FOOD ENVIRONMENT, HEALTH, and CHRONIC DISEASE

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Editor:
Catherine Chan
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We are what we eat

Such a simple phrase, yet fraught with visible and invisible forces that make what we EAT less than optimal, even in a country of food abundance such as Canada, and therefore what we ARE is less than optimal. What we eat is not just a matter of personal preference; it depends on our ethnicity and culture, geography, education and income as well as what is grown or produced locally and what is imported, food trends, media influence and government policy. A growing literature on these factors, which are collectively termed the food environment, suggests that ensuring access to sufficient food is only part of the solution to a healthy diet.
The Burden of Chronic Disease in Canada

In Canada and around the world, the main causes of death are changing from acute infection-related deaths to diseases that take a long time to develop such as chronic toxicities (e.g., smoking, industrial pollution) or consequences of our transition from manual labour and marginal food abundance to sedentary, desk-bound jobs and highly processed, calorically-dense foods (Table 1). For example, diarrhea caused by gastrointestinal infections is no longer in the top 5 causes of death worldwide; this decrease can in part be attributed to enhancing food environments by improving food safety and hygiene practices. Conversely, the number of deaths from diabetes increased by 70% between 2000 and 2012. The World Health Organization estimates that 68% of all deaths, worldwide, were from noncommunicable diseases in 2012.1.

Table 1. Contribution of chronic diseases to overall deaths.

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Ranking Worldwide¹</th>
<th>Deaths Worldwide¹ (millions)</th>
<th>Deaths in Canada² (thousands)</th>
<th>Reduction Strategies related to food environment¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular disease including stroke</td>
<td>1</td>
<td>17.5</td>
<td>61</td>
<td>Reduce fat, sugar, salt intake; increase physical activity</td>
</tr>
<tr>
<td>Cancer</td>
<td>4</td>
<td>8.2</td>
<td>70</td>
<td>Reduce overweight/obesity; increase fruit &amp; vegetable intake and physical activity</td>
</tr>
<tr>
<td>Diabetes (including type 1 and type 2)</td>
<td>7</td>
<td>1.5</td>
<td>7</td>
<td>Reduce overweight/obesity; increase physical activity</td>
</tr>
</tbody>
</table>


The reduction strategies suggested in Table 1 seem simple! Why can’t people eat healthier food and be more physically active? Is it a problem of will-power or are there external forces influencing our individual choices and behaviours?
An ecological view of the forces that shape our health behaviours

The things that we do as individuals to influence our health are called health behaviours and broadly include such things as healthy eating, being physically active or sedentary, coping with stress, consumption of alcohol, smoking and so on. Our own knowledge and attitudes in part determine these behavior but they are also shaped by many external forces, most of them beyond our control. According to ecological models of health promotion (e.g. Figure 1), an ever expanding and more generalized array of forces are powerful determinants of health behaviours and must be considered when trying to facilitate healthier behaviours in individuals.
To put this model in the context of the food environment as it relates to chronic disease, a web of how these higher-level and often conflicting factors might influence an individual's food choices is depicted in Figure 2.

**Figure 2.** An example of how the complex, sometimes conflicting nature of our ecology influences our health behaviours, in this case, when faced with a buffet for lunch.

In the accompanying articles, authors from the University of Alberta tackle questions related to specific states of health and disease. Dr. Rhonda Bell leads off by defining a framework for considering the food environment’s diverse dimensions on health and examines how the framework can be applied. Dr. Anna Farmer looks at how the food environment affects children, specifically in the context of childcare, an environment in which many pre-school children spend the majority of their waking hours. Dr. Noreen Willows tackles the question of how the food environment and food security is influenced by cultural and past political forces in First Nations communities in Alberta. Drs. Vera Mazurak and Carla Prado examine the relationship of the food environment to cancer and note that there are still many unanswered questions. Dr. Catherine Chan identifies elements of the food environment that cause difficulty for people with diabetes trying to improve their diet. Finally, Dr. Kim Raine wraps up the series of essays by examining how government food and agricultural policies and media influence shape the different dimensions of the food environment. In all of the essays, we look to the future and ways that the food environment can be improved by the actions of government, industry, communities and individuals.
A large and important question is, “If we could change the food environment, could we alter the course of chronic disease progression or prevent it from happening in the first place?” The World Health Assembly of the United Nations in 2012 set a goal of reducing deaths from noncommunicable diseases by 25% by 2025. The Lancet, a leading medical journal published in the United Kingdom, convened a series of articles published in 2013 in an attempt to provide guidance to the UN and nations around the world in how to tackle this lofty objective. There are studies that show that altering the food environment can reduce risk of developing and progression of chronic diseases such as diabetes. The big question remains how to translate these findings into broad-based initiatives.

One example comes from Finland, the North Karelia Project, which was launched in 1972 because of concern over high mortality rates from cardiovascular disease in Finland. The North Karelia project was a multi-pronged, community-based initiative involving food providers (agriculture, food industry, grocery stores), health and other social service providers, non-governmental organizations, media campaigns, schools and community organizations. One of the most important features of the initiative was the several approaches were applied to result in a coordinated effort at multiple levels. Another important factor was community involvement, which enabled ownership and flexibility of the program. Thirdly, congruence of media messaging with program objectives was important to avoid littering the landscape with conflicting information and advice. Government involvement in the form of legislation and policy was formulated to promote the program's objectives. With respect to food, the main objectives were to lower saturated fat intake while increasing vegetable and fruit consumption, which was accomplished by a variety of approaches. A summary of the outcomes of the North Karelia Project was published in 2002 to commemorate the 25th anniversary of the start of the project. Some of the key outcomes are listed in Table 2.

<table>
<thead>
<tr>
<th>Dimension Measured</th>
<th>Before</th>
<th>After 20-25 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking in men</td>
<td>52%</td>
<td>31%</td>
</tr>
<tr>
<td>Use of vegetable oil instead of animal fat</td>
<td>90%</td>
<td>7%</td>
</tr>
<tr>
<td>Cholesterol in the blood</td>
<td>Decreased by 17%</td>
<td></td>
</tr>
<tr>
<td>Premature death from cardiovascular disease in men (less than 65 years old)</td>
<td>Decreased by 73%</td>
<td></td>
</tr>
<tr>
<td>Deaths from lung cancer</td>
<td>Decreased by 70%</td>
<td></td>
</tr>
<tr>
<td>Life expectancy</td>
<td>Increased by 7 years in men and 6 years in women</td>
<td></td>
</tr>
</tbody>
</table>

*Similar results were observed for women for all but smoking behavior, which increased slightly but from a very low baseline.*

The North Karelia Project initiatives were later implemented across Finland, with similar results across the population. Analysis of the processes applied to achieve these outcomes leads to the conclusion that big challenges require complex solutions, implementation in small steps, education, consistent messaging and a long-term view of the outcomes. For example, North Karelia had many demographic and socioeconomic characteristics that might have made change difficult, such as low access to medical resources, a traditional lifestyle, an economy based on the dairy industry that promoted butter consumption, and generally lower socio-economic status. Yet, careful planning, focus on a big problem of concern (cardiovascular deaths), the community involvement and multiple levels of interventions were all big factors in its success.
Homegrown Initiatives to Improve the Food Environment in Alberta

The North Karelia Project and others like it emphasize the importance of a multi-faceted approach that addresses all aspects of the ecological model to improve the food environment (Table 3). Even a cursory examination of practices in Alberta point to many encouraging actions by stakeholders that, if focused and delivered in a more unified, strategic way and systematically evaluated, could lead to improved health and reduced chronic disease in the province.

Table 3.

<table>
<thead>
<tr>
<th>Summary of North Karelia Project initiatives related to food</th>
</tr>
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<tbody>
<tr>
<td>Target saturated fat (decrease) and vegetables and fruit (increase)</td>
</tr>
<tr>
<td>Information dissemination – the link between lifestyle and health</td>
</tr>
<tr>
<td>Provision of professional support, training (culinary skills) and social support</td>
</tr>
<tr>
<td>Government policy allowed mixing vegetable oil with butter; enabled low-fat milk production and changed agricultural subsidies to promote different milk products</td>
</tr>
<tr>
<td>Food labeling changes</td>
</tr>
<tr>
<td>Food industry advertising promoted healthy products</td>
</tr>
<tr>
<td>Food industry developed new products and marketing strategies eg. lower fat and sodium deli meats; altered bread formulations</td>
</tr>
<tr>
<td>Consumer surveys to show industry where demand lay</td>
</tr>
<tr>
<td>Promoted berry consumption (local products)</td>
</tr>
<tr>
<td>Development of a local canola industry</td>
</tr>
<tr>
<td>Local supermarkets participated in “health days” with free nutrition advice</td>
</tr>
</tbody>
</table>

An example of government activities includes the developing of nutrition guidelines for both adults and children and youth. As described in the article by Dr. Farmer, the Alberta Nutrition Guidelines for Children and Youth are targeted at public institutions where young people spend considerable amounts of time: childcares, schools and recreation facilities. Ongoing research suggests that these guidelines, being voluntary, have been implemented to a greater-or-lesser extent in these settings. Moreover, attempts to implement the guidelines identified barriers, such as a lack of foods meeting the guidelines that could be put in vending machines. Guidelines such as these have a longer term potential to raise awareness of healthier eating practices that can lead to increased consumer demand for healthier choices in a wider range of places where people eat.

Alberta Agriculture and Rural Development promotes development of healthy food products through provision of resources targeted at the food industry and consumers. For example, pulse grains are good to excellent sources of protein, fibre, B vitamins and several minerals including iron but
consumption by Canadians is low. Strategies to increase pulse consumption could be of benefit in the control of blood cholesterol and blood glucose. The ARD website presents the results of a consumer survey of pulse consumption, a marketing segmentation toolkit and links to pulse industry websites. ARD also has a Food and Bio Processing Division, which operates a food processing development centre (Leduc), a food science and technology centre (Brooks) and a sensory evaluation program (Leduc and Edmonton) to help the food industry develop new products. While not solely focused on healthy products, these incubators can help those in industry to diversify, hone their marketing strategies, and get new products to market.

Within the healthcare system, strategic clinical networks have been created by Alberta Health Services for the purpose of enhancing translation of research findings into clinical practice. There are several networks that relate to chronic disease including cancer, cardiovascular disease and stroke, and diabetes, obesity and nutrition. While not directly focused on the food environment, these networks are interested in preventative strategies and working with other agencies to promote health and reduce the burden of chronic disease.

Working from a different perspective, researchers at the University of Alberta created a program called APPLE Schools in 2008 to promote the health of children using schools as vehicles for education and program delivery. The program is now managed and delivered independently from the researchers to 40 schools in Alberta and touches 20,000 children.

Resources have been created to promote activities such as classroom gardens, taste-testing of foods and healthy options for celebrations. Ongoing research and evaluation is being conducted to further refine the program as well as disseminate the process and outcomes. In Food Security among Alberta First Nations, Dr. Noreen Willows describes collaborative work with First Nations schools to positively influence the food environment.

More difficult to document but equally important to organized efforts to improve the food environment are grassroots initiatives started in and run by communities or nongovernmental associations across the province. One example is Alberta Food Matters (http://www.foodsecurityalberta.org/about), an organization with the stated mission of “working together to foster leadership, relationships and actions that reconnect people, land and food in Alberta; Alberta Food Matters grows through community development, research and evidence-based approaches, policy development and skill building, educational projects, programs and workshops.” A major focus of this group is food insecurity, which affects 1 in 10 people in Alberta. Other examples include the proliferation of grass-roots efforts to increase the number of community gardens and farmers’ markets in Alberta communities. It could be that the impact of local initiatives would be even greater if part of a comprehensive strategy to improve the food environment, as envisaged in Dr. Raines’ article Creating Health Promoting Food Environments through Policy.
Where Can We Go From Here?

The authors of the essays that follow have suggested a number of strategies for improving the food environment in Alberta, with an eye to maintaining health, lowering chronic disease risk and complications. We are fortunate that agriculture is one of the economic drivers in Alberta, which provides access to fresh, wholesome foods and ingredients. Still, the challenges are many. Despite having the highest median family income in Canada, 10% of the population still exists in a state of food insecurity. Most Albertans consume more than the recommended amount of sodium, a risk factor for cardiovascular disease and stroke. The dietary patterns that contribute most to cancer are still not understood. At-risk populations such as Aboriginal peoples and immigrants face cultural barriers in addition to other elements of the food environment, such as accessibility and availability. Children pick up lifelong food preferences and attitudes to eating early in life so it’s important to make sure that childcares and schools have appropriate meal programs in place. While many initiatives are best-served by a community-based, bottom-up approach, government can facilitate success by conducting meaningful evaluations, delivering legislation and policies that enable and promote success, and by allowing expansion of programs that work into sustainable, embedded pathways to health.
Rhonda C. Bell, PhD is Professor, Division of Human Nutrition, Department of Agricultural, Food and Nutritional Science, University of Alberta. Her current research focuses on the role of nutrition in the prevention of chronic diseases, with a strong focus on maternal and infant nutrition.

The 4-A Framework for Promoting Healthy Dietary Intake

Adequate

Available

Accessible

Acceptable

The 4-A Framework: Food for All

*Photo – Edmonton Sun
Key Points

Evidence-based nutrition guidelines are directed at helping individuals make healthy food choices, but most people do not adhere to such guidelines. In part, this may reflect the fact that guidelines do not consider the complex influence of the food environment in shaping dietary intake.

The 4-A Framework is a conceptual “map” that can be used to understand how the adequacy, accessibility, acceptability, and availability of foods influence dietary intake. This information can be used to guide successful interventions that positively impact on food choices.

The 4-A Framework may help bring together groups of scientists who contribute to the ‘upstream’ determinants of the food environment. For example, in the Physical Activity and Nutrition for Diabetes in Alberta (PANDA) project, clinical specialists, nutritionists and physical activity experts worked side-by-side with plant scientists, biochemists, economists and health messaging experts to develop more sustainable, health-improving programs for people with type 2 diabetes, using the 4-A Framework as a guiding principle. This type of activity represents an opportunity for new information to be generated that will help re-shape the food environment to support improved adherence to a healthy diet.

What's the Problem?

**Adherence to nutrition recommendations and guidelines**

Healthy eating and sound nutritional practices are cornerstones of good health as they help to protect against all forms of malnutrition as well as non-communicable diseases including obesity, diabetes, heart disease, stroke and cancer. Considerable effort in human nutrition science has focused on defining the elements of a healthy diet, and there is now strong consensus that a healthy diet includes: an energy intake that balances energy expenditure; regular intake of fruits, vegetables, legumes (e.g. lentils, dried beans), nuts and whole grains (e.g. unprocessed maize, millet, oats, wheat, brown rice); less than 30% of total energy from fat with an emphasis on unsaturated fats (e.g. fats found in fish, avocado, nuts, oil seeds and olives) rather than saturated fats (e.g. fats found in fatty meat, butter, palm and coconut oil, cream, cheese, ghee and lard); limited intake of free sugars (<10% of total energy); and a low salt intake (<5 g/day) through the use of iodized salt. Furthermore, industrial trans fats (those found in processed food, fast food, snack food, fried food, frozen pizza, pies, cookies, margarines and spreads) are not part of a healthy diet. The exact make-up of a healthy, balanced diet will vary depending on individual needs and are influenced by a number of inherent factors such as age, gender, life stage, physiological state (e.g. pregnancy), lifestyle, and degree of physical activity.

Detailed dietary guidance is provided to individuals through national food guides and recommendations. Food guides, such as Eating Well with Canada’s Food Guide (CFG), are directed at helping individuals translate nutrient-based recommendations into food choices. The foods included in food guides represent those that are widely consumed by people living in the specific country. Foods are grouped to represent good sources of particular nutrients (e.g. protein, carbohydrate, vitamins) and the number of servings/day that should come from each food group to meet nutritional requirements are indicated. Some food guides also include types of foods to avoid.

Despite the sound scientific principles on which food guides are based and the long-standing and widespread availability of documents such as CFG, few people adhere to these recommendations. Belanger et al reported that in 2004 (the most recent national survey of dietary intake in Canada), Canadian men over the age of 15 years consumed only half of the recommended servings of fruits and vegetables and fibre, while exceeding recommended salt intakes by 57%. Women fared better but also consumed lower than recommended amounts of fruit and vegetables (60% of recommendations), fibre (67% of recommendations) and excess salt (17% above recommendations). In that same report it was estimated that approximately 30,500 deaths out of a total of ~85,500 could have been averted or delayed if people adhered to the dietary guidelines.
outlined by CFG. This begs asking the critical question – why do people not regularly adhere to sound dietary guidelines?

What’s Coming Up?

An Ecological Model and the 4A Framework Informs Our Understanding of Food Choices

Interventions and initiatives geared at promoting healthy eating often focus on improving an individual’s food choice, yet there is strong recognition that eating behaviours reflect the complex interactions between and among individual, social, economic and environmental influences. Factors such as increased production of and access to processed food, rapid urbanization, and changing lifestyles, all influence individual food choices. Ecological models of health (see Food Environment, Health and Chronic Disease) consider the connectivity between people and their sociocultural and physical environments, and how these interactions are further shaped by government policies as outlined in Creating Health Promoting Food Environments through Policy. The Ottawa Charter, first described in 1986, outlines 5 priority actions that are critical to achieve health for all. These actions are: 1) build healthy public policy; 2) create supportive environments; 3) strengthen community action; 4) re-orient health services; and 5) develop personal skills. The challenge is to identify and implement specific actions that apply to supporting healthy nutrition and dietary intake and thus enable all people to successfully apply their skills and knowledge to adhere to a healthy diet in their daily life.

The 4-A Framework

The 4-A Framework is a conceptual “map” that can be applied to Action 2 of the Ottawa Charter, i.e. creating supportive environments. The 4-A Framework considers key elements of the food environment, namely Adequacy, Accessibility, Acceptability and Availability as factors that can facilitate or detract from adherence to a healthy diet. Adequacy is defined as regular intake of foods that meet dietary guidelines for health, are rich in nutrients and when included in the diet in appropriate amounts helps protect from all forms of malnutrition (both under- and over-nutrition) while protecting from the development of non-communicable diseases. Adequacy also includes the concept of dietary variation since a healthy balanced diet requires that people consume a variety of foods. Accessibility is defined as ensuring that foods be financially and physically accessible. Acceptability is defined as foods that people find desirable to eat from multiple perspectives: acceptable hedonic qualities, consistent with cultural practices, traditions and consumption habits, safe from contaminants, etc. Availability is defined as ensuring that foods being readily and regularly accessible to all people for purchase or procurement in socially acceptable ways.

The strength of the 4A Framework is that it provides a focus for assessing the food environment, for guiding the development and implementation of interventions, and for evaluating and refining approaches to building and improving environments where “the healthy food choice is the easy choice” in all areas where Canadians live, learn, work and play.

Evidence for the Importance of the 4A Framework Elements in Understanding Food Intake

There is growing appreciation for the importance of the food environment in shaping people’s food choices as a result of studies that assess and act to change the food environment. Studies advancing knowledge in this area provide examples of the complex ways individuals interact in many different settings, such as schools, places of work, home, grocery stores and restaurants, and how their dietary behaviours, in turn, are influenced by the public and private sectors including the food industry, government, and societal attitudes and beliefs.

Many of these studies take place in disadvantaged settings (e.g. low income populations; adolescents living in large urban centres; First Nations communities in the north of Canada) where the environment has been thought to be a particularly important determinant of eating behaviors (for examples see 7, 8, 9, 10). Interestingly, the factors identified in the 4-A Framework apply broadly, but the specific interpretations of accessibility, acceptability, availability, and adequacy vary within the local environment. For example, a study of low income adolescents in Baltimore indicated that the specific...
types of foods available (and not available) at carry-out restaurants, fast food chains and corner stores, along with poor neighbourhood safety, lack of grocery stores and lack of transportation to stores outside of their neighbourhood limited their ability to eat a healthy diet. In the Canadian north, lack of availability and high cost of certain foods (e.g. fruits, vegetables, dairy products) in combination with nutrition transition, characterized by reductions in procurement and consumption of traditional/country foods and higher intakes of store-bought food, are important determinants of poor quality diets 9,10.

The school setting has also been the subject of many studies to date, and results highlight the importance of availability, accessibility and acceptability in affecting food intake in children, adolescents, and young adults. For example, Henry et al11 conducted an intervention study in schools in Saskatoon, SK and varied the availability of plain and chocolate milk, as well as whether students had to purchase the milk or had it provided to them at no cost over a period of 12 weeks. Investigators measured milk intake throughout the study and interviewed a subgroup of the children to gain insight into why milk intake behaviours changed. Milk intake was higher when both plain and chocolate milk were both available compared to when only plain milk was available. From the interviews with the children it was noted that drinking milk was dependent on accessibility, i.e. the children said they were more likely to consume milk regularly when it was easily accessible. The children also indicated that they did not like to spend their own money on plain milk at school since it was generally available at home “for free”. Additional insights regarding childcare settings are offered in Dr. Farmer’s article Food Environments and Child Health in the Preschool Years.

Deliens and colleagues12 investigated factors that influence university students’ eating and drinking behaviours. Food availability, accessibility and acceptability all impacted on students’ eating and drinking in both positive and negative ways. For example, some students reported consuming French fries regularly because they were available at dining halls in residence, while others said that they ate more healthily, and less fried foods, because they did not have access to a fryer in the kitchen of their residence. Several students noted that they had limited time for cooking with their busy class, exam and social schedules and therefore they were more likely to eat unhealthy convenience foods. While some noted that being part of social groups at university encouraged consumption of alcohol, others reported taking time to cook a healthy meal together with peers on a regular basis. Results from these studies underline the importance of evaluating the specific role that the food environment plays in affecting intake among different groups of people. Furthermore, results from these studies highlight the fact that additional work is needed to better understand the role of the food environment in affecting dietary choices in the broader population.

What Needs to Be Done?

While the 4-A Framework is a robust and widely applicable model that can aid in the evaluation and interpretation of results examining factors affecting dietary intakes, work is needed to understand how this Framework can guide interventions to improve and support a healthy food environment. Studies thus far have focused on how food environments shape food choices and habits. It has considerable potential to also help us understand how “upstream” determinants of food availability, accessibility, acceptability and adequacy can shape the environment. This area is largely unexplored but deserves attention. Such studies would offer the opportunity for agrologists, crop scientists, food production specialists, those involved in retail, distribution chains and others to work closely with nutrition experts to consider how best to create supportive environments that allow people to succeed in adhering to healthy dietary guidelines. Effective and sustainable approaches to health promotion and disease prevention, treatment and care are rooted in healthy dietary intakes and require cross-sectoral, multidimensional strategies that are diverse, coordinated and reinforcing across different levels of the complex, multifaceted environment that shapes individual food choices.

Attention needs to be given to the importance of evaluating environmental components in the context of dietary intake to enable effective nutrition interventions to move beyond those focused on individual skills and knowledge and include designing and implementing an environment that improves adherence and allows people to be successful in consistently eating a healthy diet.
Food Environments and Child Health in the Preschool Years

Anna Farmer, PhD, MPH, RD.
Dr. Farmer is Associate Professor in the Department of Agricultural, Food and Nutritional Science and the Centre for Health Promotion Studies at the University of Alberta and Registered Dietitian. In addition, Dr. Farmer is a member of Health Canada’s Food Expert Advisory Committee. Her research focuses on the impact of food environments on healthy eating and active living in children in child cares as well as the influence of dietary sodium behaviours on the health of Canadians.

The preschool years present a critical window for preventing obesity because it is a time when young children establish healthy eating and physical activity habits. Despite public health efforts in Canada, over 20% of children aged 2-5 years of age are overweight and it is concerning that more severe forms of obesity are rising among children. Several factors contribute to the rising incidence of obesity such as poor eating habits, low intake of fruits and vegetables, and milk and milk products, and eating too many high energy snacks and being less active. Overlapping food environments in the home, school, child care and communities where children live, eat, learn and play influence children’s eating patterns and choices.
Food and nutrient intake trends in children and the food environment

Young children in Canada are not meeting the dietary recommendations proposed by Eating Well with Canada’s Food Guide. Over the last decade, there is a trend toward consuming less milk, vegetables, whole grain breads and eggs, and an increasing intake of fruit and fruit juice, soft drinks, salty snacks, poultry and cheese. More than one-third of children aged 4 to 9 years do not consume the minimum recommended two daily servings of milk, which is a source of essential nutrients such as calcium and vitamin D. By adolescence the likelihood of meeting milk consumption recommendations is more than 60%. Low income Canadian children are more likely to have low access to and consumption of milk (“milk insecurity”) because they cannot afford to buy enough milk to meet daily requirements. Milk prices in Canada are 2-4 times higher than international peers because of Canada’s dairy supply management system. Making milk more affordable for lower income families is a one strategy for ensuring vulnerable children can afford to eat nutritious foods such as milk.

Consuming vegetables and fruits is part of a healthy diet that provides essential vitamins and minerals and fibre. More than 70% of Canadian children aged 4 to 8 years do not meet the minimum daily recommendations of 5 servings for vegetables and fruits. Children who eat fewer than 5 servings of fruit and vegetables are significantly more likely to be overweight or obese. Accessing vegetables and fruits is a major barrier to healthy eating among low income Canadian children. Families who have difficulty accessing fresh fruits and vegetables in their communities are often more likely to have higher rates of obesity and other chronic diseases. As well, those from lower income groups are unlikely to own a car for shopping and are limited to purchasing what they can carry. Thus, they may be more likely to rely on smaller corner stores where prices are higher and fresh vegetables and fruits are limited or not offered. Some possible solutions to increasing access to vegetables and fruits are to reduce transportation barriers, offer shuttle buses to existing grocery stores and increase access to foods to inner-city by exploring alternative sources of fresh foods markets such as incentives to smaller corner stores to sell healthier food options.

Children are snacking more often than ever before and more of their daily energy is coming from snacks other than from a main meal. For Canadians 4 years and older, more than 41% of snack calories are from foods high in energy, sodium, sugar and fats. In Canada, soft drinks are the most popular beverage among children and adolescents. The Breakfast for Learning Report Card on Nutrition for School Children found that 37% of children aged 6 to 17 years consumed 1 or more servings of regular soft drinks per day. High consumption of sugar-sweetened beverages, which provide excess calories and sugars, is associated with increased risk of obesity and lower intake of essential nutrients. For instance, children with a high consumption of soft drinks consume less milk and fruit juice. Indeed, there is room for improving children’s eating habits by reducing consumption of energy-dense foods and increasing intake of nutrient-dense foods to enhance the overall quality of children’s diet.
Child Food Preferences, Environment and Behaviour

An ecological approach to eating considers the home, preschool/childcare, and community environments that shape food options available to young children and their families. Ecological models provide a framework for addressing interactions across individual, social and environmental spheres of influence to understand factors affecting the food environment and this piece builds on the work discussed by others in this issue. Children's eating behaviours are influenced by factors that are individual to the child, but are also influenced by the environments in which children live, play and learn. Creating food environments where all children have the opportunity to access and consume healthier food options is an important step to improving children's health.

Parents and the family environment are key factors in the development of food preferences, patterns of food intake, eating styles, activity preferences and patterns that shape children's weight. Children's early experiences with food and eating are shaped by parents and other caregivers. Family meals provide important opportunities for parents to be healthy eating role models to children. When parents serve as role models, children will follow their lead.9 Research shows that learned preferences for healthy foods and healthy food choices occur when children are exposed to healthy food environments coupled with individual food preferences and appropriate feeding practices.10

An example of how taste preferences develop is that of salt. Children are born with an aversion to salty flavours.11 However, over time, infants habituate to saltier tastes as they transition to table foods served at family meals. Children as young as one year-old are consuming twice the recommended daily intake of sodium.12 The majority of Canadians rely on convenience and processed foods, such as pizza, pasta dishes and sauces for quick meals, which tend to be high in sodium.13 It is noteworthy that some food products, such as cereals available in Canada, are higher in sodium than counterparts sold in Europe or the US. This is partly due to Canadians’ taste preferences for saltier foods and consumer demand. Hence, it is not surprising that children develop salty taste preferences early in life.14 Children with sodium laden diets have a higher risk of developing high blood pressure, a leading cause of heart disease.15 An optimal way to reduce daily sodium intake is to create healthier food environments by reducing the amount of sodium in processed and convenience foods available to consumers.16

In an effort to improve access to healthier, lower sodium foods and reduce high sodium habits of Canadians, Health Canada proposed a multicomponent voluntary Sodium Reduction Strategy. Reducing the sodium content of processed and convenience foods is one of four specific recommendations made in the strategy, which is thought will have the greatest impact on public health.17 Other countries such as Finland and Britain have experienced some success with this comprehensive approach to sodium reduction. The Finnish and British governments provided incentives and educational programs to assist food producers to systematically reduce the sodium content of foods as well as increasing consumer awareness through mass media campaigns. By changing the food environment and educating the public on the benefits of lower sodium intakes, these countries experienced a positive shift in the population's health - lower sodium intakes and lower blood pressure. Health Canada was hoping for a similar response in the efforts to lower sodium and improving the health of Canadians. Unfortunately, little progress has been made since the launch of the voluntary plan five years ago. The majority of foods in the marketplace remain high in sodium, and consumers have not decreased their intake of dietary sodium - in fact, sodium intakes appear to be increasing among Canadians.
Food Environments in Childcare Centres

The majority of preschool children in Canada are in some form of childcare, making these settings important for health promotion. In 2008, the Alberta Nutrition Guidelines for Children and Youth were disseminated to all child care settings in an effort to assist them to create an environment that provides and promotes healthy food choices and healthy attitudes toward food.18 Our research found that childcare centres in Edmonton experience challenges in providing children access to high quality food (including vegetables and fruit), children’s attitudes towards new foods, caregivers’ promotion of healthy behaviours for children, parents’ encouragement of and support for children to make healthy food choices at home.19 Access of culturally appropriate foods, including a better understanding of the social aspects of the food environment were limited in the settings we evaluated.

Childcare staff are important agents for behaviour change as their role modelling behaviour can have a positive or a negative effect on children’s healthy behaviours; this is especially important in young children. Children aged 2 to 5 accepted novel foods more quickly and consumed more of that food when child care staff ate similar food.20 It is not uncommon for childcare staff to overlook opportunities for promoting healthy eating behaviours at meal times. Supportive healthy eating conversations at meal time and encouraging children to listen to their hunger and satiation cues help to support a healthy food environment. The provision of continuing education to child care staff can positively reinforce healthy eating behaviours in children and promote positive food environments. Indeed, childcare settings are potentially important for promoting healthy eating and active living.

Improving the food environments where children live, eat, play and learn is one step to improving children’s health. By making fresh fruits and vegetables, and milk and milk products more accessible and affordable to children is one way to reduce health inequities in our most important and precious resource – our children.
Food Security among Alberta First Nation

Aboriginal Peoples in Canada

“Aboriginal peoples” is a collective name for the indigenous peoples of Canada and their descendants. The Canadian constitution recognizes three groups of Aboriginal people: First Nations (until more recently referred to as North American Indians), Métis (individuals of mixed First Nations and European heritage) and Inuit, each with unique histories, languages, cultural practices and spiritual beliefs. Prior to European contact, First Nations and Inuit had good health due to an active lifestyle and healthy traditional diets. There was an almost complete absence of chronic diseases associated with obesity, like diabetes, and few dental cavities, in these populations. Today, among Aboriginal peoples, as among non-Aboriginal peoples, obesity-related chronic diseases and dental caries attributable in part to diets high in refined carbohydrates (sugars and starches) are prevalent.

The 2011 National Household Survey (NHS) indicated that 46% of individuals in the Aboriginal population are under age 25 years, compared to 29% for the rest of the Canadian population. The Aboriginal population is growing faster than the rest of the Canadian population because of its young age structure. Thus, attending to the health and nutritional needs of infants, children, youth and young women of childbearing age is important.
The majority of Aboriginal peoples in Alberta are First Nations. The 2011 NHS showed that 116,670 First Nations people lived in Alberta, representing 13.7% of all First Nations people in the country. The most commonly spoken First Nations languages in Alberta are Blackfoot, Cree, Chipewyan, Dene, Sarcee, and Stoney (Nakoda Sioux).1

Income-Related Food Insecurity in Aboriginal Households

The Food and Agriculture Organization (FAO) of the United Nations states that the “right to adequate food is a universal human right that is realized when all people have physical and economic access at all times to adequate food or the means for its procurement, without discrimination of any kind.”2 Food security is an important aspect of the right to adequate food. The definition agreed upon at the 1996 World Food Summit states that food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life.2 Health Canada, the Federal government department responsible for helping Canadians maintain and improve their health, uses the Household Food Security Survey Module to capture the complex phenomenon of household (i.e., family) food insecurity status related to limited household financial resources. Moderate food insecurity means the quality and/or quantity of food consumed is compromised among household members. Severe food insecurity indicates reduced food intake and disrupted eating patterns, including hunger, among household members.3

Both national and regional surveys indicate that Aboriginal households are more vulnerable than non-Aboriginal households to income-related food insecurity. Nationally, 28.2% of Aboriginal households located off-reserve are food insecure as compared to 12.6% of households in the general population. Of Aboriginal households, 14.8% are moderately food insecure and 8.3% are severely food insecure.4

Household food insecurity is associated with poor nutrition. Food insecurity likely contributes to the increased risk of diet-associated chronic diseases in the Aboriginal population.5 Food insecure individuals are also less able to manage chronic diseases like type 2 diabetes. Household food insecurity is associated with self-reported poor general health, high stress, and life dissatisfaction.6 Aboriginal children are particularly vulnerable to the negative nutritional outcomes of household food insecurity. In Inuit households with child food insecurity, there are times when children are fed less expensive food and less healthy food, and times when children do not eat enough because of a lack of money to buy food.7

To be food secure, a household must have enough money to purchase food. Household food insecurity is elevated in the Aboriginal population because poverty persists in it.8 Thus, poverty reduction efforts are required to reduce food insecurity in the Aboriginal population through actions that will improve employment opportunities and income. These actions include education (e.g., high school completion and post-secondary education), higher wages (e.g., higher minimum wage for unskilled positions and access to more highly paid skilled positions), and improved social assistance benefits, especially for lone women raising children.

Non Income-Related Conditions For Food Insecurity Among Aboriginal Peoples

“Cultural food security” is an important consideration of Aboriginal food security, in addition to income-related food security. For Aboriginal peoples, the traditional foods of their cultural groups are valued. All Aboriginal peoples historically hunted, fished, trapped and gathered plants for food and medicines from local food systems. First Nations horticulturalists planted crops such as corn, beans and squash. There is evidence of crop cultivation predating the arrival of Europeans among First Nations living on the Prairies.9 The historic relationship between First Nations peoples and the wild plants they used was complex. Prairie First Nations, for example, had a profound ethnobotanical knowledge of more than 185 plants, and some ‘wild’ plant species were actively managed.

Traditional foods are often of higher nutritional quality than the numerous processed, store-bought foods now consumed. The perspective of many Aboriginal peoples is that traditional food by its
very nature is health promoting and good to eat. In addition to nourishing the body, traditional food has the advantage over commercially available food of also nourishing the mind and spirit, being an anchor to Aboriginal culture and personal wellbeing, and being an essential agent to promoting holistic health. The implication is that health promotion strategies should include traditional foods.

**Impediments To Food Security**

As discussed by other scientists in this volume, food choices are complex decisions influenced by a dynamic relationship between individual and environmental factors. The Ecological Model of Health Promotion in the overview, *Food Environment, Health and Chronic Disease* shows that Public Policy is an overarching determinant of food choice behaviour. Historic government policies that dispossessed Aboriginal peoples from their traditional lands and that sought to undermine and destroy Aboriginal cultures are important considerations when discussing Aboriginal food insecurity and health. These policies resulted in the reserve system, the inability of First Nations to farm reserve lands, residential schools, and habitat loss. Agricultural policies and other policies and regulations severely constrained, and continue to constrain, the cultural and economic food security of Alberta First Nations.

**Indian reserves**

Beginning in the late 1800s, Canada undertook a series of land surrender treaties with First Nations. First Nations were encouraged to settle on reserve lands. Their lands were given to European settlers to farm. In Alberta, there are 45 First Nations in three treaty areas, 140 reserves, and approximately 812,771 hectares of reserve land. Of the 82.9% of Alberta First Nations with registered Indian Status (Treaty Indian), 47.3% lived on a reserve. Some reserves are located in areas where economic opportunities are limited, and the reserves themselves provide few resources. Reserves are federal Crown land. There are many requirements in the *Indian Act* that make development on reserve land difficult and that discourage private investment and business activity.

**Government agriculture policy**

A prime stated motive for establishing the reserve system was to encourage First Nations peoples to farm. Treaty 6, signed in 1876, includes Alberta First Nations. The Treaty states that, “Her Majesty the Queen hereby agrees and undertakes to lay aside reserves for farming lands.” Treaty 6, and other Treaties, promised articles for the encouragement of the practice of agriculture to the First Nations bands that ceded their rights, titles and privileges to their ancestral lands. The promised articles included farming implements; wheat, barley, potatoes and oats to plant the land; and livestock.

Following the settlement of reserves, many First Nations were eager to establish farming practices. By the late 1880’s, some First Nations farmers were more successful than European farmers at agriculture. To diminish their competition with European farm settlers, the government reacted to the success of First Nations farming by implementing repressive policies and discriminatory legislation to restrict First Nations people’s ability to farm, including not honouring Treaty terms. For example, the farming implements, seeds and livestock that First Nations were promised when reserves were established often never materialised. Following many enactments that reduced agricultural capacity on reserves, government agents used First Nations’ marginal agricultural production to justify reducing the size of reserve lands, further decreasing agricultural production on reserves and further impoverishing the individuals living on them.

Today in Alberta, Bands such as the Mikisew Cree First Nation (http://mikisewcree.ca/) press for their Treaty 8 rights to Agricultural Benefits. Other Bands situated on prime agricultural land actively practice agriculture. The Piikani First Nation, for example, is made up mostly of agricultural land, with between 20,000 and 30,000 acres under cultivation. There is a 650-head cattle-ranching operation. Some Alberta First Nations lease their farmland for crop cultivation.

**Residential schools**

Residential schools were an extensive school system established in the 1880s by the Canadian government and administered by churches. The
last residential school closed in 1986. The intent of residential schools was to educate Aboriginal children in European subject matter and assimilate them into mainstream Canadian society. This was done by separating children from their families and forbidding them to acknowledge their Aboriginal heritage and culture, or to speak their own language. As a result, many children became alienated from the traditional practices of their cultural group, including practices related to traditional food production.

Residential schools often had farm animals cared for by students, and kitchen gardens where vegetables were grown and tended by the students under staff supervision. School administrators of one Manitoba residential school believed that First Nations boys would never become extensive grain growers but could grow root vegetables. They thought that the school’s vegetable garden provided the most useful training for students. Thus, boys were deprived the skills to grow crops. The farm and garden labour forced upon children in residential schools resulted in some of them growing up with negative feelings about animal husbandry and home gardening.

**Changing environments and habitat loss**

Aboriginal peoples have a reduced intake of traditional foods because of a decline in traditional plant and animal species resulting from changing climactic conditions, environmental degradation, deforestation, overharvesting, and contamination with heavy metals or other toxins. Access to traditional foods is further restricted by hunting and fishing costs; legislative restrictions on hunting, fishing, trapping and gathering; and, a loss of knowledge of traditional harvesting skills due to residential schools and other events.

**Actions To Address First Nations Food Security**

Numerous governmental and non-governmental initiatives exist to increase Aboriginal food security. Some are small scale and short term, limiting their ability to effectively reduce food insecurity. Others are ‘top-down’ initiatives that do not have a foundation in Aboriginal cultural values. Large scale, national and regional initiatives created by Aboriginal peoples, or in consultation with Aboriginal peoples, to reduce poverty, restore habitats, and develop legislation that enhances harvesting rights is required. Aboriginal Self Determination must be honoured when these initiatives are created. Self Determination includes the right for Aboriginal peoples to direct the social, cultural, spiritual and economic advancement of their peoples.

Participatory and mutually respectful initiatives to build food security in First Nations communities in Alberta have happened. In Alexander First Nation, the Alexander Research Committee, comprised of local community members and academic researchers, is working to secure healthy nutrition for children attending Kipohtakaw Education Centre. One project, EarthBox Kids, involved children planting and tending classroom container gardens, and preparing and eating what they grew. The result was children’s increased preferences for vegetables and fruit. Albert Agriculture and Rural Development supported the project.

**KEY POINTS:**

1. To ensure food security for Aboriginal peoples, efforts to address cultural food security and reduce poverty are required.

2. An important dimension of food security for Aboriginal peoples includes having access to culturally acceptable traditional foods obtained through the pursuit of indigenous livelihoods such as hunting, fishing, trapping, gathering, and agriculture.

3. The legacy of Government agricultural policies for individuals living on reserves are important to bear in mind when considering contemporary First Nations agricultural practices.

4. Aboriginal peoples are actively resisting colonial policies and agitating for their right to food security.
Cancer is one of the most prevalent chronic diseases in Canada and the leading cause of death, being responsible 1 in every 3 deaths in the nation. Considerable research is emerging on the relationship between food environment and chronic diseases, however the emphasis has been on obesity and cardiovascular disease. Little research exists to aid in understanding of how the physical and social surroundings can impact cancer incidence. In view of the prevalence and significance of cancer, and the association between diet and cancer risk, interventions that promote healthier eating habits can positively impact cancer prevention.

What’s going on?

According to the Canadian Cancer Society, 2 out of 5 Canadians will develop cancer at some point of their lifetime and 1 out of 4 will die of the disease. In 2011, the number of deaths caused by cancer in Canada surpassed 70,000 and, in 2014, 210 Canadians were expected to die from cancer every day. Therefore, it is crucial to develop public health strategies focusing on preventing of the leading cause of death in Canada.

Dietary interventions are a strategy applied to reduce cancer incidence. A significant association between overweight/obesity, poor eating habits (low fruit and vegetable intake, and high intake of red meat, sweets and desserts) and higher risk of cancer
mortality have been reported (Table 1).

As eloquently outlined in preceding essays, the food environment is an important determinant of food choice, influencing fruit and vegetable consumption, fat and caloric intake, and food patterns3,4.

<table>
<thead>
<tr>
<th>Food and nutrients</th>
<th>Cancer type</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Fiber Intake (fruit, vegetables and whole-grain)</td>
<td>Colorectal cancer, Esophageal cancer, Gastric cancer, Breast cancer</td>
</tr>
<tr>
<td>n-3 Polyunsaturated Fatty Acids Intake</td>
<td>Colorectal cancer, Breast cancer, Endometrial cancer</td>
</tr>
<tr>
<td>Vitamin and minerals (i.e. vitamin D, calcium, selenium, vitamin E, folate)</td>
<td>Breast cancer, Prostate cancer, Colorectal cancer, All cancer (nonspecific protection)</td>
</tr>
<tr>
<td>Red and Processed Meat Intake</td>
<td>Colorectal cancer, Pancreatic cancer, Gastric cancer, Bladder cancer, Prostate cancer, Esophageal cancer</td>
</tr>
<tr>
<td>Saturated Fat Intake</td>
<td>Prostate cancer, Breast cancer, Oral cancer, All cancer (nonspecific risk increase)</td>
</tr>
<tr>
<td>High Sugar Intake</td>
<td>Colorectal cancer, Pancreatic cancer, Breast cancer</td>
</tr>
</tbody>
</table>

The definition of food environment takes into account factors such as access, availability, affordability and price of food in the environment5. A study conducted in Edmonton, Alberta showed that overall, supermarkets are relatively accessible in the city. However, six neighborhoods were identified that were characterized as “food deserts” by the authors. The residents in these neighborhoods travel a distance between 2.1 and 2.5 km to the closest supermarket. Considering that two of these neighborhoods had the lowest income rates and the highest elderly and no-vehicle rates in Edmonton, limitations in transportation represents a barrier to access to healthy food6. Another study in Edmonton showed that lower socio-economic status neighborhoods tend to have a higher concentration of fast-food outlets7. Typical fast food meals have significantly high energy density and fat content, and are low in micronutrients and fiber. Limited access to fresh, nutrient dense foods can directly increase the incidence of cancer8.

**Why does it matter?**

An effective way to reduce cancer incidence is by targeting modifiable risk factors such as diet. Some of the strategies to reduce cancer rates involve increasing the intake of fruit, vegetables and whole-grains and decreasing intake of highly processed food and high fat foods9. Nonetheless, to promote a dietary-focused intervention to reduce cancer incidence, it is important to consider the food environment of that particular population. As the consumption of certain foods depends on its availability and affordability, the effectiveness of such interventions is directly related to food environment, which is in turn a result of economic/policy, social and physical contexts10 (Figure 1).
Figure 1. Contextual settings that ultimately influence food environment. Adapted from a discussion in Sturm & Ruopeng 2.
People living in areas with low socioeconomic status face greater difficulties to improve their eating habits. Studies have shown that the cost of healthful foods is higher in low socioeconomic status neighborhoods than in wealthier communities. Price disparity is partially due to these neighborhoods having a lower concentration of larger groceries stores and prices tend to be higher in smaller stores. Smaller stores typically have access to food products of limited variety and quality. As an example, variety in items like whole-grain and low fat products may be limited or not available and fresh food is limited. Supermarkets are less accessible to those with lower socioeconomic status and minorities, populations that are at higher risk of developing cancer.

Therefore, the role of health professionals goes beyond promoting healthy eating habits for cancer prevention. Interventions have to take into account individual's socioeconomic reality, including the food environment they inhabit. Ignoring the context of food environment as an important determinant of food intake may lead to limited success of interventions.

What's coming up?

The understanding of how the food environment can affect population health status need to be complemented with research on dietary patterns known to decrease cancer risk.

Alberta is well positioned to advance knowledge on cancer risk and food environment with data from the ongoing Tomorrow Project (www.in4tomorrow.ca), which is collecting a comprehensive set of health data (including food and nutrition intake) in thousands of Albertans to discover more about what causes cancer. The results will inform researchers and policy makers about key components of the food environment that drive cancer risk.

Considering aspects of food environment to influence dietary choices will prevent not only cancer, but other chronic diseases. Approaches enabling a comprehensive view of food environments and interactions with other variables to affect population dietary behaviours, ultimately empowering individuals as consumers to campaign for better food environments, but also to advocate for better conditions in the community they are working and living in.

Finally, knowledge on different food environments within a city, province or even country is an important tool for planning policy and resources management, considering that it provides information on the most susceptible populations.

KEY POINTS:

1. Knowledge about the influence of the food environment on cancer risk is emerging.

2. The food environment influences dietary patterns which, in turn, are directly related to cancer risk.

3. Considering the context of the food environment as a determinant of food intake is important to ensure successful interventions.
The Food Environment, Nutrition Transition and Type 2 Diabetes

In this essay, the food environment in the specific context of contributing to both the cause and the prevention of two highly prevalent chronic diseases, type 2 diabetes and cardiovascular disease will be addressed.

The increase in prevalence of diabetes (type 1 and type 2 combined, with type 2 accounting for approximately 90% of cases) is illustrated in Figure 1 and shows that over 10 years the proportion of Albertans with diabetes has increased by 60%. Diabetes is a major risk factor for cardiovascular disease; compared to people without diabetes, people with diabetes are 2-4 times more likely to suffer a stroke, heart attack or heart failure.

Furthermore, the distribution of diabetes cases across the province varies considerably. For example, prevalence in five First Nations communities is more than 15% whereas in our mountain playgrounds of Banff and Lake Louise, prevalence is less than 3.5%. These data suggest that there are differences between communities, both genetic and environmental, that contribute to development of type 2 diabetes and related chronic diseases.

Nutrition Transitions

Nutrition transitions occur when populations adopt broadly different food use that is accompanied
by changes in nutrition-related diseases.\(^2\)

Within Alberta (as in other jurisdictions in North America), several nutrition transitions have occurred since World War II. The most broad-reaching transition that affected the entire population to some extent,\(^2\) resulted from changes in farming practices and food production that led to increased availability of calories relative to need, a burgeoning variety of ready-to-eat, processed foods and emergence of fast food restaurants. The nutrition transition occurred in concert with increased automation of workplaces and home environments, leading to decreased overall physical activity. Over about the same timeframe, changes were occurring in First Nations communities’ food acquisition practices, with decreased reliance on traditional foods and increased consumption of store-bought foods. (This topic is addressed in greater detail in the article Food Insecurity Among Alberta First Nations). In the past 2-3 decades, Alberta has experienced a greater influx of non-European immigrants than in the past. These populations have also been exposed to a nutrition transition associated with acculturation to mainstream Canadian culture.\(^3\)

**Food Environment**

Changes in food use or patterns that occur during nutrition transitions are predicted by changes in the food environment, which refers to the accessibility, acceptability and availability of foods, as explained in *The 4-A Framework for Promoting Healthy Dietary Intake*.

In Alberta, food environment challenges vary by geography. In large urban centres, food environment is not just about what foods are produced and imported, but about whether people have transportation to get to grocery stores, whether the grocery outlet nearest one’s home is a convenience store or a supermarket as well as an individual’s socioeconomic status. In small towns, rural and northern settings, where there might only be one food store, the food environment has added challenges such variety, freshness and nutritional profile of the foods on offer. The cost of food, especially for perishable items, is generally higher in remote and rural locations than in urban centres. Similarly, urban centres offer a broader variety of dining out options.

**Relationship of the Food Environment to Type 2 Diabetes**

When an individual is diagnosed with type 2 diabetes, counseling is recommended and most people receive information about healthy diet choices based on the recommendations of the Canadian Diabetes Association (CDA).\(^4\)

Recently, our research group has examined how income and time spent working impacts food choices and diet quality in people who have type 2 diabetes. We found that diet quality worsened (decreased vegetables and fruit relative to increased sodium and fatty foods) as time spent working increased and this was also related to less optimal blood sugar control. This relationship was strongest for people with a household income above $60,000 per year, which was surprising at first. However, it suggests that elements of the food environment, such as meals available in food courts, snack foods and ready-to-eat foods may be more frequently purchased by people who spend more time working, particularly if they are higher-income earners. Convenience plays a larger role in what food is selected.\(^5\) To illustrate this point, we averaged the nutritional information for a hamburger (no fries) offered by three sit-down restaurants in Canada (Table 1).

We found that many people who have diabetes report that enjoyment of dining out decreases after diagnosis. This may speak to the fact that many restaurants do not serve diabetes-friendly options,
that portion sizes are too large for health. In the example in Table 1, all three burgers provided at least 40% of daily energy intake (for someone with an intake of 2000 kcal per day), with an unbalanced distribution of more than half of energy from fat. (The recommendation for people with diabetes is not more than 30% of energy from fat). If a person selected the burger with the lowest calories and fat, it would come with the highest amount of sodium. A recent study of American data suggests that among people with higher education, increased neighbourhood restaurant density predicted increased prevalence of obesity. Conversely, among people with lower education levels, reduced price of food eaten at home was a stronger predictor of increased obesity prevalence. 

Policy makers must account for particular healthfulness of the food environment.

Portion sizes of food began increasing in the 1970s in North America and parallel the upward trend in obesity. Although it is intuitive that reducing portion sizes should lower energy intake, there is surprisingly little research done, most of the studies are short-term in nature and the results are not conclusive. For example, while people may consume less energy when presented with fixed-calorie snack packages it is not clear if they subsequently compensate for the small snack with a larger snack or meal at a later time. The relationship between portion size and value-pricing (the Super-Size Me effect, reflecting the 2004 movie in which the protagonist eats only McDonald’s food for 30 days) also complicates our understanding of this issue. 

Research regarding consumer purchasing patterns, caloric intake and product pricing is needed.

The Outlook

The example of the challenges posed by the food environment in restaurants highlights only one facet of the problem for people with diabetes and cardiovascular disease. At present, the best means for an individual to take control of the food environment is to prepare foods “from scratch” at home so as to reduce salt, fat and sugar. However, it is widely acknowledged that burdening individuals with finding solutions is not a long-term solution for the population. Furthermore, the population of Alberta is currently relatively young, with a diabetes prevalence lagging below the Canadian average. As the population ages, the number of people attempting lifestyle change will increase. Changes at the level of society, that is, changes in the food environment in which we live are required for a successful strategy to improve healthy eating. What are the roles of government, the food industry and consumers (people with and at risk of diabetes or cardiovascular disease)? Dr. Raine will tackle aspects of government and community policy in her essay Creating Health Promoting Food Environments through Policy as it relates to the general population. With regard to the food industry, a brief glimpse at some recent initiatives may shed light on programs that could have broader reach.

Example 1 - Food Processing Industry: Sodium-lowering initiatives

According to Health Canada, the average Canadian consumes two times as much sodium as required for health every day. Initiatives at the public health level include educational strategies to increase awareness and reduce intake of sodium. Research funding has been targeted to further understand how sodium intake affects physiology, to evaluate how well Health

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Average (Range)</th>
<th>% of 2000 kcal/day diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcal)</td>
<td>939 (818–1160)</td>
<td>47 (40 – 58)</td>
</tr>
<tr>
<td>Fat (grams)</td>
<td>57 (30 – 81)</td>
<td>25 (14 – 36)</td>
</tr>
<tr>
<td>Saturated fat (grams)</td>
<td>21 (12 – 32)</td>
<td>9 (5 – 14)</td>
</tr>
<tr>
<td>Carbohydrate (grams)</td>
<td>61 (55 – 64)</td>
<td>12 (11 – 13)</td>
</tr>
<tr>
<td>Fibre (grams)</td>
<td>5 (3 – 7)</td>
<td>20 (12 – 28)</td>
</tr>
<tr>
<td>Sugar (grams)</td>
<td>11 (9 – 13)</td>
<td>2</td>
</tr>
<tr>
<td>Protein (grams)</td>
<td>49 (35 – 73)</td>
<td>10 (7 – 15)</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>No data given</td>
<td>43</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>No data given</td>
<td>12</td>
</tr>
<tr>
<td>Calcium</td>
<td>No data given</td>
<td>28</td>
</tr>
<tr>
<td>Iron</td>
<td>No data given</td>
<td>49</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>2115 (1560 – 3016)</td>
<td>92 (of upper limit, 2300 mg)</td>
</tr>
</tbody>
</table>

Table 1. Nutritional profile of an “average” burger (based on data supplied by three Canadian restaurants)
Canada’s sodium reduction strategy is working and to examine how interventions may work at the population level. Rather than using legislation, voluntary sodium reduction strategies for the food industry have been proclaimed. A survey conducted by Agriculture AgriFood Canada indicates that food manufacturers and retailers had products that met the guidelines, some of which had been modified or developed to meet the specified sodium targets. Therefore, the food industry has made some strides to producing low-sodium products. However, of the main reasons for a company having a sodium reduction strategy, consumer demand was listed as the third most important.8 Since change in taste is a major barrier to lowering sodium in foods, the voice of consumers in advocating for change is particularly important for longevity of sodium-reduced products on store shelves; lack of sales could lead to their disappearance from the marketplace, reducing the likelihood that the sodium reduction strategy will be successful. As discussed in Food Environment and Child Health in the Preschool Years, the success of this policy-driven intervention in Canada has been less than optimal.

Example 2 - Agriculture Industry: Growing healthier raw ingredients

Development of new varieties of Alberta-grown crops and livestock is helping the industry cope not only with forces such as global warming, environmental impact, yield and storage capability but can also be directed to increase healthful properties of products. For example, the Alberta Innovates Phytola Centre was founded to spur research into lipid chemistry and molecular biology to develop novel oil products. One current initiative is to increase the content of heart-healthy omega-3 fatty acids in canola and flax. Husbandry practices can markedly affect the healthful properties of meat products. Ruminant animals grazed on grass versus being grain fed, have meat and milk enriched in vaccenic acid, a fatty acid that has been reported to reduce cardiovascular disease and diabetes risk.9 Studies in rodent models show that feeding vaccenic acid can reduce risk factors associated with cardiovascular disease and diabetes, although sufficiently large trials have not yet been done in humans to determine if the effects can be translated.

Moving Forward

Interdisciplinary research between agricultural, food science and human nutrition specialists can help to increase the pace of developing and delivery of more healthful products to the food environment. Activities must also be mindful of food production practices that minimize other environmental impacts, such as greenhouse gas production, soil and water conservation.10 Diet has been identified as a link between the environment and human health. Promoting dietary patterns that also promote a healthy environment will benefit everyone.

KEY POINTS:

1. The food environment is a contributor to the upsurge in obesity, type 2 diabetes and cardiovascular disease.

2. Factors such as total calories, nutrient balance and portion sizes make it difficult for people with diabetes to find healthy options, particularly when purchasing restaurant meals or processed foods.

3. Because consumers increasingly rely on food that’s convenient to prepare and eat, there is an opportunity for the agriculture and food industries to better formulate products.
Food is one of our most basic human needs for survival and maintenance of health. Food is also at the core of our needs for sharing, celebrating and caring for others. Eating is not an isolated act, but a deeply contextualized behaviour embedded in complex food environments that shape the availability, affordability and social acceptability of food and nutrition “choices”. While it is ultimately a personal choice to raise a fork to one’s mouth, people do not make food choices in a vacuum. Research is demonstrating associations between food environments and diet-related outcomes\textsuperscript{1,2}. The nutritional health of the public is related to their food environment! While individual qualities such as knowledge, attitudes and skills can help to navigate increasingly complex food environments, whether they be within families, at school, at work or in the community at the supermarket, understanding that there are broader forces at play that shape our food environments is essential to stimulating change that can improve food environments\textsuperscript{3}. Some of the most powerful means of modifying food environments, for better or for worse, are through policy.

Food is not only central to human health and social wellbeing, but it is at the heart of every productive society. Entire societies have been organized around means of accessing, producing and sharing foods, from hunter-gatherers to agrarian societies, and from...
communal sharing to industrialized food production, processing, commercialized sales and international trade. While the ways in which societies are organized may seem far removed from the process of making food choices, it is political decisions that largely shape the ways that food is made available, affordable and attractive to people. As such, policy decisions and political actions at every link in the food chain can be an ideal target for intervention to improve the health of populations.

The concept of food environments is somewhat nebulous and, therefore, can be difficult to describe, to measure, or to change. However, a useful organizing framework broadly classifies food environments as **physical** (availability), **economic** (affordability), **social** (norms and values) and **communication** (marketing, education, information)\(^4\). The **political** food environment broadly refers to the rules and laws in place within each of these contexts, as policies are at play at several levels (organizational, municipal, federal) in all of these environments. For example, a school policy to adopt a healthy food policy influences the school's physical environment because only healthy products are available. A federal policy to subsidize agricultural production of a certain crop influences the economic environment, making that product and the foods produced from it more affordable. A breastfeeding friendly policy at a workplace makes breastfeeding a more socially acceptable behaviour. A policy that privileges free market with no restrictions on marketing creates a communication environment in which people are exposed to food advertising in almost every corner of their lives. Policy, therefore, can influence what is available, affordable, acceptable and in public consciousness.

**Available Evidence Relevant to Policy Influence on Food Environments**

**Physical Environment/ Food Availability**

Policies relevant to the **physical** food environments include those that target our national or regional food supply, including agricultural supply management policies that influence production through income supports, pricing and marketing of commodities\(^5\). Trade policies that influence what we import and export also influence the food supply. While Canada has a safe, relatively stable and well-monitored food supply, from a nutritional health point of view, challenges exist. The priority of food safety is evident in public health (one does not have to think very far back to recall *E-coli* or *Listeria* scares\(^6\), yet, we seem less inclined to use policy to protect us from the cumulative effects of poor nutritional choices over time. For example, while data are not readily available for Canada, recent analysis of the US Food Availability Data System compared food availability to a composite measure of nutritional quality, known as the Healthy Eating Index. From 1970 to 2010 the Healthy Eating Index for the food supply was only approximately half of optimal (scores of 48-55 out of 100). In other words, the US food supply is not consistent with current dietary guidelines, with foods such as sugar, salt and fat present at much higher levels than recommended, while fruits and vegetables are less available than recommended\(^7\). Canada is unlikely to be dramatically different. It may be time to revisit the utility of agricultural policies in promoting a food supply that supports the current health needs of the Canadian population.

At a more local level, the physical food environment can be influenced by municipal zoning policies, which control (or don’t control) the number and type of food outlets (e.g. grocery stores, fast food outlets, convenience stores, farmers’ markets, community gardens). Some relevant Canadian research of physical food environments in municipalities includes “Charting the Foodscape” of Edmonton which used Geographic Information Systems (GIS) to map grocery stores as a proxy for healthy foods, and fast food outlets as a proxy for less healthy foods. Not only did availability of fast food outlets far outnumber grocery stores (more than ten-fold), but fast food outlets were concentrated in neighbourhoods with lower income populations such that lower income residents were exposed to 4.3 times as many fast food outlets than their middle to higher income counterparts\(^8\). In the same city, the lower the ratio of fast-food restaurants
and convenience stores to grocery stores and produce vendors near people’s homes, the lower the odds of being obese\textsuperscript{2}. More recent and nuanced research of food environments captured by the “NEWPATH” project in the Region of Waterloo revealed that a fast food outlet or convenience store is half the distance from the average household than a supermarket. Within one kilometer of the average home, there was more than three times the shelf space dedicated to energy-dense snack foods than fruits and vegetables. Both diet quality and obesity measures were associated with objective food environment measures\textsuperscript{9}. Once again municipal policies may hold a key to promoting the nutritional health of Canadians.

At an even more micro level, recently policy has been enacted throughout many Canadian jurisdictions to protect children in schools by ensuring all school foods meet “healthy” criteria (e.g.\textsuperscript{10}). Workplaces, recreation centres, and hospitals (ironically) are other local settings with calls for policy action to create healthy food environments.

**Economic Environment/ Food Affordability**

Agricultural supply management policies such as income supports, pricing and marketing of commodities also influence the cost of food, and thus the economic food environment. While the cost of food is in the headlines on a regular basis, there is little agreement as to whether Canadian food costs too much (and is therefore inaccessible to low income or northern populations), or too little, implying that food producers are not paid adequately for their commodities. The relative cost of healthy versus less healthy options is also a frequent debate, and policies have been proposed to promote a less costly healthier food supply as chronic disease prevention measures. For example, using economic modeling on the US food supply, subsidizing fruits and vegetables had a greater potential to increase their consumption and reduce chronic disease risk than did taxing less healthy products such as fat\textsuperscript{11}.

Pricing food baskets in several jurisdictions have revealed that low-income Canadians on minimum wage or social assistance cannot afford the cost of a healthy diet, which suggest the need for policy change to promote a living wage or adequate social assistance rates\textsuperscript{12}. The cost of transporting food to the north, even with subsidies, has recently made headlines as controversial policies associated with the Nutrition North program have come under fire\textsuperscript{13}. This has implications for aboriginal food insecurity, as discussed in Dr. Willows’ essay.

**Social Environment/ Food Acceptability**

The social food environment broadly refers to food norms and values, and can include ethnic and religious influences on food choice. However, culture is much more insidious than overtly declared. The popular press has done an excellent job of critiquing the gradual but significant shift in food culture towards a reliance on highly marketed convenience and packaged “fast” foods\textsuperscript{14}. And while we may be exposed to food through television celebrity chefs, Canadians have generally become less skilled in food preparation\textsuperscript{15}, and more dependent upon processed foods such that over 60% of Canadians’ energy (calories) now comes from processed foods\textsuperscript{16}. It appears social norms may have collectively and unwittingly contributed to a culture that undervalues “real” food. Policies that could help to promote a food environment where the love of real food abounds include school food strategies that include not only provision of local, healthy meals at school but a food related curriculum that includes knowledge of where food comes from, hands on local gardening projects and cooking skills programs.

**Communication Environment/ Food Awareness**

Traditionally, Canadians have been subject to individually focused policies such as nutrition labelling\textsuperscript{17} that enable consumers to make informed choices, and general guidance such as Eating Well with Canada’s Food Guide\textsuperscript{18}. However, most communication that Canadians hear about food...
comes from commercial marketing, where advertising budgets are enormous relative to what governments spend to promote healthy eating. To temper the potentially biased messages of commercial marketing, policies that limit exposure to marketing and intensity of messages have been proposed. One of the most innovative policies is in the province of Quebec, where marketing to children has been banned since 1980. While initially intended to protect children from the commercialization of childhood, since marketing of unhealthy foods and beverages is included in the legislation, international jurisdictions are looking to Quebec as a model. Recent research has shown that Quebec children (particularly Francophone children) are less likely to view media from outside of Quebec and consume fast foods is lower.

Key Messages and Conclusions

Political decisions largely shape the ways that food is made available, affordable and attractive to people. As such, policy decisions and political actions at every link in the food chain and every level of society can be an ideal target for intervention to improve the health of populations.

A useful organizing framework to explain the concept of food environments classifies food environments as

- **physical** (availability),
- **economic** (affordability),
- **social** (norms and values) and
- **communication** (marketing, education, information).

The political food environment broadly refers to the rules and laws in place within each of these contexts, as policies are at play at several levels (organizational, municipal, federal) in all of these environments. Of interest is a Framework for Assessing Decisions about Food and Agriculture, published by the Institute of Medicine earlier in 2015 and adapted in Figure 1, below. While focused on the United States, the ideas presented in the framework have broad applicability.

Examining food environments within this organizing framework brings more clarity to the potential for policy interventions to address the problem of food environments and health. It is up to each person to determine where they have influence, and to exert that influence to promote progressive policy change.
A FRAMEWORK FOR ASSESSING DECISIONS ABOUT FOOD & AGRICULTURE

The food supply chain is deeply interconnected with human health, the health of the environment, and social and economic systems. Decisions, therefore, have impacts far beyond the supply chain itself.

To ensure that the benefits of a decision outweigh its risks, decision makers must carefully consider the full range of potential effects in the health, environmental, social, and economic domains.

THE FRAMEWORK

SIX STEPS FOR ASSESSMENT

Figure 1. Framework for Assessing Decisions about Food and Agriculture
References

Food Environment, Health and Chronic Disease: Prologue


The 4-A Framework for Promoting Healthy Dietary Intake


Food Environments and Child Health in the Preschool Years


**Food Security among Alberta First Nation**


**Food Environment and Reduction of Cancer Risk Reduction**


**The Food Environment, Nutrition Transition and Type 2 Diabetes**


**Creating Health Promoting Food Environments through Policy**


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