eating and physical activity. Annual Review of Public Health. 2001;22:309–335.

[38] Kumanyika S, Jeffery RW, Morabia A, Ritenbaugh C, Antipatis VJ. Obesity prevention: the case for action. International Journal of Obesity. 2002;26(3):425–436.

[39] Kumanyika SK, Obarzanek E, Stettler N, Bell R, Field AE, Fortmann SP, et al. Population-based prevention of obesity: the need for comprehensive promotion of healthful eating, physical activity, and energy balance – a scientific statement from American heart association council on epidemiology and prevention, interdisciplinary committee for prevention (formerly the expert panel on population and prevention science). Circulation. 2008;118(4):428–464.

[40] Story M, Kaphingst KM, Robinson-O'Brien R, Glanz K. Creating healthy food and eating environments: policy and environmental approaches. Annual Review of Public Health. 2008;29:253–272.

[41] Raine KD. Determinants of healthy eating in Canada: an overview and synthesis. Canadian Journal of Public Health. 2005;96:S8–S14.

[42] Sallis JF, Glanz K. Physical activity and food environments: solutions to the obesity epidemic. The Milbank Quarterly. 2009;87:123–154.

[43] Lytle LA. Measuring the food environment: state of the science. American Journal of Preventive Medicine. 2009;36(4S):S134–s144.

[44] Hill JO, Peters JC. Environmental contributions to the obesity epidemic. Science. 1998;280:1371–1374.

[45] Faulkner GEJ, Grootendorst P, Nguyen VH, Andreyeva T, Arbour-Nicitopoulos K, Auld MC, et al. Economic instruments for obesity prevention: results of a scoping review and modified Delphi survey. International Journal of Behavioral Nutrition and Physical Activity. 2011;8:109.

[46] Lee JH, Ralston RA, Truby H. Influence of food cost on diet quality and risk factors for chronic disease: a systematic review. Nutrition & Dietetics. 2011;68:248–261.

[47] Cerin E, Frank LD, Sallis JF, Saelens BE, Conway TL, Chapman J, et al. From neighborhood design and food options to residents' weight status. Appetite. 2011;56:693–703.

[48] White M, Bunting J, Raybould S, Adamson A, Williams E, Mathers J. Do food deserts exist? a multilevel geographical analysis of the relationship between retail food access, socioeconomic position and dietary intake. Newcastle upon Tyne: Newcastle University; 2004.

[49] Nutrition North Canada. [Internet]. About the program. [cited 2012 June 20]. Available from **http://nutritionnorthcanada.ca/abt/index-eng.asp**

[50] Farley TA, Rice J, Bodor JN, Cohen DA, Bluthenthal RN, Rose D. Measuring the food environment: shelf space of fruits, vegetables, and snack foods in stores. Journal of Urban Health-Bulletin of the New York Academy of Medicine. 2009;86(5):672–682.

[51] Rose D, Hutchinson PL, Bodor JN, Swalm CM, Farley TA, Cohen DA, et al. Neighborhood food environments and body mass index: the importance of in-store contents. American Journal of Preventive Medicine. 2009;37(3):214–219.

[52] Moore LV, Roux AVD, Nettleton JA, Jacobs DR. Associations of the local food environment with diet quality – a comparison of assessments based on surveys and geographic information systems. American Journal of Epidemiology. 2008;167(8):917–924.

[53] Giskes K, van Lenthe F, Brug J, Mackenbach JP, Turrell G. Socioeconomic inequalities in food purchasing: the contribution of respondent-perceived and actual (objectively measured) price and availability of foods. Preventive Medicine. 2007;45:41–48.

[54] Moore LV, Diez-Roux A, Franco M. Measuring availability of healthy foods: agreement between directly measured and self-reported data. American Journal of Epidemiology. 2012;175(10):1037–1044.

[55] Moore LV, Roux AVD, Brines S. Comparing perception-based and geographic information system (GIS)-based characterizations of the local food environment. Journal of Urban Health-Bulletin of the New York Academy of Medicine. 2008;85(2):206–216.

[56] Freedman DA, Bell BA. Access to healthful foods among an urban food insecure population: perceptions versus reality. Journal of Urban Health. 2009;86(6):825–838.

[57] Ohri-Vachaspati P, Leviton LC. Measuring food environments: a guide to available instruments. American Journal of Health Promotion. 2010;24(6):410–426.

[58] Larsen K, Gilliland J. Mapping the evolution of 'food deserts' in a Canadian city: supermarket accessibility in London, Ontario, 1961–2005. International Journal of Health Geographics. 2008;7:16.

[59] Sharkey JR, Horel S. Neighborhood socioeconomic deprivation and minority composition are associated with better potential spatial access to the ground-truthed food environment in a large rural area. Journal of Nutrition. 2008;138(3):620–627.

[60] Apparicio P, Cloutier MS, Shearmur R. The case of Montreal's missing food deserts: evaluation of accessibility to food supermarkets. International Journal of Health Geographics. 2007;6:4.

[61] Zenk SN, Schulz AJ, Israel BA, James SA, Bao SM, Wilson ML. Neighborhood racial composition, neighborhood poverty, and the spatial accessibility of supermarkets in metropolitan Detroit. American Journal of Public Health. 2005;95(4):660–667.

[62] Inagami S, Cohen DA, Brown AF, Asch SM. Body Mass Index, neighborhood fast food and restaurant concentration, and car ownership. Journal of Urban Health-Bulletin of the New York Academy of Medicine. 2009;86(5):683–695.

[63] Spence JC, Cutumisu N, Edwards J, Raine KD, Smoyer-Tomic K. Relation between local food environments and obesity among adults. BMC Public Health. 2009;9:192.

[64] Moore LV, Roux AVD. Associations of neighborhood characteristics with the location and type of food stores. American Journal of Public Health. 2006;96(2):325–331.

[65] Morland KB, Evenson KR. Obesity prevalence and the local food environment. Health & Place. 2009;15(2):491–495.

[66] Andreyeva T, Blumenthal DM, Schwartz MB, Long MW, Brownell KD. Availability and prices of foods across stores and neighborhoods: the case of New Haven, Connecticut. Health Affairs. 2008;27(5):1381–1388.

[67] Block D, Kouba J. A comparison of the availability and affordability of a market basket in two communities in the Chicago area. Public Health Nutrition. 2006;9:837–845.

[68] Bodor JN, Rose D, Farley TA, Swalm C, Scott SK. Neighbourhood fruit and vegetable availability and consumption: the role of small food stores in an urban environment. Public Health Nutrition. 2008;11(4):413–420.

[69] Gantner LA, Olson CM, Frongillo EA, Wells NM. Prevalence of nontraditional food stores and distance to healthy foods in a rural food environment. Journal of Hunger and Environmental Nutrition. 2011;6(3):279–293.

[70] Forsyth A, Lytle LA, Van Riper D. Finding food: issues and challenges in using geographic information systems to measure food access. The Journal of Transport and Land Use. 2010;3(1):43–65.

[71] Baker EA, Schootman M, Barnidge E. The role of race and poverty in access to foods that enable individuals to adhere to dietary guidelines. Preventive Chronic Disease. 2006;3(3):A76.

[72] Horowitz CR, Colson KA, Hebert PL, Lancaster K. Barriers to buying healthy foods for people with diabetes: evidence of environmental disparities. American Journal of Public Health. 2004;94(9):1549–1554.

[73] Cummins S, Macintyre S. Food environments and obesity – neighbourhood or nation? International Journal of Epidemiology. 2006;35:100–104.

[74] Burns CM, Bentley R, Thornton L, Kavanagh A. Reduced food access due to a lack of money, inability to life and lack of access to a car for food shopping: a multilevel study in Melbourne. Public Health Nutrition. 2011;14(6):1017–1023.

[75] Coveney J, O'Dwyer LA. Effects of mobility and location on food access. Health & Place. 2009;15(1):45–55.

[76] Rahman T, Cushing RA, Jackson RJ. Contributions of built environment to childhood obesity. Mount Sinai Journal of Medicine. 2011;78(1):49–57.

[77] Zenk SN, Schulz AJ, Hollis-Neely T, Campbell RT, Holmes N, Watkins G, et al. Fruit and vegetable intake in African Americans – income and store characteristics. American Journal of Preventive Medicine. 2005;29(1):1–9.

[78] Boone-Heinonen J, Gordon-Larsen P, Kiefe CI, Shikany JM, Lewis CE, Popkin BM. Fast food restaurants and food stores. Longitudinal associations with diet in young to middle-aged adults: the CARDIA study. Archives of Internal Medicine. 2011;171(13):1162–1170.

[79] Richardson AS, Boone-Heinonen J, Popkin BM, Gordon-Larsen P. Neighborhood fast food restaurants and fast food consumption: a national study. BMC Public Health. 2011;11(1):543.

[80] Gibson DM. The neighborhood food environment and adult weight status: estimates from longitudinal data. American Journal of Public Health. 2011;101(1):71–78.

[81] Block JP, Christakis NA, O'Malley AJ, Subramanian SV. Proximity to food establishments and body mass index in the Framingham heart study offspring cohort over 30 years. American Journal of Epidemiology. 2011;174(10):1108–1114.

[82] Lee H. The role of local food availability in explaining obesity risk among young school-aged children. Social Science & Medicine. 2012;Feb 10 (Epub ahead of print).

[83] Gittelsohn J, Sharma S. Physical, consumer, and social aspects of measuring the food environment among diverse low-income populations. American Journal of Preventive Medicine. 2009;36(4 Suppl): S161–S165.

[84] Odoms-Young A, Zenk SN, Mason M. Measuring food availability and access in African-American communities: implications for intervention and policy. American Journal of Preventive Medicine. 2009;36(4S):S145–S150.

[85] Slater J, Green CG, Sevenhuysen G, Edginton B, O'Neil J, Heasman M. The growing Canadian energy gap: more the can than the couch? Public Health Nutrition. 2009;12(11):2216–2224.

[86] Gordon C, Purciel-Hill M, Ghai NR, Kaufman L, Graham R, Van Wye G. Measuring food deserts in New York City's low-income neighborhoods. Health & Place. 2011;17(2):696–700.

[87] Franco M, Diez Roux AV, Glass TA, Caballero B, Brancati FL. Neighborhood characteristics and availability of healthy foods in Baltimore. American Journal of Preventive Medicine. 2008;35(6):561–567.

[88] Zenk SN, Schulz AJ, Israel BA, James SA, Bao SM, Wilson ML. Fruit and vegetable access differs by community racial composition and socioeconomic position in Detroit, Michigan. Ethnicity & Disease. 2006;16(1):275–280.

[89] Franco M, Diez-Roux AV, Nettleton JA, Lazo M, Brancati F, Caballero B, et al. Availability of healthy foods and dietary patterns: the multi-ethnic study of atherosclerosis. American Journal of Clinical Nutrition. 2009;89(3):897–904.

[90] Izumi BT, Zenk SN, Schultz AJ, Mentz GB, Wilson C. Associations between neighborhood availability and individual consumption of dark-green and orange vegetables among ethnically diverse adults in Detroit. Journal of the American Dietetic Association. 2011;111:274–279.

[91] Casagrande SS, Franco M, Gittelsohn J, Zonderman AB, Evans MK, Kuczmarski MF, et al. Healthy food availability and the association with BMI in Baltimore, Maryland. Public Health Nutrition. 2011;14(6):1001–1007.

[92] Dachner N, Ricciuto L, Kirkpatrick SI, Tarasuk V. Food purchasing and food insecurity among low-income families in Toronto. Canadian Journal of Dietetic Practice and Research. 2010;71(3):e50–e56.

[93] Drewnowski A, Darmon N. The economics of obesity: dietary energy density and energy cost. American Journal of Clinical Nutrition. 2005;82(S1):S265–S273.

[94] Drewnowski A, Darmon N. Food choices and diet costs: an economic analysis. Journal of Nutrition. 2005;135(4):900–904.

[95] Carlson A, Frazao E. [Internet]. Are healthy foods really more expensive? It depends on how you measure the price. [cited 2012 September 20]. United States Department of Agriculture, Economic Research Service; 2012. Available from **www.ers.usda.gov/publications/eib-economic-information-bulletin/eib96.aspx**

[96] Hatfield M, Pyper W, Gustajtis B. [Internet]. First comprehensive review of the market basket measure of low income. [cited 2012 Nov 15]. Available from **http://publications.gc.ca/site/eng/372293/publication.html**

[97] Todd J, Leibtag E, Penberthy C. [Internet]. Geographic differences in the relative price of healthy foods: United States Department of Agriculture. [cited 2012 September 20]. Available from **www.ers.usda.gov/publications/eib-economic-information-bulletin/eib78.aspx**

[98] French SA. Pricing effects on food choices. Journal of Nutrition. 2003;133(3):841S-843S.

[99] French SA, Harnack L, Jeffery RW. Fast food restaurant use among women in the Pound of Prevention study: dietary, behavioral and demographic correlates. International Journal of Obesity. 2000;24(10):1353–1359.

[100] French SA, Jeffery RW, Story M, Breitlow KK, Baxter J, Hannan PJ, et al. Pricing and promotion effects on low-fat vending snack purchases: the CHIPS study. American Journal of Public Health. 2001;91(1):112–117.

[101] Jeffery RW, French SA, Raether C, Baxter JE. An environmental intervention to increase fruit and salad purchases in a cafeteria. Preventive Medicine. 1994;23(6):788–792.

[102] Crockett EG, Clancy KL, Bowering J. Comparing the cost of a Thrifty Food Plan market basket in three areas of New York State. Journal of Nutrition Education. 1992;24:71–78.

[103] McDonald JM, Nelson PE. Do the poor still pay more? Food price variations in large metropolitan areas. Journal of Urban Economics. 1991;30:344–359.

[104] Glanz K, Sallis JF, Saelens BE, Frank LD. Nutrition Environment Measures Survey in Stores (NEMS-S): development and evaluation. American Journal of Preventive Medicine. 2007;32(4):282–289.

[105] Cummins S, Macintyre S. A systematic study of an urban foodscape: the price and availability of food in greater Glasgow. Urban Studies. 2002;39:2115–2130.

[106] Winkler E, Turrell G, Patterson C. Does living in a disadvantaged area entail limited opportunities to purchase fresh fruit and vegetables in terms of price, availability, and variety? Findings from the Brisbane Food Study. Health & Place. 2006;12(4):741–748.

[107] Cassady D, Jetter KM, Culp J. Is price a barrier to eating more fruits and vegetables for low-income families? Journal of the American Dietetic Association. 2007;107(11):1909–1915.

[108] Ball K, Timperio A, Crawford D. Neighbourhood socioeconomic inequalities in food access and affordability. Health & Place. 2009;15:578–585.

[109] Sturm R, Datar A. Food prices and weight gain during elementary school: 5-year update. Public Health. 2008;122(11):1140–1143.

[110] Beydoun MA, Powell LM, Chen X, Wang Y. Food prices are associated with dietary quality, fast food consumption, and body mass index among U.S. children and adolescents. The Journal of Nutrition. 2011;141:304–311.

[111] Gordon-Larsen P, Guilkey DK, Popkin BM. An economic analysis of community-level fast food prices and individual-level fast food intake: a longitudinal study. Health and Place. 2011;17(6):1235–1241.

[112] Cummins S, Smith DM, Taylor M, Dawson J, Marshall D, Sparks L, et al. Variations in fresh fruit and vegetable quality by store type, urban-rural setting and neighbourhood deprivation in Scotland. Public Health Nutrition. 2009;12(11):2044–2050.

[113] Zenk SN, Odoms-Young AM, Dallas C, Hardy E, Watkins A, Hoskins-Wroten J, et al. You have to hunt for the fruits, the vegetables: environmental barriers and adaptive strategies to acquire food in a low-income African American neighborhood. Health Education & Behavior. 2011;38(3):282–292.

[114] Sloane DC, Diamant AL, Lewis LB, Yancey AK, Flynn G, Nascimento LM, et al. Improving the nutritional resource environment for healthy living through community-based participatory research. Journal of General Internal Medicine. 2003;18:568–575.

[115] Sooman A, Macintyre S, Anderson A. Scotland's health – a more difficult challenge for some? The price and availaiblity of healthy foods in socially constrasting localities in the west of Scotland. Health Bulletin. 1993;51:276–284.

[116] Giskes K, van Lenthe F, Kamphuis CBM, Huisman M, Brug J, Mackenbach JP. Household and food shopping environments: do they play a role in socioeconomic inequalities in fruit and vegetable consumption? A multilevel study among Dutch adults. Journal of Epidemiology and Community Health. 2009;63:113–120.

[117] Inglis V, Ball K, Crawford D. Socioeconomic variations in women's diets: what is the role of perceptions of the local food environment? (vol 62, pg 191, 2008). Journal of Epidemiology and Community Health. 2008;62(4):376–376.

[118] Brug J, van Lenthe F, Kremers S. Revisiting Kurt Lewin: how to gain insight into environmental correlates of obesogenic behaviors. American Journal of Preventive Medicine. 2006;31:525–529.

[119] Ball K, Timperio A, Crawford D. Understanding environmental influences on nutrition and physical activity behaviors: where should we look and what should we count? International Journal of Behavioral Nutrition and Physical Activity. 2006;3(33):1479–1486.

[120] Cummins S. Neighbourhood food environment and diet - time for improved conceptual models? Preventive Medicine. 2007;44(3):196–197.

[121] Minaker L, Raine K, Wild TC, Nykiforuk CIJ, Thompson M. Construct validation of four food environment assessment methods: adapting a multitrait-multimethod matrix approach for environmental measures. American Journal of Preventive Medicine. Submitted.

[122] Gustafson AA, Sharkey J, Samuel-Hodge CD, Jones-Smith J, Folds MC, Cai J, et al. Perceived and objective measures of the food store environment and the association with weight and diet among low-income women in North Carolina. Public Health Nutrition. 2011;14(6):1032–1038.

[123] Williams LK, Thornton L, Ball K, Crawford D. Is the objective food environment associated with perceptions of the food environment? Public Health Nutrition. 2011;15(2):291–298.

[124] Zenk SN, Lachance LL, Schultz AJ, Mentz G, Kannan S, Ridella W. Neighborhood retail food environment and fruit and vegetable intake in a multiethnic urban population. American Journal of Health Promotion. 2009;23(4):255–264.

[125] Zenk SN, Schultz AJ, Lachance LL, Mentz G, Kannan S, Ridella W, et al. Multilevel correlates of satisfaction with neighborhood availability of fresh fruits and vegetables. Annals of Behavioral Medicine. 2009;38(48–59).

[126] Caldwell EM, Kobayashi MM, DuBow WM, Wytinck SM. Perceived access to fruits and vegetables associated with increased consumption. Public Health Nutrition. 2009;12(10):1743–1750.

[127] Ho SY, Wong BYM, Lo WS, Mak KK, Thomas GN, Lam TH. Neighbourhood food environment and dietary intakes in adolescents: sex and perceived family affluence as moderators. International Journal of Pediatric Obesity. 2010;5(5):420–427.

[128] Hearst MO, Pasch KE, Laska MN. Urban v. suburban perceptions of the neighbourhood food environment as correlates of adolescent food purchasing. Public Health Nutrition. 2011;15(2):299–306.

[129] Garriguet D. [Internet]. Diet quality in Canada. [cited 2012 September 16]. Available from **www.statcan.gc.ca/pub/82-003-x/2009003/article/10914-eng.htm**

[130] Macintyre S. Deprivation amplification revisited; or, is it always true that poorer places have poorer access to resources for healthy diets and physical activity? International Journal of Behavioral Nutrition and Physical Activity. 2007;4:32–39.

[131] Kirkpatrick SI, Tarasuk V. Assessing the relevance of neighbourhood characteristics to the household food security of low-income Toronto families. Public Health Nutrition. 2010;13(7):1139–1148.

[132] Fielding JE, Simon PA. Food deserts or food swamps? Archives of Internal Medicine. 2011;171(13):1171–1172.

[133] Latham J, Moffat T. Determinants of variation in food cost and availability in two socioeconomically contrasting neighbourhoods of Hamilton, Ontario, Canada. Health & Place. 2007;13(1):273–287.

[134] Peters EJ, McCreary TA. Poor neighbourhoods and the changing geography of food retailing in Saskatoon, Saskatchewan, 1984–2004. Canadian Journal of Urban Research. 2008;17(1):78–106.

[135] Daniel M, Kestens Y, Paquet C. Demographic and urban form correlates of healthful and unhealthful food availability in Montreal, Canada. Canadian Journal of Public Health. 2009;100(3):189–193.

[136] Bertrand L, Thérien F, Cloutier MS. Measuring and mapping disparities in access to fresh fruits and vegetables in Montreal. Canadian Journal of Public Health. 2008;99(1):6–11.

[137] Páez A, Mercado RG, Farber S, Morency C, Roorda M. Relative accessibility deprivation indicators for urban settings: definitions and application to food deserts in Montreal. Urban Studies. 2010;47(7):1415–1438.

[138] Pouliot N, Hamelin AM. Disparities in fruit and vegetable supply: a potential health concern in the greater Québec City area. Public Health Nutrition. 2009;12(11):2051–2059.

[139] Smoyer-Tomic KE, Spence JC, Amrhein C. Food deserts in the prairies? Supermarket accessibility and neighborhood need in Edmonton, Canada. Professional Geographer. 2006;58(3):307–326.

[140] Smoyer-Tomic KE, Spence JC, Raine KD, Amrhein C, Cameron N, Yasenovskiy V, et al. The association between neighborhood socioeconomic status and exposure to supermarkets and fast food outlets. Health & Place. 2008;14(4):740–754.

[141] Black JL, Carpiano RM, Fleming S, Lauster N. Exploring the distribution of food stores in British Columbia: associations with neighbourhood sociodemographic factors and urban form. Health & Place. 2011;17(4):961–970.

[142] Sadler RC, Gilliland JA, Arku G. An application of the edge effect in measuring accessibility to multiple food retailer types in Southwestern Ontario, Canada. International Journal of Health Geographics. 2011;10.

[143] Kestens Y, Daniel M. Social inequalities in food exposure around schools in an urban area. American Journal of Preventive Medicine. 2010;39(1):33–40.

[144] Travers KD, Cogdon A, McDonald W, Wright C, Anderson B, MacLean DR. Availability and cost of heart healthy diet changes in Nova Scotia. Journal of the Canadian Dietary Association. 1997;58(4):176–183.

[145] Hemphill E, Raine K, Spence JC, Smoyer-Tomic KE. Exploring obesogenic food environments in Edmonton, Canada: the association between socioeconomic factors and fast-food outlet access. American Journal of Health Promotion. 2008;22(6):426–432.

[146] Jones J, Terashima M, Rainham D. Fast food and deprivation in Nova Scotia. Canadian Journal of Public Health. 2009;100(1):32–35.

[147] Human Resources and Skills Development Canada. [Internet]. Canadians in context – geographic distribution. [cited 2011 July 13]. Available from **www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=34**

[148] Dean WR, Sharkey JR. Rural and urban differences in the associations between characteristics of the community food environment and fruit and vegetable intake. Journal of Nutrition Education and Behavior. 2011;43(6):426–433.

[149] Lawn J, Robbins H, Hill F. Food affordability in air stage communities. International Journal of Circumpolar Health. 1998;57(Suppl 1):182–188.

[150] Wesche SD, Chan HM. Adapting to the impacts of climate change on food security among Inuit in the western Canadian Arctic. EcoHealth. 2010;7:361–373.

[151] Gittelsohn J, Roache C, Kratzmann M, Reid R, Ogina J, Sharma S. Participatory research for chronic disease prevention in Inuit communities. American Journal of Health Behavior. 2010;34(4):453–464.

[152] Mead E, Gittelsohn J, Kratzmann M, Roache C, Sharma S. Impact of the changing food enviornment on dietary practices of an Inuit population in Arctic Canada. Journal of Human Nutrition and Dietetics. 2010;23(Suppl 1):18–26.

[153] Lambden J, Receveur O, Marshall J, Kuhnlein HV. Traditional and market food access in Arctic Canada is affected by economic factors. International Journal of Circumpolar Health. 2006;65(4):331–340.

[154] Schuster RC, Wein EE, Dickson C, Chan HM. Importance of traditional foods for the food security of two First Nations communities in the Yukon, Canada. International Journal of Circumpolar Health. 2011;70(3):286–300.

[155] Ford JD. Vulnerability of Inuit food systems to food insecurity as a consequence of climate change: a case study from Igloolik, Nunavut. Regional Environmental Change. 2009;9:83–100.

[156] Egeland G, Pacey A, Cao Z, Sobol I. Food insecurity among Inuit preschoolers: Nunavut Inuit Child Health Survey, 2007–2008. Canadian Medical Association Journal. 2010;182(3):243–248.

[157] Veugelers PJ, Sithole F, Zhang S, Muhajarine N. Neighborhood characteristics in relation to diet, physical activity and overweight of Canadian children. International Journal of Pediatric Obesity. 2008;3:152–159.

[158] Wu XY, Ohinmaa A, Veugelers PJ. Sociodemographic and neighbourhood determinants of health-related quality of life among grade-five students in Canada. Quality of Life Research. 2010;19: 969–976.

[159] Seliske LM, Pickett W, Boyce WF, Janssen I. Association between the food retail environment surrounding schools and overweight in Canadian youth. Public Health Nutrition. 2009;12(9):1384–1391.

[160] Leatherdale ST, Pouliou T, Church D, Hobin E. The association between overweight and opportunity structures in the built environment: a multi-level analysis among elementary school youth in the PLAY-ON study. International Journal of Public Health. 2011;56:237–246.

[161] Prince SA, Kristjansson EA, Russell K, Billette JM, Sawada MC, Ali A, et al. Relationships between neighborhoods, physical activity, and obesity: a multilevel analysis of a large Canadian city. Obesity. [serial on the Internet]. 2012 Jan 19; [cited 2012 September 20]; Available from **www.nature.com/oby/journal/vaop/ncurrent/full/oby2011392a.html**

[162] Minaker L, Raine K, Wild C, Nykiforuk CIJ. Neighbourhood food environments: objective features predict perceptions and diet-related health outcomes. Health & Place. Submitted.

[163] Prince SA, Kristjansson EA, Russell K, Billette JM, Sawada M, Ali A, et al. A multilevel analysis of neighbourhood built and social environments and adult self-reported physical activity and body mass index in Ottawa, Canada. International Journal of Environmental Research and Public Health. 2011;8(10):3953–3978.

[164] Pouliou T, Elliott SJ. Individual and socio-environmental determinants of overweight and obesity in urban Canada. Health & Place. 2010;16:389–398.

[165] Daniel M, Paquet C, Auger N, Zang G, Kestens Y. Association of fast-food restaurant and fruit and vegetable store densities with cardiovascular mortality in a metropolitan population. European Journal of Epidemiology. 2010;25(10):711–719.

[166] Alter D, Eny K. The relationship between the supply of fast-food chains and cardiovascular outcomes. Canadian Journal of Public Health. 2005;96(3):173–177.

[167] Zenk SN, Schulz AJ, Odoms-Young AM. How neighborhood environments contribute to obesity. American Journal of Nursing. 2009;109(7):61–64.

[168] Statistics Canada. [Internet]. Statistics Canada: 2006 Community profiles. [cited 2009 December 10]. Available from **www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-591/details/Page.cfm?Lang=E&Geo1=CD&Code1=3530&Geo2=PR&Code2=35&Data=Count&SearchText=Waterloo&SearchType=Begins&SearchPR=01&B1=All&Custom=**

[169] Weiss L, Ompad D, Galea S, Vlahov D. Defining neighborhood boundaries for urban health research. American Journal of Preventive Medicine. 2007;32(6S):S154–S159.

[170] Leal C, Chaix B. The influence of geographic life environments on cardiometabolic risk factors: a systematic review, a methodological assessment and a research agenda. Obesity Reviews. 2011;12(3):217–230.

[171] Kestens Y, Lebel A, Daniel M, Theriault M, Pampalon R. Using experienced activity spaces to measure foodscape exposure. Health & Place. 2010;16:1094–1103.

[172] Lebel A, Kestens Y, Pampalon R, Theriault M, Daniel M, Subramanian SV. Local context influence, activity space, and foodscape exposure in two Canadian metropolitan settings: is daily mobility exposure associated with overweight? Journal of Obesity. [serial on the Internet]. 2012; [cited 2012 September 20]; 2012: [9 pages]; Available from **www.hindawi.com/journals/jobes/2012/912645/**

[173] Zenk SN, Schultz AJ, Matthews SA, Odoms-Young A, Wilbur J, Wegrzyn L, et al. Activity space environment and dietary and physical activity behaviors: a pilot study. Health & Place. 2011;17:1150-–1161.

[174] Roux AVD. Investigating neighborhood and area effects on health. American Journal of Public Health. 2001;91(11):1783–1789.

[175] Kerr J, Frank L, Sallis JF, Saelens B, Glanz K, Chapman J. Predictors of trips to food destinations. International Journal of Behavioral Nutrition and Physical Activity. 2012;9:58.

[176] Sharkey JR. Measuring potential access to food stores and food-service places in rural areas in the U.S. American Journal of Preventive Medicine. 2009;36(4S):151–155.

[177] Hillier A, Cannuscio C, Karpyn A, McLaughlin J, Chilton M, Glanz K. How far do low-income parents travel to shop for food? Empirical evidence from two urban neighborhoods. Urban Geography. 2011;32(5):712–729.

[178] Food Matters Manitoba. [Internet]. Community food assessments hub: what are they? [cited 2012 June 15]. Available from **www.communityfoodassessments.ca/?page_id=12**

[179] Public Health Observatory. Food access in Saskatoon. Saskatoon, SK: Saskatoon Health Region; 2010.

[180] Malabar M. [Internet]. North end food assessment report. [cited 2012 June 20]. Available from **http://foodmattersmanitoba.ca/content/food-security-reports-research**

[181] Martin Prosperity Insitute. [Internet]. Food deserts and priority neighbourhoods in Toronto [cited 2012 June 13]. Available from **http://martinprosperity.org/2010/06/15/food-deserts-and-priority-neighbourhoods-in-toronto/**

[182] Partnership HC. [Internet]. Distance to nearest supermarket - priority areas. [cited 2012 June 12]. Available from **http://wx.toronto.ca/inter/health/food.nsf/0dad47ac378eabca85256dcd0059fa59/4AA90EE71B7A73048525789300640BBD/$file/Distance%20to%20Supermarkets%20&%20Income%201500m+%20%28FINAL%29.pdf**

[183] Heart and Stroke Foundation. [Internet]. Heart and stroke foundation report asks: what's in store for Canada's heart health? New report reveals big inconsistencies in price and accessibility of healthy food across Canada. [cited 2012 June 20]. Available from **www.heartandstroke.com/site/apps/nlnet/content2.aspx?c=ikIQLcMWJtE&b=4955951&ct=6715269**

[184] Aboriginal Affairs and Northern Development Canada. [Internet]. Regional results of price surveys. [cited 2012 June 20]. Available from **www.aadnc-aandc.gc.ca/eng/1100100035986**

[185] Thompson S, Kamal AG, Wong K. Is healthy food on the table in Northern Manitoba? Evaluating Northern Healthy Foods Initiative for sustainability and food access: University of Manitoba; 2010.

[186] Region of Waterloo Planning Housing and Community Services. [Internet]. Planning information bulletin: population and employment forecasts, 2006–2009. [cited 2012 June 20]. Available from **www.regionofwaterloo.ca/en/discoveringTheRegion/resources/Population_and_Employment_Forecasts.pdf**

[187] Region of Waterloo Public Health. [Internet]. A healthy community food system plan. [cited 2012 May 20]. Available from **http://chd.region.waterloo.on.ca/en/researchResourcesPublications/resources/FoodSystem_Plan.pdf**

[188] Frank L, Van Loon J, Raine K, Minaker LM, Fisher P, Thompson M. Evaluating built environment relationships with physical activity, diet and body weight: the NEWPATH study. Canadian Journal of Public Health. Submitted.

[189] Minaker L, Raine K, Thompson M, Wild C, Nykiforuk CIJ. Does food purchasing frequency explain the relationship between food environments and diet-related outcomes? American Journal of Public Health. Under development.

[190] Region of Waterloo. [Internet]. Rapid transit. [cited 2012 June 10]. Available from **http://rapidtransit.regionofwaterloo.ca/en/**

[191] Coalition Poids. [Internet]. Mission: making it easier to eat well and to be more active! [cited 2012 June 20]. Available from **www.cqpp.qc.ca/en/about-us/mission**

[192] Paquin S. Le zonage municipal: un outil contribuant à créer un environnement bâti favorable aux saines habitudes alimentaires: Institut national de santé publique du Québec; 2009.

[193] Bergeron P, Reyburn S. L'impact de l'environnement bâti sur l'activité physique, l'alimentation et le poids: Institut national de santé publique du Québec; 2010.

[194] Robitaille E, Bergeron P, Lasnier B. Analyse géographique de l'accessibilité des restaurants-minute et des dépanneurs autour des écoles publiques québécoises. Quebec City: Institut national de santé publique du Québec; 2009.

[195] Association pour la santé publique du Québec. [Internet]. The school zone and nutrition: courses of action for the municipal sector. [cited 2012 May 10]. Available from **www.aspq.org/documents/file/guide-zonage-version-finale-anglaise.pdf**

[196] Statistics Canada. [Internet]. Census profile Nunavut. [cited 2010 June 15]. Available from **www12.statcan.ca/census-recensement/2011/dp-pd/prof/details/Page.cfm?Lang=E&Geo1=PR&Code1=62&Geo2=PR&Code2=01&Data=Count&SearchText=Nunavut&SearchType=Begins&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=62**

[197] Nunavut Tunngavik Inc. [Internet]. About NTI. [cited 2012 June 10]. Available from **www.tunngavik.com**

# APPENDIX A: REVIEWS EXAMINING ASSOCIATIONS BETWEEN FOOD ENVIRONMENTS AND DIET-RELATED OUTCOMES

| Author, Year | Purpose | Perspective | Subjects | Main Findings |
|---|---|---|---|---|
| Richter et al., 2000 | To describe factors influencing physical activity and nutrition and to review environmental measures in the literature | Socio-ecological | Children | The 16 studies reviewed illustrate the diversity of environmental measures, with little consistency between studies. Only one of five community-level, food-related studies examined correlations between food environment (in grocery stores) and residents' diets. The other four examined reliability of environmental, direct-observation tools. The one study to date examining correlations between food environment and diet found associations between residents' self-reported dietary intake and grocery store measures (e.g., the proportion of low-fat milk in milk displays). The high prevalence of cross-sectional designs limits the ability to infer causation. |
| Kamphuis et al., 2006 | To describe which environmental determinants are associated with fruit and vegetable consumption | Socio-ecological | Adults | There was great diversity in environmental factors studied, with little consistency between studies, limiting the strength of conclusions that can be made about any one environmental factor. Good local availability of fruits and vegetables seem to be positively related to intake, although evidence is limited. Little is known about the theoretical relationship between environmental attributes and fruit and vegetable consumption. Future research should be longitudinal to understand causal pathways. |
| Papas et al., 2007 | To review empirical evidence for the influence of the built environment on the risk of obesity. | Socio-ecological | Children and adults | The inconsistency of built environment measurements limits the ability to make conclusive statements about the impact of the built environment on obesity. Of the six studies addressing some aspect of food access and BMI, four found significant associations. Only 2 of the 20 studies reviewed were longitudinal in nature, which is a limitation of the body of research. |
| White, 2007 | To demonstrate the effects of food retailing on diet and food purchasing | Implicitly socio-ecological | Children and adults | There is not yet strong evidence that food retailing, in isolation, affects diet. The lack of longitudinal studies in the field is a large gap and presents a barrier to inferring causation. Concern about retail availability and access may not be the most profitable direction for thinking about modifying diets in the future. Only one experimental study has been conducted to date, which is a limitation in this body of research. |
| Van der Horst, 2007 | To review observational studies on environmental correlates of dietary behaviours in children and adolescents | Socio-ecological: the ANGELO framework | Children and youth | Sociocultural factors at the household level are the most frequently studied environmental factors for dietary behaviours of children and youth. The lack of study replication among specific environment-dietary behaviour combinations result in a lack of compelling evidence for associations between environmental factors and dietary intake. Since most studies were cross-sectional, it is not possible to draw conclusions about direction and possible causality. |

| Author, Year | Purpose | Perspective | Subjects | Main Findings |
|---|---|---|---|---|
| Black & Macinko, 2008 | To critically evaluate the literature on neighborhood determinants of obesity in high-income countries | Socio-ecological | Children and adults | The availability of healthy versus unhealthy food was inconsistently related to obesity. In the United States, neighborhoods do vary significantly in terms of factors that are expected to influence diet, such as the pricing and availability of healthy food. Trends are mixed in other countries. Many inconsistencies exist in the literature because of inconsistent methods, the high prevalence of cross-sectional studies, common use of secondary data, and poor rationales for defining 'neighborhood'. |
| Raine et al., 2008 | To synthesize evidence on structural and community-level characteristics of urban environments as well as interventions that influence healthy weights in urban populations | Socio-ecological | Children and adults | Only six studies examined geographic access to food in urban environments, and only one showed a positive association between food access and diet quality. Area-level disadvantage is associated with decreased access in the United States Residents' perceptions of healthy food predict healthy food choices. The strongest levels of evidence for associations between environmental characteristics and obesogenic diets or body weight are physical, socio-cultural, and economic settings and economic and socio-cultural sectors. |
| Holsten, 2009 | To examine the relationship between obesity and the community and/or consumer food environment | Socio-ecological | Children and adults | Five of the seven studies reviewed showed significant associations between an aspect of the food environment and BMI. The majority of the studies were cross-sectional and used secondary data, which may limit the strength of the conclusions that can be drawn. No studies directly measured the consumer nutrition environment within food outlets, highlighting a large gap in the literature, and all but one study defined communities with administrative boundaries, which do not have a conceptually-founded geographic context to the health outcome of obesity. |
| Larson et al., 2009 | To review research that examines social, physical and macro-environmental factors related to food choice | Socio-ecological | Children and adults | Relationships between aspects of the physical food environment such as food access and availability and dietary outcomes have been found, but inconsistently. The high prevalence of cross-sectional studies limits the ability to infer direction of causation. Few measures of food environments have been tested for validity or reliability and existing measures vary widely in scale and scope. This leads to inconsistent methods and findings. The majority of studies reviewed have methodological limitations that limit their credibility to guide interventions and policy change. |
| Feng et al., 2010 | To evaluate the extant literature for evidence of association between the built environment and obesity | Socio-ecological | Children and adults | There was very little similarity of methods among studies, which prevented estimation of pooled effects and limits what can be learned from this body of evidence. Of the 22 studies examining aspects of the food environment and weight status, 14 showed significant associations in the expected direction, six showed no association, and two showed significant associations in an unexpected direction. There is an absence of agreement on how the built environment should be measured and modeled in the literature, resulting in inconsistent findings. Better understandings of built environment metrics and 'place', more evaluations of longitudinal associations, and multidisciplinary collaboration will strengthen the field. |

| Author, Year | Purpose | Perspective | Subjects | Main Findings |
|---|---|---|---|---|
| de Vet et al., 2011 | To conduct a systematic review of reviews to integrate findings on environmental correlates that do and do not influence physical activity or dietary behaviours | Socio-ecological | Children and youth | Interpersonal factors played a stronger role in dietary behaviours than other factors. There were no neighbourhood or societal factors that were consistently related to dietary behaviours. Measurement inconsistencies and the lack of understanding of causal mechanisms due to the high prevalence of cross-sectional studies may be the reasons for the inconsistent findings regarding associations between aspects of the food environment and dietary behaviours. |
| Giskes et al., 2011 | To review recent literature on how features of the food environment are associated with dietary intakes and overweight/obesity to identify factors to be targeted in policy and interventions. | Socio-ecological | Adults | Weight status was consistently associated with food access. Greater supermarket accessibility and lower fast food outlet accessibility were associated with a lower BMI or prevalence of overweight/obesity. Obesogenic dietary behaviours, however, were inconsistently related to the food environment. Therefore, environmental factors may influence BMI through a more complex interplay of factors, including physical activity. There was great variation in conceptualization, measurement, and summary of both environmental factors and dietary behaviours, which may have contributed to unrelated findings. |
| Fleischhacker et al., 2011 | To examine the methodology and current evidence on fast food access and its associated outcomes. | Socio-ecological | Children and adults | The majority of studies found that the prevalence of fast food outlets varied by racial and socioeconomic composition of the area. Areas with a high population of ethnic minorities and low-income families have increased access to fast food. Results regarding the association between BMI and fast food outlet access are mixed. 39 of the 40 papers reviewed were cross-sectional, so causality could not be inferred. Definitions of neighbourhoods were inconsistent across studies, as were definitions of fast food and fast food access. |
| Casey et al., 2011 | To review the existing knowledge of the relationship between objectively-assessed built environment features and weight status in youth | Socio-ecological | Children and youth | Thirteen studies assessed relationships between weight and food environments. Overweight status was positively related to spatial accessibility to convenience stores. Associations between weight status and grocery stores and restaurants were less consistent. There was great variation in defining and categorizing built environment characteristics and in geographic metrics used across studies, which made it challenging to compare results. |

# APPENDIX B: EVIDENCE FOR THE EXISTENCE OF FOOD DESERTS IN CANADA

(-) Evidence suggests that lower socio-economic position is associated with increased access (evidence against food deserts)
(+) Evidence suggests that lower socio-economic position is associated with decreased access (evidence for food deserts)
(=) Evidence is equivocal (evidence neither for nor against food deserts)

| Author, year | Urban/ rural | Region | Province | Main findings | Evidence |
|---|---|---|---|---|---|
| **Seliske, Pickett, Boyce, and Janssen, 2009** | Urban and Rural | National sample | Canada | Access to fast food restaurants, sub/sandwich restaurants, donut/coffee outlets, and convenience stores within 1km was not associated with SES of schools. Access to full-service restaurants increased with increasing SES. Within 5 km, there was a positive association between SES and the number of food outlets for all food retailer types. | - |
| **Smoyer-Tomic, Spence, and Amrhein, 2006** | Urban | Edmonton | Alberta | Supermarket accessibility was better for inner-city neighbourhoods, neighbourhoods with low proportions of vehicle owners, and high proportions of low-income households. In the six neighbourhoods identified as potential food deserts, residents needed to travel about 2.1 to 2.5 km to the nearest supermarket, compared to the city median of 1.4km. | - |
| **Hemphill, Raine, Spence, and Smoyer-Tomic, 2008** | Urban | Edmonton | Alberta | Increased access to fast food restaurants was associated with higher area-level proportions of unemployed residents, low-income people, and renters. | - |
| **Smoyer-Tomic, Spence, Raine, Amrhein, Cameron, Yasenovskiy, et al, 2008** | Urban | Edmonton | Alberta | Fast food outlet access but not supermarket access was negatively associated with area-level median income and dwelling value. It was positively associated with area-level proportions of: Aboriginals, renters, lone parents, low-income households, and public transportation commuters. The increased exposure to fast food among lower-income, single parent families was not offset by increased access to supermarkets. | - |
| **Cameron, Amrhein, Smoyer-Tomic, Raine, Chong, 2010** | Urban | Edmonton | Alberta | Several regions of 'food desolate' neighbourhoods were identified, and had a significantly higher percentage of seniors, and older housing stock than areas that were not 'food desolate'. | = |
| **Black, Carpiano, Fleming, and Lauster, 2011** | Urban | Metropolitan areas | British Columbia | Neighbourhoods with higher median household income had significantly poorer access to food stores. | - |
| **Jones, Terashima, and Rainham, 2009** | Urban and Rural | 266 regions | Nova Scotia | An inverse relationship was found between community-level material deprivation and fast food restaurant density. Positive relationships were found between fast food restaurant density and psychosocial deprivation. | - |

| Author, Year | Urban/ rural | Region | Province | Main Findings | Evidence |
|---|---|---|---|---|---|
| **Latham and Moffat, 2007** | Urban | Hamilton | Ontario | The lower-income area assessed was dominated by variety stores that stocked fewer healthy food items in general than grocery stores. This finding may indicate that residents in the lower-income area studied have lower access to healthy foods. | + |
| **Larsen and Gilliland, 2008** | Urban | London | Ontario | Residents of low-income, inner-city neighbourhoods have the poorest access to supermarkets, a finding that has increased over time. Although populations in the majority of urban census tracts had good supermarket access via public transit, one neighbourhood in particular still had poor access by transit. | + |
| **Kirkpatrick and Tarasuk, 2010** | Urban | Toronto | Ontario | There were no associations between distance to the nearest discount supermarket and food insecurity, nor were there significant associations between geographic access to discount supermarkets and severe food insecurity in a study of 12 high-poverty neighbourhoods in Toronto. | - |
| **Sadler, Gilliland and Arku, 2011** | Rural | Middlesex County | Ontario | Residents in the most socioeconomically distressed neighbourhoods had better accessibility to all types of food retailers. | - |
| **Apparicio, Cloutier, Shearmur, 2008** | Urban | Montreal | Quebec | Geographic accessibility of healthy foods (measured as access to supermarkets) is higher among low-income populations than in the rest of the population. A few isolated cases of "potential food deserts" do not represent a public health concern. Access to supermarkets is lower among the peripheral neighbourhoods, whereas the more urban centre had good access. | - |
| **Bertrand, Thérien, and Cloutier, 2008** | Urban | Montreal | Quebec | For consumers who shop by car, access to fresh fruits and vegetables is generally good, although 28% of people living in Montreal are unable to buy fresh fruits or vegetables within 500m of their homes. There was no association observed between area-level median income and the food supply. The area with the poorest index of fruit and vegetable availability was also one of the wealthiest areas in the region. | - |
| **Daniel, Kestens, and Paquet, 2008** | Urban | Montreal | Quebec | Neighbourhoods (defined as Census Metropolitan Areas) with lower education and more French-speaking households have lower access to stores selling fruits and vegetables. Median household income was not related to the density of fast food outlets or stores selling fruits and vegetables. | - |
| **Drouin, Hamelin, and Ouellet, 2009** | Urban | Quebec City | Quebec | There was no evidence of price disparities in fruits and vegetables across neighbourhood material deprivation index. Store type does appear to vary by material deprivation index. | - |

| Author, Year | Urban/ rural | Region | Province | Main Findings | Evidence |
|---|---|---|---|---|---|
| **Pouliot and Hamelin, 2009** | Urban and Rural | Quebec City | Quebec | The in-store quantity and diversity of fresh fruits and vegetables were associated neither with urban environments nor with the area-level deprivation. Supermarket access is more limited in rural settings. | - |
| **Paez, Mercado, Farber, Morency, and Roorda, 2010** | Urban | Montreal | Quebec | Low-income households have equal or better food accessibility near the centre of the city but are at a disadvantage in terms of accessibility in the city's periphery. Access to fast food is fairly egalitarian with respect to income status. Despite these equivocal findings, authors find evidence for the existence of food deserts in Montreal, especially around the periphery of the city. | = |
| **Kestens, Lebel, Daniel, Theriault, and Pampalon, 2010** | Urban | Montreal | Quebec | 'Foodscape experience' (that is, the amount of exposure to certain types of food outlets) varies with age and income. An inverse relationship was found between income and food exposure or accessibility to food stores, even after mobility patterns are accounted for. | - |
| **Kestens and Daniel, 2010** | Urban | Montreal | Quebec | Food source exposure for fast food outlets, full-service restaurants and fruit and vegetable stores around schools was inversely associated with neighbourhood income, even after accounting for commercial density. | - |
| **Peters and McCreary, 2008** | Urban | Saskatoon | Saskatchewan | Historical changes in food retailing in Saskatoon have resulted in reduced access to low cost, healthy foods for the high-poverty neighbourhoods. The cost of groceries in high-poverty neighbourhoods was slightly higher than the cost of groceries in other areas. | + |

# APPENDIX C: LIST OF PROJECTS IDENTIFIED BY KEY INFORMANTS

| Location | Name | Project description |
|---|---|---|
| **Vancouver, British Columbia** | Jennifer Black | The project is called, Think Eat Green at School (see http://thinkeatgreen.ca/). One of the aims of the project is to look at food environments around schools (such as access to fast food and convenience stores) as well as within schools (such as school nutrition policies), and how they shape behaviours, perceptions, attitudes, and practices. |
| **British Columbia** | Ellen Lo | Ms. Lo is developing indicators for assessing healthy eating/food environments for a provincial healthy eating strategy under the name Healthy Families BC. The indicators are still under development and will be adapted for and implemented in workplaces, health care facilities, schools, publicly funded institutions, and municipal and community facilities. |
| **Saskatoon, Saskatchewan** | Rachel Engler-Stringer | The projects currently underway have involved GIS mapping of grocery stores, other food stores, and restaurants in the city of Saskatoon. The NEMS-S was implemented in all stores and the NEMS-R was implemented in restaurants. Dietary assessments, and measured weight and height will be conducted with school-aged children, 10–13 years (n=1500). Another phase of the project will include doing some qualitative research with a subsample of the participants to examine perceptions. The final phase will include doing key informant interviews with community-based organizations, public health practitioners, and decision makers to see how the study's results can be used to benefit their practice. |
| **Saskatoon, Saskatchewan** | Jill Aussant | Ms. Aussant is working on a food system assessment to examine the capacity of community food production within 100km of Saskatoon. The goal of the project is to create a directory of local producers for consumers to link local supply with demand in the community. |
| **Saskatoon, Saskatchewan, and Winnipeg, Manitoba** | Yvonne Hanson | The project is called "Cartographies of Salt", and it examines food insecurity in rural, remote, and urban women in and around Saskatoon and Winnipeg. The purpose of the study is to investigate and map the relationship between the built environment and food and salt consumption, understand access to food in urban settings, and understand how increased sodium is understood by women. Although the study is mostly qualitative, some mapping and census-tract data to examine the idea of food deserts was also used. Participants self-identified as living in one of three neighbourhoods per city (two food deserts and one non-food desert). |
| **Manitoba** | Stefan Epp-Koop | Food Matters Manitoba (www.foodmattersmanitoba.ca/) has been involved with many community food assessments and has recently conducted them in Winnipeg's North End and in St. Vital. GIS mapping of grocery store access was conducted in these two communities. |
| **Manitoba** | Shirley Thompson | Dr. Thompson's work relates to food insecurity in Northern Manitoba communities (see, for example, http://home.cc.umanitoba.ca/~thompso4/Food.html). She has additionally used GIS to map food access in Winnipeg, and has used the National Nutritious Food Basket to compare the cost of a healthy diet in northern and remote communities to the cost in southern communities in Manitoba. Most of the communities she works in are First Nations. |
| **Nunavik, Quebec; Northern Labrador, Newfoundland** | Chris Furgal | Dr. Furgal examines environmental change and how it impacts health and food security among Inuit. He does this by examining traditional food availability and quality, partnering with wildlife researchers to examine population models of country foods (e.g., the size of stock of caribou herds or Arctic char schools) or zoonotic diseases in the populations, and by examining hunters' and elders' perception of the accessibility and distribution of traditional foods. Dr. Furgal is also doing work with community freezers to evaluate interventions to promote food security in Inuit communities. |

| Location | Name | Project description |
|---|---|---|
| **Kingston, Ontario** | Rachael Goodmurphy | The project used the Retail Food Environment Index (ratio of the number of fast food outlets and convenience stores to the number of grocery stores and specialty stores) to determine food access in the city of Kingston. The NEMS-S and NEMS-R surveys in stores and restaurants, respectively, were also used to assess the consumer nutrition environment. The data will be mapped onto census tract deprivation levels to indicate whether the food environment differs between more deprived vs. less-deprived areas, and to highlight whether there are any priority areas in terms of improving food access. |
| **Region of Waterloo, Ontario** | Pat Fisher | The NEWPATH project used many different measures of the food environment (including shelf-space measures in food stores, the NEMS-S and NEMS-R in stores and restaurants, and several measures of food access, including the RFEI, proximity to different outlet types, store and restaurant intensity, and diversity) to characterize food environment features in the three cities of Cambridge, Kitchener, and Waterloo. Other NEWPATH data include information on dietary behaviours, food purchasing, and weight outcomes. Individual diet-related outcome data are being linked to the food environment data to try to examine how food environments are tied to these outcomes. |
| **Toronto, Ontario** | Catherine Mah | Dr. Mah runs the Food Policy Research Initiative (http://foodpolicyresearch.eventbrite.com), and has worked with colleagues across sectors to produce maps that layer food access onto area-level income measures. These were also mapped onto transit access, walkability, and cultural concentration. A participatory mapping exercise involved crafting personal maps to reveal peoples' lived experience in terms of food environments. In addition, Dr. Mah is currently working on a Mobile Produce Vending Pilot project, to evaluate the impact of sending mobile produce vendors into underserved neighbourhoods. |
| **Toronto, Ontario** | Valerie Tarasuk | In 2010, a study was conducted in five cities, including Toronto, to examine charitable meal programming (meal programs, food banks, places providing food hampers). The programs were mapped, and it was found that there is no consistent logic to the dates, times, or locations of the charitable meal programs. |
| **Baie-Saint-Paul, Lavaltrie, Gatineau, Quebec** | Suzie Pellerin | Several food environment assessments have been done in Quebec, including food access mapping of both food stores and fast food outlets. To begin the process of using zoning regulations to improve the food environments, Ms. Pellerin and her colleagues mapped the locations of fast food outlets and convenience stores around schools and showed that students have high access to fast food and convenience stores. Ms. Pellerin worked with a lawyer to review the legal processes involved in implementing zoning regulations. Several jurisdictions are currently in the process of attempting to adopt zoning regulations prohibiting fast foods around schools. |
| **Nova Scotia** | Tarra Penney | This project involves GIS mapping of grocery stores, big box stores, restaurants or coffee shops, small independently owned restaurants, and convenience stores throughout Nova Scotia. The GIS mapping data were matched with 276 community boundary files for comparison across communities, and CCHS data are being used for outcomes (BMI, physical activity behaviours, dietary behaviours) and control variables (income, education, other socioeconomic and demographic variables). |
| **Newfoundland and Labrador** | Kristie Jameson | CFAs have been conducted in Newfoundland and Labrador using the cost of northern food baskets as well as some mapping to describe the food access issues that exist in northern and remote communities. |
| **Humber Valley, Newfoundland and Labrador** | Katie Temple | Ms. Temple is conducting a community food assessment in seven communities in the Humber Valley portion of the Humber River Basin. The objective is to provide an understanding of the strengths and weaknesses of local food production and distribution, with a specific focus on commercial food production rather than personal or community food provisioning. |
| **Newfoundland and Labrador** | Deborah McPhail | Dr. McPhail is examining cultural eating using qualitative methods. Specifically, she is examining people's concern about obesity and the importance of cultural, traditional foods in Newfoundland and Labrador. She is examining differences between urban dwellers, rural dwellers, and people who live in remote communities. |

| Location | Name | Project description |
|---|---|---|
| **Nunavut** | Jennifer Wakegijig | The Nutrition North Canada program subsidizes perishable, nutritious food shipment to the North with the intention of making nutritious foods more available and affordable to remote, northern communities. The program will be evaluated with respect to health outcomes. Ms. Wakegijig has also identified several other interventions underway that are relevant to the food environment and are not being evaluated with respect to health outcomes. |
| **Northwest Territories** | Elsie DeRoose | Ms. DeRoose mentioned the community food assessment that took place in Yellowknife, Ndilo and Dettah in 2008. Although she is not aware of any food environment assessments currently underway, she confirmed that more food environment assessments are desired in Northwest Territories. |

# APPENDIX D: LIST OF COMMUNITY FOOD ASSESSMENTS COMPLETED OR UNDERWAY IN CANADA (NOT EXHAUSTIVE)

| Location | Year |
|---|---|
| Calgary, Alberta | Underway |
| St. Vital, Manitoba | 2012 |
| Ottawa (Barrhaven), Ontario | 2012 |
| Burin Peninsula, Newfoundland and Labrador | 2011 |
| Labrador West, Newfoundland and Labrador | 2011 |
| Upper Lake Melville, Newfoundland and Labrador | 2011 |
| Halton, Ontario | 2011 |
| La Ronge, Saskatchewan | 2011 |
| Dawson, Yukon | 2011 |
| North End of Winnipeg, Manitoba | 2010 |
| Downtown Eastside Vancouver, British Columbia | 2010 |
| Yellowknife, Ndilo, and Dettah, Northwest Territories | 2010 |
| Prince George, British Columbia | 2010 |
| Hopedale, Newfoundland and Labrador | 2010 |
| Bonne Bay, Newfoundland and Labrador | 2009 |
| Clayoquot, British Columbia | 2009 |
| Waterloo, Ontario | 2007 |
| North Shore, British Columbia | 2006 |
| Richmond, British Columbia | 2005 |
| Capital Region, Victoria, British Columbia | 2004 |
| Thunder Bay, Ontario | 2004 |
| North Kootenay Lake, British Columbia | Data |