INSIGHT ON CANCER

news and information on nutrition and cancer prevention

volume two – supplement two: Ontario's food security and cancer prevention

- More than 1 in 10 Ontario adults were food insufficient
- Low socioeconomic status has the strongest association with food insufficiency
- Ontarians who:
  - are lone adults with or without children younger than 18 years
  - are new to Canada within the last 20 years
  - are current smokers
  - have fair or poor health
  - think vegetables and fruit are too expensive or good quality produce is not available

  are more likely to live in a food insufficient household
- Women who live in a food insufficient household are less likely to:
  - eat 5+ servings of vegetables and fruit daily
  - have a healthy body weight
  - believe they need 5+ servings of vegetables and fruit daily
  - be confident they will eat more vegetables and fruit in the next month

  putting them at increased risk of developing certain types of cancer
- Barriers, such as food insufficiency, prevent adequate intake of foods that reduce the risk of cancer

Insight on Cancer is a series of joint Cancer Care Ontario and Canadian Cancer Society (Ontario Division) publications, designed to provide up-to-date information for health professionals and policy-makers about cancer and cancer risk factors in the province.

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The editors of the *Insight on Cancer: News and Information on Nutrition and Cancer Prevention* supplement series are:

Loraine D. Marrett[a]
Melody Roberts[b]

Published and distributed by the Canadian Cancer Society (Ontario Division). The authors of this report are:

Melody Roberts[b]
Michael Innes[a]
Christine Lyons[a]

a Cancer Care Ontario
b Formerly of Cancer Care Ontario; Ministry of Health and Long-Term Care, Public Health Branch, Chronic Disease Prevention and Health Promotion Division

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Disclaimer
The tables and figures in this report contain information from the Ontario Nutrition and Cancer Prevention Survey. Cancer Care Ontario made efforts to ensure accuracy of this information at the time of writing this report. However, errors may be discovered as data analysis continues. Results in future reports may therefore differ slightly from those presented here.

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CONTEXT

About Cancer Care Ontario

Cancer Care Ontario is the government's principal adviser on cancer issues, with a mission to improve the performance of the cancer system by driving quality, accountability and innovation in all cancer-related services. In addition to working in partnership with hospitals providing cancer care across the province, Cancer Care Ontario directly manages the Ontario Breast Screening Program, the Ontario Cervical Screening Program, the Ontario Cancer Registry and the New Drug Funding Program, and runs a multifaceted program in cancer research. In its prevention blueprint, Cancer Care Ontario declares that cancer prevention is the best opportunity to reduce cancer deaths in Ontario. Cancer Care Ontario maintains that one of its main strategies to do this is to eliminate the causes of cancer and prevent the disease from getting started in the first place. Cancer Care Ontario singles out tobacco use, unhealthy diets and physical inactivity as significant causes of cancer.[1,2]

Definitions

Definitions are provided for a number of terms used throughout this report. These terms are identified with the symbol: ▼. The definition of some words can be found in the Glossary of Terms at the end of this report. Words that have definitions are only identified the first time they are used.

Appendices

The interested reader is encouraged to refer to the Appendices at the end of this report for more details regarding the survey questions, the sample, data tables and statistical information, including methodology and the limitations of the survey data and its interpretation.

EXECUTIVE SUMMARY

Food security refers to the availability, adequacy and accessibility of food to all individuals and families. Conversely, food insecurity exists whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain. In this second supplementary report on the findings of the Ontario Nutrition and Cancer Prevention Survey, the results around food security are examined.

The Ontario Nutrition and Cancer Prevention Survey (ONCPS), conducted in 2001–2002 by Cancer Care Ontario and several partners, solicited information about vegetable and fruit intake, physical activity and body weight, as those factors are linked to cancer prevention. The initial results of the survey were published in *Insight on Cancer. News and Information on Nutrition and Cancer Prevention*, which reviewed the scientific evidence that made explicit the link between vegetables and fruit, body weight and physical activity, and cancer. While estimates vary, these three factors may be causally related to approximately one-third of all fatal cancers.

This supplemental report provides an analysis of the responses to the questions about food insecurity and how these issues influence dietary consumption of vegetables and fruit. It is from this perspective that the current study seeks to understand the scope and to some degree, the nature of food insecurity and its influence on dietary consumption of vegetables and fruit, body weight and physical activity levels of Ontario adults and explore the potential role of food insecurity and cancer risk.

Key findings

The survey found that food insecurity is the result of a number of factors and can range from worrying about not having enough money to buy food, to compromising the quality and quantity of food in the diet. The following are the key findings:

- More than 1 in 10 Ontario adult respondents were food insufficient. This means that at some point during the year, more than 763,900 adults were living in households that were uncertain of having, or unable to acquire, enough food to meet the needs of all household members because of insufficient money or other resources.

- The survey confirmed that low socioeconomic status (measured as low education and low household income adequacy) has the strongest association with food insufficiency.

- The survey found similar levels of food insufficiency among adult respondents living in urban and rural areas.

- The composition of the household had a significant influence on food insufficiency. Respondents living in households with one adult and one or more children less than 18 years of age and households with one adult had an increased prevalence of food insufficiency.

Although this study did not measure childhood hunger, previous studies have shown that children in food insecure households are at significantly higher risk of hunger than other children.

- Adult respondents who immigrated to Canada in the last 20 years were almost twice as likely to live in a household that was food insufficient compared with Ontario adults born in Canada. The survey found

almost 19% of immigrant adult respondents had experienced the uncertainty of having, or inability to acquire, enough food to meet their needs because of insufficient money or other resources.

- More respondents who were current smokers lived in households that experienced food insufficiency and hunger compared with non-smokers and former smokers. Once other important variables were accounted for, Ontario adult respondents who currently smoke have 1.8 times higher odds of being food insufficient compared with non-smokers.

- Of the adults who reported their health as fair to poor, 20% also reported that their household experienced food insufficiency. Only 10% of those who reported good to excellent health lived in a household that experienced food insufficiency.

- Respondents who lived in households experiencing food insufficiency were more likely to report that vegetables and fruit were too expensive and that good quality produce was not available. Compared with those who did not report a lack of availability of good quality produce, respondents who did agree were almost twice as likely to live in a household that was food insufficient.

- The survey did not find an association between food insufficiency and physical inactivity. Both food sufficient and insufficient respondent households are not meeting the minimum recommendation for physical activity.

Methodology

A total of 2,997 Ontario adults participated out of a possible 3,004 aged 18 to 64 years sampled for the ONCPS. Descriptive cross-tabulations were used to estimate the prevalence of food insufficiency in relation to certain sociodemographic and health-related variables, as well as the prevalence of food insufficiency among various nutrition-related factors (i.e., vegetable and fruit intake, body weight, and physical activity). Multivariate analyses were conducted to examine the associations between food insufficiency and these variables while controlling for the effects of other factors.

Where do we go from here?

The analysis of the survey findings has led to an attempt to understand the scope and the nature of food insecurity and its influence on vegetable and fruit consumption, body weight and physical activity of Ontario adults, as these factors play a significant role in the development of cancer. Based on this analysis, the authors make the following recommendations:

- Based on the clear regional variations when it comes to availability of produce, it is important that subsequent research and policy development ensure a coherent policy framework that tries to make healthy food choices the easiest choices through easier access to better quality and more affordable food in all parts of Ontario.

- The survey found that more than 1 in 10 Ontario adult respondents were living in food insufficient households because they were uncertain of having or unable to acquire enough food to meet their households' needs. Initiatives—such as the Ontario government's recent announcement of an increase to basic allowance and shelter allowance and an increase to the minimum wage—are needed to assist vulnerable Ontario adults to meet basic food needs. In particular, interventions are needed to assist those who may be at much greater risk of developing cancer and other chronic diseases due to their inadequate vegetable and fruit intake.

- The survey found that individual respondents with lower socioeconomic status had a higher prevalence of smoking, matching similar findings of other studies. As well, the survey found that respondent Ontario smokers with lower socioeconomic status also have inadequate vegetable and fruit intake. Additional services and improved access to cessation programs will help reduce the elevated cancer risk of this population.

- In addition to ongoing surveillance of food insecurity issues, monitoring of higher risk populations must be initiated. The results of this monitoring should be reported annually and used to inform strategy and set performance standards and accountability for social and health policy decisions and programs.

Conclusion

The benefits of a diet with an adequate number of vegetables and fruit have been borne out by scientific evidence. Barriers, such as food insecurity, that prevent availability, adequacy and access to foods that reduce our risk for cancer, as well as a number of other chronic diseases must be removed through provincial policies and programs. The authors hope that these findings of the ONCPS will encourage a dialogue among key stakeholders and produce action on this important issue.

WHAT IS FOOD SECURITY?

"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 an active and healthy life."[3,4]

What are the key elements behind the concept of food security?

Food security is internationally recognized as a concept that includes both supply and demand elements, and can be applied at the individual and household level, as well as the broader community, regional, provincial/territorial, national and international levels of the food system.[5–7] This report focuses on individual and household food security.

A key factor that can affect the supply side for individuals or households is availability. **Availability** refers to being able to physically access a supply of sufficient, safe and nutritious foods. In Ontario, more remote communities may suffer from geographic isolation. In turn, this can affect availability and is dependent upon whether there is a sufficient market to organize an efficient and profitable food distribution network. In some of the most isolated communities, due to small populations and distance from major centres, federal government support is necessary to provide a reliable food supply throughout the year.[8] Another provincial example is the recent short-term interruption of the available food supply that was experienced by a large portion of Ontario's population during the extended power blackout in August 2003.

Key factors that affect how people obtain food (the demand for food) include both adequacy and access:

- **Adequacy** refers to the quality of a person's and household's diet throughout the lifecourse to meet nutritional needs not only for growth and development and health maintenance, but also for preventing chronic diseases.[4] Groups that may be more nutritionally vulnerable during certain stages of the lifecourse include: high-risk pregnant women, low-birth-weight babies and children, individuals whose immune systems are compromised due to chronic illness, and older adults.[9] Adulthood is the time during which the majority of chronic diseases (including cancer) are expressed, and also the critical time for preventive reduction of exposure to dietary and related risk factors known to increase risk of disease (obesity, physical inactivity), as well as for increase of those dietary factors known to be protective against disease (vegetable and fruit consumption).[10]

- **Access** refers to the individual's or household's ability to acquire sufficient and personally acceptable food in socially acceptable ways.[11] In Canada, this generally means equitable financial access to buy food, and is therefore related to adequate real income.[12] However, in some communities it can also mean the ability to grow as well as hunt, fish and gather food, depending on cultural traditions and social norms.[3] Charitable food aid is another means to acquire food. On a global basis, it is used to alleviate famine during complex emergencies by providing short-term food relief, while working toward longer-term food security through a range of developmental policies and resources.[5,13] Charitable food banks have become increasingly institutionalized over their 20-year history in Canada.[14,15] Despite food banks being initiated as a response to local hunger brought on by broader social policy changes to income security programs, there is still a stigma attached to their use.[14] This suggests that although charitable food banks may increasingly play a role in providing food access, they are seen as socially unacceptable, and should not be considered as a normal channel for food distribution in contemporary Canadian society.[14]

If any of these elements—availability, adequacy or access—are diminished or absent, they can contribute to a person or household becoming food insecure. Therefore, **food insecurity** exists whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain.[11] In terms of the ability to acquire food, food insecurity tends to follow a sequence from worrying about not having enough money to buy food, to compromising the quality and then the quantity of the diet.[11] Therefore, from this standpoint, food insecurity is thought of as a continuum of risk, where the likelihood of harm can manifest as: people experiencing little or no risk (food secure); to those being at risk, where food availability and food insufficiency drive adaptive behaviours such as substitution and rationing (eating less costly or poorer quality food, or omitting entire food groups, as well as eating less often and in smaller amounts); to the most severe form, which manifests as absolute deprivation or hunger. Hunger has been described as the uneasy or painful sensation caused by lack of food.[16] This is a potential, although not necessary, consequence of food insecurity. Furthermore, hunger described in this way is involuntary, and should not be confused with reducing intake due to conscious intent as a means of weight control, for example.

How is household food insecurity relevant to cancer prevention?

Cancer is not a single disease, but is in fact a large group of diseases, which is characterized by the uncontrolled growth of abnormal, malignant cells.[17,18] Cancer can be studied at many levels, but is commonly researched at the genetic or cellular level.[19] However, the occurrence of cancer can also be studied by understanding common contributing causes, known as risk factors, related to the disease. An earlier *Insight on Cancer* report reviewed the scientific evidence that made explicit the link between vegetables and fruit, body weight and physical activity, and cancer.[20–22] While estimates vary, these three factors may be causally related to approximately one-third of all fatal cancers.[20,21]

Dietary, body weight and physical activity risk factors, while operating at the individual level, can also be understood from a population perspective. In particular, "society is not merely a collection of individuals but is also a collectivity, and the behaviour and health of its individual members are profoundly influenced by its collective characteristics and social norms."[23] Therefore, the scale and pattern of cancer reflects the way that people live and their social, economic and environmental circumstances. Thus, while components of the diet—such as energy, phytochemicals, and macro and micronutrients—may ultimately have effects at the cellular level and influence the development of cancer as expressed in various organ systems within individuals, in fact, the variety of individual exposures from dietary risk factors have common social, economic and political causes at the population level.[19] It is from this perspective that the current study seeks to understand the scope and to some degree, the nature, of food insecurity and its influence on dietary consumption of vegetables and fruit, body weight and physical activity levels of Ontario adults, and to explore the potential role of food insecurity and cancer risk. A complete list of study questions can be found in Appendix 1.

WHAT IS THE ONCPS ABOUT?

To get a better understanding of health practices in Ontario in 2001–2002, Cancer Care Ontario conducted the Ontario Nutrition and Cancer Prevention Survey (ONCPS), with several partners (see Acknowledgements). The focus of the survey was to solicit information about vegetable and fruit intake, physical activity and body weight, as these risk factors are linked to cancer prevention. Additional questions focused on behaviours, knowledge▼, attitudes▼ and beliefs of the participants, as well as food security. Details of the questions can be found in Appendix 2.

A random sample of Ontarians aged 18–64 years was telephoned and invited to participate. The survey was completed between June 2001 and May 2002. The final sample of 3,183 men and women (63% of invited adults) was from 6 geographic areas of the province (see Appendix 3 for a description of the sample). These 6 areas, as outlined in the map below, corresponded with the 8 cancer planning regions▼ in Ontario, as the South and Southwest planning regions were combined, as well as the East and Southeast regions (Figure 1).

Figure 1. Key map of Ontario regions

Source: Cancer Care Ontario (Ontario Cancer Registry, 2003)
SAS, 1999-2001

▼ See Glossary of Terms, Appendix 5

The ONCPS sample was stratified to ensure that there were at least 375 participants in each of the 6 regions. Toronto Public Health, which provided financial support for an enlarged Toronto sample within the Central East Region, reported on their results separately.[24] Participants were interviewed by telephone for 20–25 minutes by surveyors from York University's Institute for Social Research. Approximately 265 interviews were completed monthly between June 2001 and May 2002. The data presented in this report are self-reported and cross-sectional in nature.

For the purposes of this analysis, **adequacy** of diet was measured by assessing responses to a 14-item Food Frequency Questionnaire to determine whether Ontario adult respondents met daily minimum recommendations for vegetable and fruit intake according to current Health Canada recommendations, and cut-points consistent with the scientific literature for cancer prevention (at least 5 servings per day).[20,21,25]

Availability of good quality produce was assessed by asking respondents where they shop or get food. These results were triangulated with other findings from Ontario studies that used qualitative analyses.

Food **access** was measured two different ways. First, building on the food adequacy and availability items, respondents were asked their perception of produce prices in their locale. These results were then compared with ongoing market basket monitoring results from key communities across the province. Second, access was examined using a more in-depth approach to ranking household food insufficiency and hunger, and was measured using the validated abbreviated 6-item subset of the 18-item United States Food Security Survey Module.[26,◆] The 6-item questionnaire has been demonstrated to be a reliable substitute to the 18-item version, showing reasonably high sensitivity and specificity and minimal bias.[27] A respondent's level of food insufficiency and hunger was captured using responses to a series of 6 questions on specific conditions, experiences and behaviours known as indicators that represent the varying degrees of severity.

The primary focus of the questions on the food security survey module is characterization of whether a respondent had *enough* food or money to meet basic needs over the previous 12 months. Other elements of food security apart from financial constraint, such as food safety, nutritional quality of diets, and reduced mobility or function for isolated or ill persons, are not described by this particular measure.

The food security survey module is based on Item Response Theory. A respondent's scale value depends on his/her overall pattern of response to all items (i.e., the number of affirmative responses to increasingly severe questions). Severity of food insufficiency on the 6-item food security survey module is expressed by numerical values ranging from 0–6. A respondent who did not affirm any of the conditions of food insufficiency was assigned a raw score of 0, while a respondent who had experienced all of them was given a raw score of 6. A respondent's food sufficiency status was classified into one of 3 categories: food sufficient (0 or 1 affirmatives), food insufficient without hunger (2–4 affirmatives), or food insufficient with hunger (5 or 6 affirmatives). Of interest to note, the 6-item module identifies respondents reporting adult hunger but lacks the further detail that identifies the most severe scale range required to identify children's hunger.

◆ Because the Ontario Nutrition and Cancer Prevention Survey measured other aspects of food insecurity, such as adequacy and availability, the United States terminology of labelling respondents food secure, and food insecure with and without hunger, was changed to food sufficient, and food insufficient with and without hunger, in order to distinguish these concepts.

This food security survey module provides much greater specificity and sensitivity than 3-item instruments used, for example, on the Canadian Community Health Survey and National Population Health Survey (NPHS) 1998/99.[28] The 3-item instruments used on those surveys are too severe to be sensitive to low levels of food insufficiency and included too few questions to cover both low levels of insufficiency as well as the more severe level of hunger; additionally, they are too few to produce a meaningful and reliable scaled measure, so are thought to be best used individually.

Overview of the Data Analysis

A detailed description of the statistical analysis for this report can be found in Appendix 5. Briefly, 2,997 subjects were eligible for the food sufficiency analysis out of a possible 3,004 Ontario adults aged 18–64 years sampled for the survey. Descriptive cross-tabulations were used to estimate the prevalence of food insufficiency in relation to the sample's sociodemographic characteristics and the prevalence of 6 health outcomes or behaviours (knowledge, attitudes, self-efficacy,▼ behaviour related to vegetable and fruit intake, physical inactivity and overweight or obesity) among people who were or were not food insufficient. The sociodemographic characteristics included sex, age group, geography, education level,▼ household income,▼ immigrant status,▼ smoking status,▼ self-reported health, number of chronic conditions,▼ and perception of cost and availability of produce. The chi-square test was used to identify statistically significant differences in the prevalences within these characteristics. Multiple logistic regression was used to describe the associations between food insufficiency and the sample's characteristics. Stepwise elimination of variables, based on the likelihood ratio method, was used to determine the final multivariate model. This approach allowed us to identify the most important characteristics and their associations with food insufficiency.

Likewise, multiple logistic regression was used to assess the relationship between food insufficiency and the 6 health outcomes or behaviours listed above. All models were stratified by sex (except for self-efficacy about vegetable and fruit intake because of small sample size for that item), and other sociodemographic, behaviour, and psychosocial variables were included in the models to control for the potentially confounding effects of these variables on the observed associations.

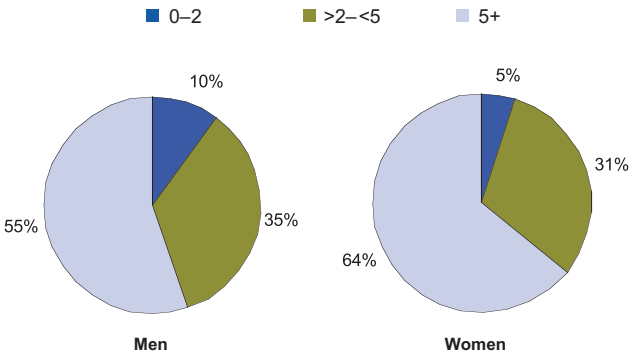
All analyses were conducted on weighted data and standard error calculations were done using the *svy* commands in the statistical software Stata (version 7) to account for the complex nature of the survey design.

▼ See Glossary of Terms, Appendix 5

Food Adequacy and Availability

The minimum amount of vegetables and fruit that adults need to consume to reduce their risk of developing cancer is 5 or more servings per day.[20,21] Furthermore, more than 250 population-based studies, including case-control and cohort studies, indicate that people who eat about 5 or more servings per day have approximately half the risk of developing digestive and respiratory tract cancers of those who eat fewer than 2 servings per day.[29,30] Our survey indicates that approximately 40% of adults in the province do not meet this guideline. In addition, 10% of men and 5% of women are at twice the risk of developing cancer due to consuming 2 or fewer servings per day (Figure 2).

Figure 2.
Prevalence of vegetable and fruit consumption among Ontario adults



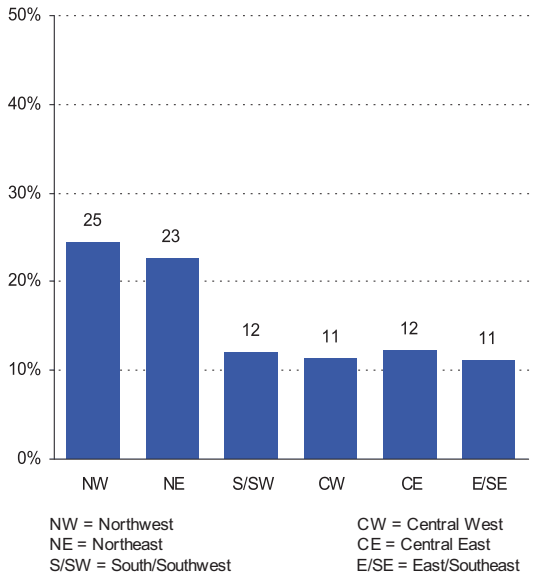
Significant differences between men and women (p<.001)

Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

Adults who agreed good quality vegetables and fruit are not available in their area ate less vegetables and fruit (47% ate fewer than 5 servings per day) than those who were neutral (42%) or disagreed (39%). Although these findings were not statistically significant (at the 5% level), differences were observed across the regions, especially between Northern regions and the rest of the province (Figure 3).

A greater proportion of people living in Northern Ontario cited limited availability of vegetables and fruit as an issue, compared with their southern counterparts. Between 23% and 25% in the northern regions of the province versus 11%–12% in southern, central and eastern Ontario agreed that good quality vegetables and fruit are not available. The Northeast and Northwest regions, as defined in this study, contain less than 8% of Ontario's population, and due to their large area, they contain the lowest population density within the province.[31] Sheer distance from major centres and the nature of perishability of produce make availability issues more predominant in the North. It also confirms similar findings from other Ontario ethnographic studies, where participants described a qualitatively different diet due to geography.[32,33]

Figure 3. The proportion of respondents who agree that good quality vegetables and fruit are not available, by region



Significant differences between regions (p<.05)

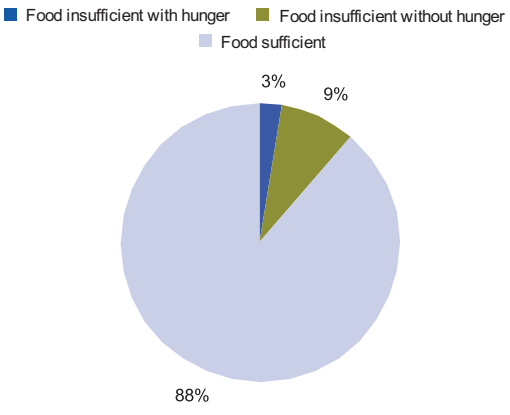
Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

A similar finding was observed for the perception of cost. In the northern regions of the province, more adults (46%–49%) perceived the costs of vegetables and fruit as being too high, compared with adults living in the south (38%–42%), however these differences were not statistically significant. This difference in perception between northern and southern Ontarians agrees with results of tracking a market basket of groceries known as the Nutritious Food Basket. The weekly cost of a nutritious food basket in select regions of Ontario for a family of four in 2002 (the time period of the survey) varied across the province. The weekly costs ranged from $131.42 in Thunder Bay,[34] to $121.06 in York Region, [35] $121 in Toronto,[36] $114.98 for the City of Greater Sudbury,[37] and $103.01 in Halton Region.[38] The average provincial weekly cost was $123.58.[39]

Economic Access

As Figure 4 illustrates, 11% of Ontario adults were food insufficient. This means that at some point during the year, more than 763,900 adults were living in households that were uncertain of having, or unable to acquire, enough food to meet the needs of all their members because they had insufficient money or other resources. This estimate is comparable to the U.S. national prevalence for adults of almost 11% during 2002,[40] the same year for which the ONCPS was completed.

Figure 4. Prevalence of food insufficiency, with and without hunger, among Ontario adults



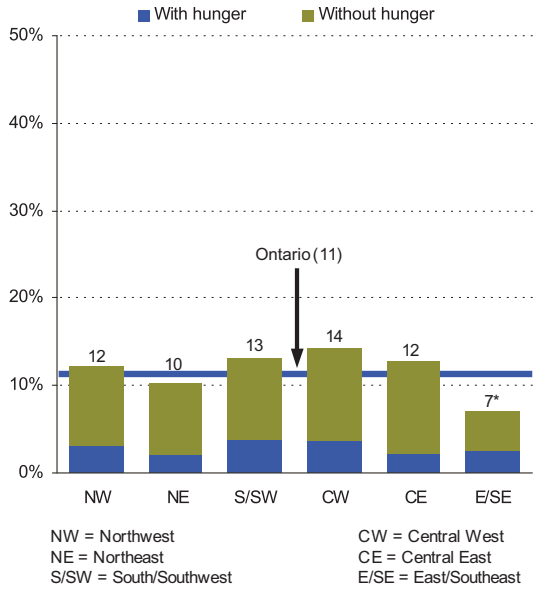
Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

Three percent or 200,000 Ontario adults were food insufficient with hunger. This means that about 22% of food insufficient adults were hungry at times during the year. The U.S. national prevalence for adults was also 3% in 2002.[40]

Food Insufficiency and Geographic Variation

As Figure 5 outlines, the prevalence of household food insufficiency varied somewhat across the province. Four out of 6 regions (Northwest, South/Southwest, Central West and Central East) had food insufficiency levels higher than the provincial prevalence estimates (ranging from 12%–14% food insufficient with or without hunger, and 2%–4% food insufficient with hunger), while Northeast and East/Southeast fell below the provincial levels. However, only East/Southeast had a prevalence of food insufficiency that was significantly different from the overall provincial value. No significant departures from the provincial prevalence of hunger were observed for any of the regions.

Figure 5. Proportion of respondents who were food insufficient, with or without hunger, by region



Significant differences between regions (p<.05)

* Significantly lower than the Ontario prevalence (p<.05)

Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

When regional variation, selected sociodemographic and other factors were analyzed using multiple logistic regression, the region of residence was not associated with food insufficiency and hunger.

Food Insufficiency and Urban and Rural Households

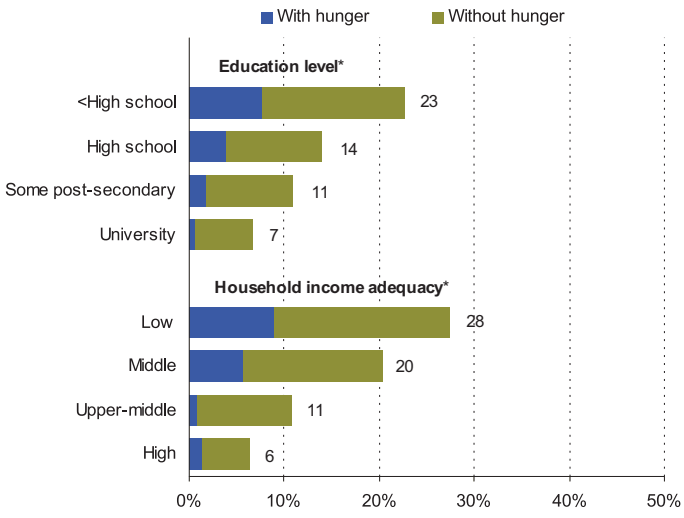
Adults living in urban areas had a non-significantly higher prevalence of household food insufficiency (both with and without hunger) compared with rural ones (12% versus 8% respectively). However, when this dichotomy was examined along with other variables using multivariate logistic regression, the urban/rural classification was no longer associated with household food insufficiency.

The findings regarding the analysis of geographic variables across Ontario's regions and types of communities may be counterintuitive for some readers, as hunger, and the risk of being hungry (household food insufficiency), is often thought of as only an inner city phenomenon and not one of the social issues facing small towns or villages in Ontario. This study indicates that, while there may very well be differences in prevalence across the province both regionally and in different sized communities, these differences were not statistically significant once other variables were accounted for. Ontario adults are as likely to be hungry in isolated, rural, small town or metropolitan communities.

Food Insufficiency and Level of Education and Household Income Adequacy▼

Figure 6 indicates that as education and income rise, the prevalence of food insufficiency and hunger falls. Ontario adults with the least amount of education had the highest proportion of household food insufficiency both with and without hunger and the highest levels of hunger. Twenty-three percent of Ontario adults with less than high school education experienced uncertainty and the inability to acquire enough food for their household sometime within the past year, and this same group experienced hunger at more than 3 times (8% versus 3%) the provincial value. In the multivariate analysis, lower education levels were strongly associated with food insufficiency independent of income and other sociodemographic factors. Those with less than high school education had a 2.4-fold likelihood (CI 95% 1.4–4.2) of being in food insufficient households than those with university degrees, while those with only a high school diploma had 1.6 higher odds of living in a food insufficient household compared with university educated Ontarians (Table 1).

Figure 6. Proportion of respondents who were food insufficient, with or without hunger, by education level and household income adequacy



* Significant differences between categories (p<.001)

Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

▼ See Glossary of Terms, Appendix 5

Table 1. Adjusted odds ratio▼ estimates for food insufficiency in relation to selected sociodemographic variables, health status, smoking status, and cost and availability of vegetables and fruit

Variables	Unweighted n[a] (n=2,644)	%[b] Food sufficient (n=353)	%[b] Food insufficient	Adjusted OR (95% CI)[c]
Sex				
Men	1323	89.9	10.1	0.8 (0.6–1.0)
Women	1674	87.4	12.6	1.0 (Reference)
Age group				
18–34	1007	85.4	14.6	1.0 (Reference)
35–49	1191	88.5	11.5	0.6 (0.5–0.9)
50–64	738	93.4	6.6	0.3 (0.2–0.4)
Household type				
1 Adult	604	84.7	15.3	1.7 (1.1–2.6)
1 Adult with child(ren) <18	157	76.0	24.0	2.1 (1.2–3.7)
2 Adults	771	90.9	9.1	1.4 (0.9–2.1)
2 Adults with child(ren) <18	858	98.1	1.9	1.0 (Reference)
Multiple adults with/without child(ren) <18	601	88.0	12.0	1.2 (0.8–1.9)
Immigrant status				
Canadian-born	2249	89.8	10.2	1.0 (Reference)
Immigrated <20 years	387	81.2	18.8	1.8 (1.2–2.7)
Immigrated 20+ years	345	89.5	10.5	1.7 (1.0–2.8)
Household income				
Low	292	72.5	27.5	4.3 (2.8–6.8)
Middle	471	79.7	20.3	2.9 (1.9–4.4)
Upper-middle	892	89.2	10.8	1.7 (1.1–2.4)
High	1293	93.6	6.4	1.0 (Reference)
Education level				
< High school	311	77.3	22.7	2.4 (1.4–4.2)
High school	709	86.1	13.9	1.6 (1.0–2.5)
Some post-secondary	1051	89.0	11.0	1.3 (0.9–1.9)
University	907	93.3	6.7	1.0 (Reference)
Self-reported health status				
Excellent/very good/good	2668	89.7	10.3	1.0 (Reference)
Fair/poor	320	79.9	20.1	1.6 (1.0–2.4)
Smoking status				
Non-smoker	1405	90.4	9.6	1.0 (Reference)
Former smoker	809	90.3	9.7	1.1 (0.8–1.7)
Current smoker	771	83.2	16.8	1.8 (1.3–2.5)
V/F too expensive				
Agree	1216	80.5	19.5	3.1 (2.2–4.2)
Neither agree/disagree	318	92.2	7.8	1.4 (0.8–2.3)
Disagree	1463	94.3	5.7	1.0 (Reference)
V/F not available				
Agree	444	77.4	22.6	1.7 (1.2–2.4)
Neither agree/disagree	177	83.1	16.9	1.6 (0.9–2.7)
Disagree	2376	90.8	9.2	1.0 (Reference)

Abbreviations: OR, odds ratio; CI, confidence interval;▼ V/F, vegetables and fruit

a Sample sizes vary due to missing data

b All proportions were calculated using weighted data (see Appendix 5)

c Adjusted for other variables listed in table

▼ See Glossary of Terms, Appendix 5

Respondents were asked about their household income, which was reclassified as a 4-level categorical variable representing income adequacy. This variable was based on gross total household income and household composition (size). The category definitions can be found in Appendix 5. This method of income categorization was developed by Statistics Canada and is commonly used to define household income adequacy.[41]

Another commonly used measure is Statistics Canada's Low Income Cut-offs (LICOs).[42] This measure of poverty was not used in this analysis because it requires more specific information regarding household income than was available with the data presented here; only broad categories in $10,000 increments were collected for this analysis. However, it is most likely that the low-income group and at least some of the middle-income group fall below the LICO.

In addition, the survey did not include a question regarding source(s) of income. Therefore, aspects such as social assistance use are not part of this analysis.

Households with low-, middle- and upper-middle incomes were more food insufficient than those in high-income households. As Figure 6 illustrates, 28% of Ontario adults living in households that reported the lowest household incomes experienced food insufficiency including hunger, more than double the provincial value. The lowest income group also experienced the highest intensity of food insufficiency with hunger, at more than threefold (9%) the provincial prevalence. However, middle-income households also had higher than provincial prevalence estimates for food insufficiency and hunger (at 20% and 6% correspondingly). An income gradient was confirmed in the multivariate analysis, where those in low-income households had the highest odds ratio (AOR 4.3) for food insufficiency with and without hunger (Table 1).

Compared with those earning the highest incomes in Ontario, the likelihood of being food insufficient including being hungry is over 4 times greater in low-income households (AOR 4.3; 95% CI 2.8–6.8), but almost triple in middle-income households (AOR 2.9; 95% CI 1.9–4.4). The prevalence of food insufficiency is lower than the provincial estimate among upper-middle-income households at a prevalence of 11% and hunger of 0.9%. However, compared with those earning the highest incomes in Ontario, the odds of being in a food insufficient household are 1.7-fold higher (95% CI 1.1–2.4) in upper-middle-incomes. This income gradient is found in other Canadian studies.[43,44]

Consistent with findings from the United States,[40] food insufficiency was not limited to low-income to middle-income households. This may be surprising for some readers. However, annual household income is a fixed measure and may not be sensitive to abrupt changes that can contribute to economic downturn and household food insufficiency, such as the loss of a job, or the separation, divorce or death of a household's sole breadwinner.[45] Nevertheless, the ability to adapt is much lower in low-income households. As Figure 6 illustrates, estimates of food insufficiency in low-income households are 4 times that of high-income households (28% versus 7%), and of hunger are 9 times that of high-income households (9% versus 1%).

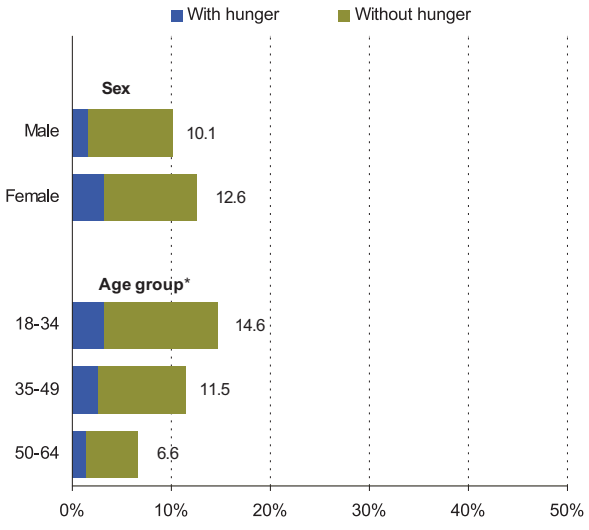
Food Insufficiency and Household Composition

Sex

As Figure 7 depicts, slightly more Ontario women than men lived in households that experienced severe deprivation of food, in the form of hunger. More women (13%) than men (10%) also reported their household experienced uncertainty of, or inability to acquire, enough food to meet their needs sometime during the year, however these differences were not statistically

significant. When sex was analyzed along with other factors, men were less likely to live in a household that was food insufficient, but this finding was only marginally significant (AOR 0.8; 95% CI 0.6–1.0). In another Canadian study, more men (9%) than women (8%) had a compromised diet, but differences in sex on their own as well as when adjusted for other variables in regression analysis, were determined not to be significant.[43] The differences in levels of analysis (national versus provincial), as well as the shortcomings in the instrument used in the NPHS, as discussed previously, can explain these results. Therefore, those results may not be comparable to the more specific and sensitive 6-item module used within the current study.[28]

Figure 7. Proportion of respondents who were food insufficient, with or without hunger, by sex and age group



* Significant differences between categories (p<.01)

Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

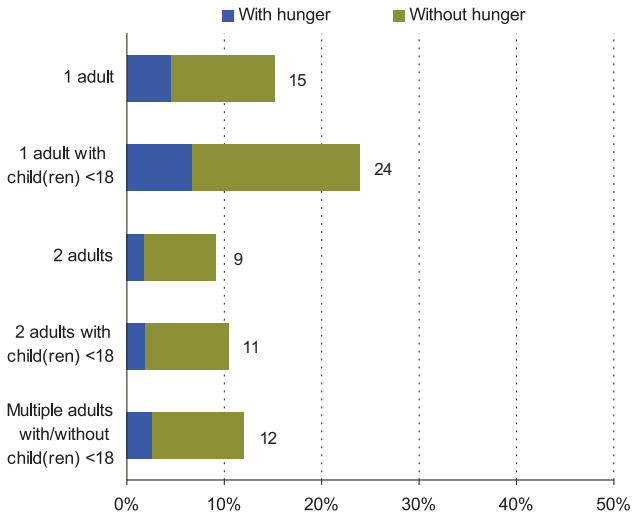
Age

The study population for this survey was adults aged 18–64. Adults under the age of 35 lived in households with the highest prevalence of food insufficiency both with and without hunger at 15% and hunger at 3%, compared with those adults aged 50–64 who had the lowest food insufficiency prevalence of 7% with 1% hunger (Figure 7). The odds of being in a food insufficient household within this oldest age group were one-third that of younger adults (see Table 1: AOR 0.3; 95% CI 0.2–0.4). This finding is consistent with trends found in other Canadian surveys.[43,44]

Household Composition

Not all households share the same likelihood of being food insufficient and hungry in Ontario. As shown in Figure 8, 24% of respondents living in single-headed households with one or more children less than 18 years of age experienced food insufficiency and experienced the severest form of deprivation, hunger, at 7%, double the provincial estimate of 3%. Respondents living in households with only one adult also had increased prevalence estimates of food insufficiency, at 15%, including a hunger prevalence of 5%. Table 1 shows that, independent of sociodemographic and other variables, respondents living in lone parent households with one or more children under 18 have twice the odds (AOR 2.1; 95% CI 1.2–3.7) of being in a food insufficient household, including being hungry, compared with a two adult household with one or more children under the same age. These results are comparable to U.S. and other Canadian studies.[40,43] Although this study did not measure childhood hunger directly, it is known from studies that use a more in-depth version of the instrument (18 questions versus 6-item questions used here), that children in food insecure households are at **significantly higher risk** of hunger than other children, and that this risk rises sharply as the severity level of the food insecurity experienced in the household rises.[46]

Figure 8. Proportion of respondents who were food insufficient, with or without hunger, by household type



Significant differences between categories (p<.05)

Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

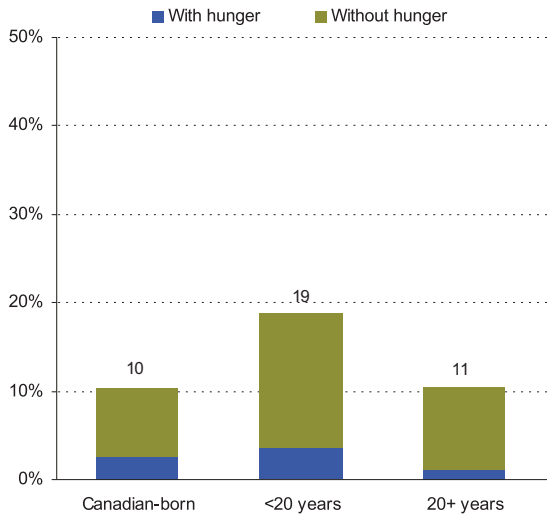
Respondents living in lone adult households are more likely (AOR 1.7; 95% CI 1.1–2.6) to be food insufficient with and without hunger than those living in two adult households with one or more children under age 18, a finding also mirrored in the U.S.[40]

Furthermore, a breakdown by sex shows that men who live alone are more likely to experience food insufficiency: 17% of lone male households were food insufficient compared with 13% of men in lone adult households with children under 18 years, and 8% of two adult households with or without children. Conversely, 26% of women in lone adult households with children under 18 years were food insufficient, compared with 14% living alone, 10% living with another adult and 13% who lived in a two adult household with children. This is similar to results in another study.[47]

Immigrant Status

As shown in Figure 9, almost 19% of adults who immigrated to Ontario in the last 20 years experienced uncertainty of having, or inability to acquire, enough food to meet their needs because they had insufficient money or other resources in the past year. Furthermore, this group experienced levels of hunger at 4%. Relative to Ontario adults born in Canada, this group has almost twice the odds of being food insufficient (AOR 1.8; 95% CI 1.2–2.7). As would be expected, the likelihood of experiencing household food insufficiency declines with the amount of time since immigration, and after 20 years, the prevalence is comparable to that of Canadian-born adults at 11% and 10% respectively. When other factors were taken into account, the odds of being food insufficient and hungry after living in Ontario for 20 years or longer was only marginally significant (AOR 1.7; 95% CI 1.0–2.8).

Figure 9. Proportion of respondents who were food insufficient, with or without hunger, by number of years since immigrating to Canada



Significant differences between categories (p<.01)

Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

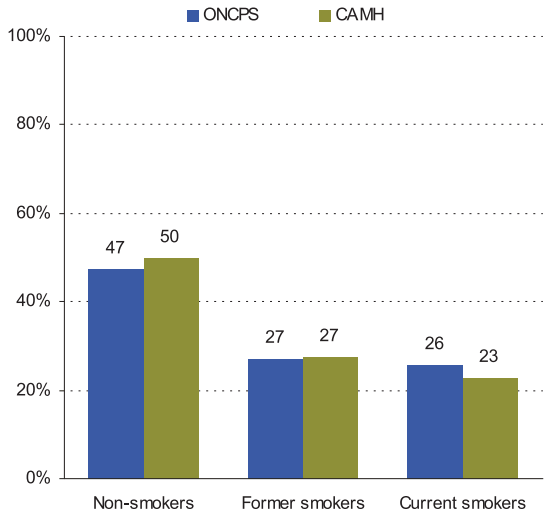
This result is different from other Canadian findings, which found that recent immigrants had lower odds of living in food insufficient households than did Canadian-born individuals.[43] This may be due in part to the differences in the length of time used as categories for the analysis. As well, there are differences in the level of analysis (national versus provincial). Ontario is unique compared with the rest of Canada, as over 56% of Canada's immigrant population live in this province, with the rest of the immigrant population shared among all other Canadian provinces and territories.[48]

Food Insufficiency and Other Health Risk Factors

Smoking Status

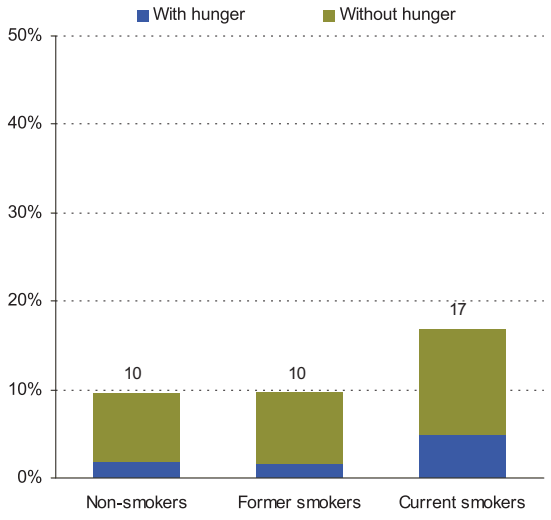
As Figure 10 illustrates, for the same time period as the survey, the prevalence estimates for smoking status in the ONCPS closely parallel that of the province.[49] In the ONCPS, 26% of respondents were classified as current smokers, 27% as former smokers and 47% as non-smokers. As shown in Figure 11, there is a significant difference in the prevalence of food insufficiency, both with and without hunger, among current smokers (17%; hunger 5%), in contrast to former and non-smokers, whose household food insufficiency (with hunger) were similar at 10% respectively, and who had similar hunger estimates of 2%, respectively. Once other important variables have been accounted for in a multivariate analysis (Table 1), Ontario adults who currently smoke have 1.8 times higher odds of living in a food insufficient household compared with non-smokers (AOR 1.8; 95% CI 1.3–2.5).

Figure 10. Smoking status of Ontarians as measured by the ONCPS and CAMH Monitor



Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003
OTRU Special Report, 2004[49]

Figure 11. Proportion of respondents who were food insufficient, with or without hunger, by smoking status



Significant differences between categories (p<.01)
Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

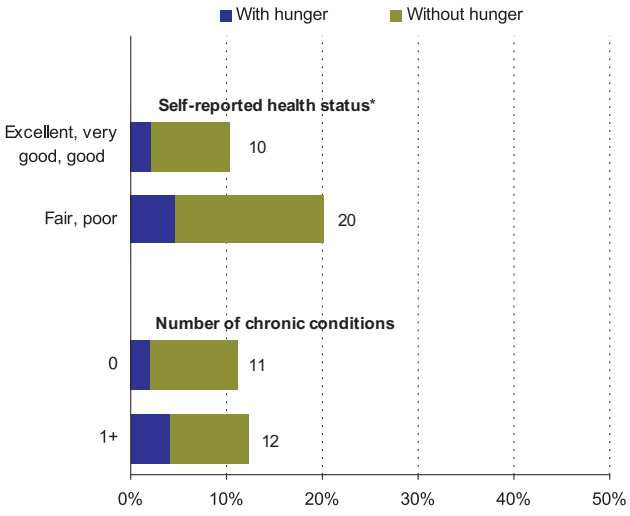
Given the convincing body of epidemiological evidence indicating a diet rich in vegetables and fruit reduces the risk of developing lung cancer[20,21] (which is caused more than 8 times out of 10 by smoking),[21,50] research to explore the relationship between current smoking and food insufficiency is merited. However, the effects of smoking on curbing appetite are well documented,[51] and this finding may indicate the use of tobacco as a coping mechanism to combat hunger. A corollary explanation may be that as the discretionary portion of a household budget becomes smaller and people become at greater risk for food insufficiency and going hungry due to the addictive nature of tobacco, smokers who are food insufficient cannot forego their habit and will spend what limited amounts of money are available to support their addiction. Regardless of the cause of the association, the policy implications to support smoking cessation are discussed at the end of this report.

Self-Reported Health

Self-perceived health is a reliable, valid assessment that has been found to be as good as or better than measures such as functional ability, psychological well-being and chronic conditions, and is more stable and highly correlated to physicians' ratings of client health.[52] Overall, 11% of ONCPS respondents reported fair or poor health. This is similar to the results of another Ontario survey completed in 1996, which reported 10% of adults with health rated as fair or poor.[31]

A greater proportion of individuals who reported having fair or poor health, also reported being food insufficient. Twenty percent of adults who reported their health as fair or poor experienced food insufficiency (Figure 12), compared with those reporting good to excellent health, of whom only 10% were food insufficient. After adjusting for the effects of other variables, the odds of food insufficiency are 1.6 (95% CI 1.0–2.4) times greater in households where respondents report fair to poor health relative to those reporting good to excellent health (see Table 1). This finding is comparable to a small Canadian study using the same U.S. Food Security Scale.[53]

Figure 12. Proportion of respondents who were food insufficient, with or without hunger, by self-reported health status and number of chronic conditions



Chronic conditions refers to diabetes, heart disease, high cholestoral, hypertension, diverticulitis/bowel disease, kidney disease

* Significant differences between categories (p<.001)

Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

Number of Chronic Conditions

Respondents were asked about certain chronic conditions that may require dietary modification to manage outcomes. The most frequently cited conditions were hypertension and hyperlipidemia (see Table 2). Dietary management of hypertension includes consuming a diet rich in vegetables and fruit.[54,55] Hyperlipidemia management requires not only reducing total, trans and saturated fat intake, and

changing the ratio of fats consumed in order to increase poly and mono-unsaturated fat intake, but LDL cholesterol levels are also lowered by increasing plant foods including vegetable, fruit, and whole grain consumption.[55] As Figure 12 outlines, 12% of adults with one or more chronic conditions requiring some form of dietary modification lived in households that were food insufficient, while 11% who had no chronic conditions lived in household that experienced food insufficiency. Taking into consideration other variables, no association was found between the number of chronic conditions and being food insufficient. Thus the data indicate that having one or more of these particular conditions is not associated with being food insufficient. This result is different from other Canadian findings and is likely due to the scope of the chronic conditions measured and differences in the study populations.[43,44,53]

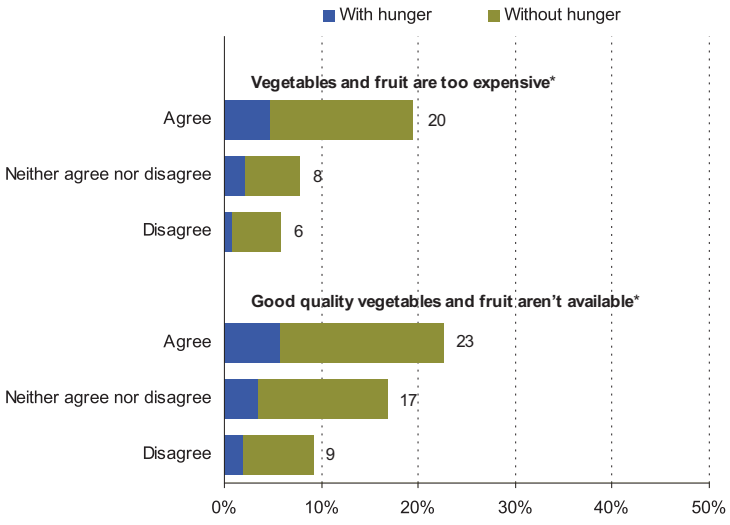
Table 2. Prevalence of chronic conditions that may affect dietary behaviour

Chronic condition	%
Diabetes	3.3
Heart disease	2.9
High cholesterol	11.4
Hypertension	11.9
Diverticulitis/bowel disease	3.5
Kidney disease	0.9

Perception of Cost and Availability

Respondents' perception of the cost and availability associated with vegetables and fruit were significantly related to food insufficiency. Among adults who agreed that vegetables and fruit are too expensive, 20% were food insufficient (Figure 13). These individuals were more likely (AOR 3.1; 95% CI 2.2–4.2) to suffer from food insufficiency than those who did not agree that vegetables and fruit are too expensive. Similarly, 23% of respondents who agree that good quality vegetables and fruit are not available are food insufficient. After adjusting for other variables, adults who agree that good quality vegetables and fruit are not available where they live are almost twice (AOR 1.7; 95% CI 1.2–2.4) as likely to be food insufficient as those who disagree that good quality produce is not available. A more in-depth analysis in terms of regional variation is not possible due to the sample size needed for stratification.

Figure 13. Proportion of respondents who were food insufficient, with or without hunger, by perception of cost and availability of vegetables and fruit



* Significant differences between categories (p<.001)

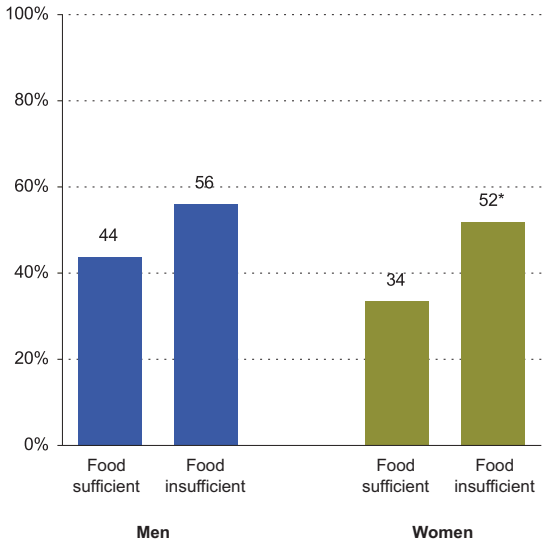
Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

Food Adequacy, Availability and Insufficiency Related to Vegetable and Fruit Consumption

This study examined the relationship between food insufficient adults and their likelihood to consume less than the recommended levels of vegetables and fruit. Nineteen percent of male adults in food insufficient households ate between 0–2 servings of vegetables and fruit (Figure 14) daily. In contrast, only 9% of men

living in food sufficient households ate this amount. Among women living in food insufficient households, 13% consumed 0–2 servings of vegetables and fruit daily, while only 4% of their food sufficient counterparts consumed this level. As epidemiological studies indicate, consumption at this minimal level doubles the risk for certain cancers.[30] Little difference was observed between men in food insufficient households compared with food sufficient households consuming more than 2 but fewer than 5 servings per day. At this consumption range (which is still less than optimal for cancer prevention), 37% of food insufficient men ate at these levels, compared with 35% of men in food sufficient households. Conversely, 39% of women in food insufficient households ate more than 2 but fewer than 5 servings per day while 30% of women in food sufficient households ate within this range. As Table 3 indicates, when further analysis adjusted for other variables, food insufficiency was not significantly associated with consumption of fewer than 5 servings per day for men (AOR 1.3; 95% CI 0.8–2.1). Conversely, consumption of fewer than 5 servings per day is significantly associated in food insufficient women (AOR 1.7; 95% CI 1.2–2.6). This finding is important as it reinforces the differences between sexes. Overall, adult women in this province are significantly more likely to consume vegetables and fruit compared with men; their median▼ number of daily servings was 6.3 compared with men's 5.4 servings per day. However, women in food insufficient households had significantly greater odds for less than optimal intake, which also predisposes this group to increased risk of developing cancer because of lower vegetable and fruit consumption.

Figure 14. Proportion of respondents who ate <5 servings of vegetables and fruit per day, by food sufficiency status



* Significant higher than food sufficient (p<.001)

Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

▼ See Glossary of Terms, Appendix 5

Table 3. Sex-specific adjusted[a] odds ratio estimates for vegetable and fruit consumption, by food insufficiency status

	Men		Women	
	OR	95% CI	OR	95% CI
Ate <5 servings/day of vegetables and fruit				
Food sufficient	1.0	Reference	1.0	Reference
Food insufficient[b]	1.3	0.8–2.1	1.7	1.2–2.6
Agree/Neither agree nor disagree that vegetables and fruit are expensive[c]	1.0	0.8–1.3	1.7	1.3–2.1
Disagree that vegetables and fruit are expensive	1.0	Reference	1.0	Reference
Agree/Neither agree nor disagree that good quality vegetables and fruit are available[d]	1.1	0.8–1.5	1.5	1.1–2.0
Disagree that good quality vegetables and fruit are available	1.0	Reference	1.0	Reference

Abbreviations: OR, odds ratio; CI, confidence interval

a Stepwise elimination of variables, based on the likelihood ratio method, was used to determine the final multivariate model[56]

b Adjusted for age group, education level, concern about pesticides on vegetables and fruit, cancer risk perception, and attitude toward eating vegetables and fruit

c Adjusted for age group, and concern about pesticides on vegetables and fruit

d Adjusted for age group, perception that vegetables and fruit take too much preparation, and concern about pesticides on vegetables and fruit

The relationship between barriers to vegetable and fruit intake, such as perceived cost and availability, and food insufficiency was also examined. As shown in Table 3, women who were either neutral or agreed that vegetables and fruit were too expensive (AOR 1.7; 95% CI 1.3–2.1) or were not available in their area (AOR 1.5; 95% CI 1.1–2.0) were more likely to eat fewer than 5 servings per day than those who disagreed with these statements. No association between either perceived cost or availability and consumption was observed among men.

Thus, for the general adult population in Ontario, household food insufficiency, and perceptions of availability of produce and cost of produce do not significantly influence less than optimal consumption levels in men; but in women, those who are household food insufficient, or who had the perception that vegetables and fruit are expensive and not available, were more likely to have less than optimal consumption. This finding may reflect the sex-specific differences in food acquisition and preparation. For example, 85% of Canadian women report being the primary grocery shoppers for their households versus 15% of Canadian men.[57] Similarly, Canadian men aged 20–64 spend between 0.4–0.5 hours per day cooking and washing up; compared with women of the same age who spend 1.0–1.3 hours per day doing meal preparation and clean-up.[58] Therefore, men's perception of cost or availability may not be relevant as predicting consumption due to their lack of involvement in household meal planning and preparation, except if they live on their own.

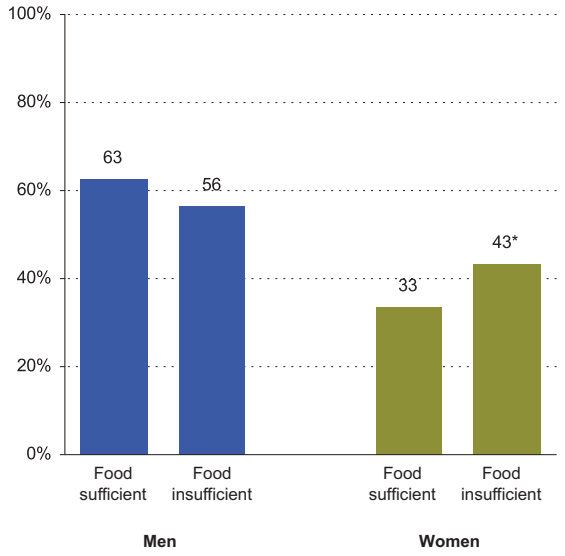
BMI▼ and Physical Inactivity

The ONCPS asked each participant their height and weight from which body mass index (BMI) was calculated. Significantly more food insufficient women than their food sufficient counterparts were overweight or obese (BMI 25+): 43% of food insufficient women, compared with 33% of women who were able to pay

▼ See Glossary of Terms, Appendix 5

for food, were overweight or obese (Figure 15). Table 4 shows that food insufficient men, compared with their food sufficient counterparts, have significantly decreased odds of being overweight or obese (AOR 0.6; 95% CI 0.4–0.9). Conversely, food insufficient women, have significantly increased odds of being overweight or obese (AOR 1.8; 95% CI 1.2–2.6) compared with their food sufficient counterparts. One of the limitations of the current study is that the sample size of underweight adults (BMI <18.5) was too small for reliable regression analysis.

Figure 15. Proportion of respondents who were overweight or obese (BMI 25+ kg/m²), by food sufficiency status



* Significantly higher than food sufficient (p<.05)

Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

Table 4. Sex-specific adjusted odds ratio estimates[a] for overweight and obesity, and physical activity, by food insufficiency status

	Men		Women	
	OR	95% CI	OR	95% CI
Overweight or obese (BMI 25+)				
Food sufficient	1.0	Reference	1.0	Reference
Food insufficient[b]	0.6	0.4–0.9	1.8	1.2–2.6
Physically active <3 hours/week				
Food sufficient	1.0	Reference	1.0	Reference
Food insufficient[c]	1.0	0.6–1.6	0.9	0.6–1.1

Abbreviations: OR, odds ratio; CI, confidence interval

a Stepwise elimination of variables, based on the likelihood ratio method was used, to determine the final multivariate model[56]

b Adjusted for age group, education level, and level of physical activity

c Adjusted for age group, education level, and immigrant status

There have been conflicting Canadian results on the association of body weight with food insufficiency and hunger. One Canadian study found a significant negative association between food insufficiency and overweight for men, but a non-significant increased odds of being overweight among women.[44] The same study reported a non-significant increased odds of obesity among men and no association with obesity among food insufficient women. The only other Canadian study completed in this area found a significant association between obesity (BMI 30+) and household food insufficiency.[43]

This current study's results are similar to those in a recent American study, which found that food insufficiency is positively related to overweight in women, but not for men.[47] Townsend and colleagues propose that in general, women's experiences of food insufficiency are different from men's.[47] Food insufficient women are often heads of households with children, whereas men reporting food insufficiency are often alone, therefore making sex comparisons

inappropriate.[47] This finding remains consistent in the ONCPS, as indicated previously under household characteristics.

American researchers also posit that women in particular report disordered eating patterns due to foregoing food so that their children can eat. This cycle is characterized by overeating when food is plentiful (i.e. when money is available) followed by a short period of involuntary food restriction (i.e. when limited food is given to children or not available for any family members), and this feast/famine pattern becomes cyclical. It is proposed that if this pattern becomes chronic, it can lead to changes in metabolism, which can result in gradual weight gain over time.[47,59,60]

Ontario's obesity prevalence (12%) is generally close to the national estimate of 15%.[61] Notwithstanding the differences in instruments used to measure household food insufficiency, this present study's finding may very well be due to the level of analysis. In particular, there is an important effect of immigration on the distribution of body weight across the Ontario population. Immigrants born in Asia have a much greater tendency to have lower BMI's than Canadian-born adults.[62] Because Ontario has over half of all Canadian immigrants,[48] this immigrant effect may modulate not only the distribution of body weight but, due to the relationship found in this current study of food insufficiency among immigrants living here less than 20 years, may in part explain the differences in relationship between overweight and obesity, and food insufficiency that has been found among these different studies. This relationship will be further explored in another *Insight on Cancer* supplement on body weight and physical activity, as well as more in-depth regression analysis for peer review literature.

For the purposes of this study, physical inactivity was defined as less than 3 hours per week of moderate to vigorous activity. This cut-point is based on the recommendation to have at least 30–45 minutes of moderate to vigorous activity on most days of the week.[63,64] There was very little difference in the prevalence of physical inactivity for both sexes in food sufficient and insufficient households. Forty-four percent of men in food insufficient households were physically inactive compared with 43% of men in food sufficient households. Fifty-three percent of women in food insufficient and food sufficient households were physically inactive. Table 4 shows that, when controlling for other factors, there is no difference between food insufficient men and food sufficient men in terms of the effect on physical inactivity (AOR 1.0; 95% CI 0.6–1.6). Women in food insufficient households were less likely to be physically inactive than women in food sufficient households, but this finding was not statistically significant (AOR 0.9; 95% CI 0.6–1.2). Therefore the effect of household food insufficiency on predicting physical inactivity is negligible, and factors other than household food insufficiency are contributing to Ontario adults' physical inactivity, for which current overall provincial prevalence is 43% of men and 53% of women aged 18–64 not meeting the minimum recommendation.[22]

Knowledge, Attitudes and Beliefs, and Self-Efficacy

For the purposes of this survey, knowledge was assessed by the response to the question asking the number of vegetable and fruit servings that are recommended for daily consumption by government and health agencies. Whereas, the respondents' attitudes were measured by asking how many servings they personally needed to eat each day in order to maintain good health. Factors that were identified as barriers (having a negative influence) to adequate vegetable and fruit intake, such as cost, spoilage, availability, preparation, lack of information on

preparation and storage, and concern about pesticides* or genetically modified foods were included. This analysis focused on perceptions of cost and availability. Finally, self-efficacy was assessed by a Likert scale asking the respondents' confidence in their ability to increase their servings of vegetables and fruit within the next month.

The provincial prevalence of men and women who do not know the recommendations of 5 to 10 vegetable and fruit servings per day is 40% and 22%, respectively. Sixty-two percent of men in food insufficient households did not know the daily number of vegetable and fruit servings recommended to eat, compared with 52% of food sufficient men. Likewise, 34% of food insufficient women did not know the recommendation, while about 26% of women who had the ability to pay for food did not know 5 or more servings are recommended. Yet, neither of these differences were statistically significant.

Taking into consideration other variables, when examining lack of knowledge in food insufficient households relative to food sufficient households, there was no difference among men (AOR 1.0; 95% CI 0.6–1.8); however, women in food insufficient households were more likely to not know the recommended levels, although this finding is not statistically significant (AOR 1.2; 95% CI 0.8–1.9) (Table 5). This is an important finding as, irrespective of being in a food sufficient or insufficient household, there is a high lack of awareness among Ontario adults, particularly among men. This indicates that it is not simply a matter of knowledge to make the necessary dietary changes needed to reduce risk for cancer. However, it also points out the fact that there is a strong need for population-wide educational campaigns and programs to increase awareness of the recommended levels of vegetable and fruit consumption.

Table 5. Sex-specific adjusted odds ratio estimates[a] for knowledge and attitudes about vegetable and fruit intake, by food insufficiency status

	Men		Women	
	OR	95% CI	OR	95% CI
Does not know 5+ servings/day recommended				
Food sufficient	1.0	Reference	1.0	Reference
Food insufficient[b]	1.0	0.6–1.8	1.2	0.8–1.9
Does not personally believe they need 5+ servings/day				
Food sufficient	1.0	Reference	1.0	Reference
Food insufficient[c]	1.2	0.7–2.2	2.0	1.3–3.1

Abbreviations: OR, odds ratio; CI, confidence interval

a Stepwise elimination of variables, based on the likelihood ratio method, was used to determine the final multivariate model[56]

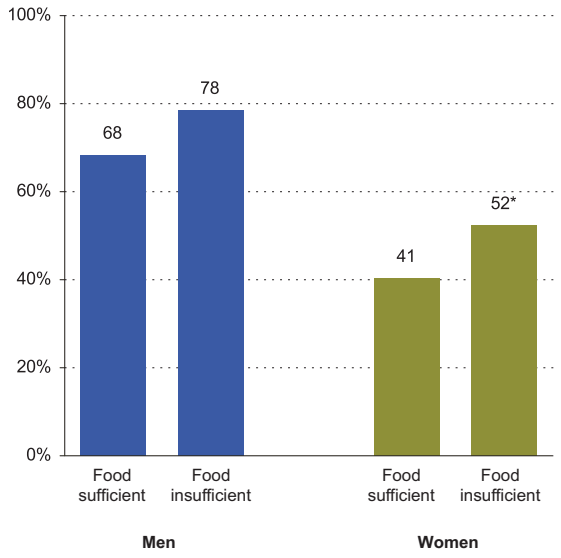
b Adjusted for age group, education level, located in a rural community, and vegetable and fruit consumption

c Adjusted for age group, education level, immigrant status, located in a rural community, and eat vegetables and fruit to prevent cancer

Significantly more women living in food insufficient (52%) than food sufficient (41%) households felt that they personally did not need to consume the recommended 5 plus servings per day (Figure 16). As well, 78% of food insufficient men felt that they personally did not need to consume the recommended servings per day compared with 68% of their food sufficient counterparts. Yet, this difference was not statistically significant. The provincial prevalence estimates for those who did not think they needed to eat the recommended levels of vegetables and fruit were 63% for men and 38% for women.

* A more in-depth examination of the perceived importance of pesticides will be presented in a future *Insight on Cancer* supplement.

Figure 16. Proportion of respondents who did not personally believe they need 5+ servings of vegetables and fruit per day, by food sufficiency status



* Significantly higher than food sufficient (p<.05)

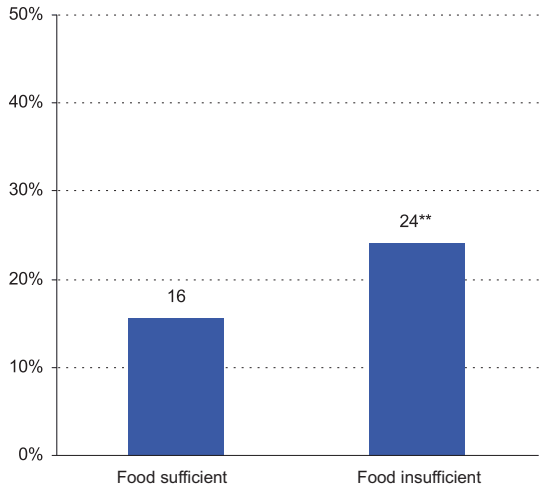
Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

Women in food insufficient households relative to those in food sufficient households were more likely to not personally believe that they needed to consume the recommended levels (AOR 2.0; 95% CI 1.3–3.1) (Table 5). Although men were also more likely to not believe they needed to eat 5 or more servings per day, the increased odds were statistically significant (AOR 1.2; 95% CI 0.7–2.2). This difference in sex illustrates that many men appeared to have poor attitudes towards their diet irrespective of whether they were at risk for hunger or not, and that food insufficient women were the least likely to believe that they did not need to consume the recommended levels. This finding may be one of the keys to widely replicated results indicating that mothers will and do forego food so that their children can eat.[65–79]

Self-efficacy is the confidence that a person feels about performing a particular activity, including the confidence in overcoming the barriers to performing that behaviour, and is a primary predictor of intention to engage in healthy eating behaviour.[80] Only respondents who were planning to eat more vegetables and fruit in the next month were asked how confident they were about this action. Therefore, the analysis was based on a subset of the survey sample. As a result, this variable was not stratified by sex because of the reduced size of the sample.

Based on a distribution of self-efficacy scores (Figure 17), 24% of respondents in food insufficient households had low self-efficacy, 55% had moderate self-efficacy and 21% had high self-efficacy. On the other hand, individuals in food secure households reported significantly better levels of self-efficacy: 16% reported low, 59% moderate, and 26% high self-efficacy with respect to improved vegetable and fruit consumption. Adults in food insufficient households had more than double the odds of having lower confidence in their ability to eat more vegetables and fruit within the next month (AOR 2.2; 95% CI 1.4–3.4) compared with adults in food sufficient households (Table 6). This is not an unexpected finding, given that resource constraints would likely affect their ability to make changes in the short term.

Figure 17. Proportion of respondents with low self-efficacy* about eating more vegetables and fruit in the next month, by food sufficiency status



* Sample restricted to only those who were eligible to answer this item on the questionnaire (n=1408)

** Significantly higher than food sufficient (p<.05)

Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

Table 6. Adjusted odds ratio estimates[a] for self-efficacy toward vegetable and fruit intake, by food insufficiency status

	OR	95% CI
Low self-efficacy about eating more vegetables and fruit in the next month		
Food sufficient	1.0	Reference
Food insufficient[b]	2.2	1.4–3.4

Abbreviations: OR, odds ratio; CI, confidence interval

a Stepwise elimination of variables, based on the likelihood ratio method, was used to determine the final multivariate model[56]

b Adjusted for sex, age group, located in a rural community, and eat vegetables and fruit intake to prevent cancer [Note: Sample restricted to only those who were eligible to answer this item on the questionnaire (n=1408)]

Of all of these variables, lack of knowledge about what to eat is not directly related to household food insufficiency. However, there appears to be a sex-specific difference with respect to attitudes, particularly among women who live in a household that experienced food insufficiency. These women appear to be twice as likely to weigh whether or not the recommendations are personally relevant compared with women living in food sufficient households. This may in part explain the fact that mothers can, and do, forego eating so that the rest of the family can eat. On the other hand, this study has found that confidence in the ability for dietary change is also significantly lower among food insufficient households. Given their economic circumstances, food insufficient adults are not confident that a change is possible in the near future, and this may also explain in part the attitudinal shift observed, particularly among women.

WHAT ARE THE POLICY IMPLICATIONS?

The analysis from this survey has led to an attempt to understand the scope and the nature of food insecurity and its influence on vegetable and fruit consumption, body weight and physical activity levels of Ontario adults, as these factors play a significant role in the development of cancer.

Availability Issues

Clearly, the availability of produce varies regionally. This finding is particularly significant for Ontarians in the North. There is a federal program in place for the most isolated, fly-in communities, to provide a reliable food supply throughout the year.[8] Effectively, this program (Food Mail) acts as an alternative to private sector food distribution channels, because it is not economically feasible for this sector to serve these communities. There are 27 eligible communities in Ontario; it is assumed that the communities that use the service do so because their freight costs through Food Mail are equal to or less than regular air cargo rates for both perishable and non-perishable food items.[81] However, the ONCPS results and the Food Mail program outcomes indicate that further research is needed to understand not only how food is or is not distributed in the North, but also the impact of transportation and fuel costs on food prices and availability, particularly for vegetables and fruit. Additional research should also explore the range of policy and program alternatives from other jurisdictions dealing with availability issues due to low population density and distance from major centres. Due to the unique mix of Aboriginal groups in this region, sensitivity to and understanding of the role of traditional diets and consumption patterns, particularly of indigenous plant foods, is also crucial formative research for any interventions being considered. The goal of the research and subsequent policy development would be to ensure a coherent policy framework that strives to make healthy choices the easiest choices through easier access to better quality and more affordable food in all parts of Ontario.[82,83]

Access and Household Food Insufficiency

This survey shows that more than 1 in 10 Ontarians, or more than 763,900 Ontario adults, were living in households that were uncertain of having, or unable to acquire, enough food to meet the needs of all their members because they had insufficient money or other resources. The issue of household food insufficiency is not a new one. In 1990 a set of 10 recommendations were given to the Ontario Government's Standing Committee on Social Development in a report on food banks.[84] This was followed in 1995 by recommendations for ensuring food security for low-income residents in a report made by the Ontario Task Force on the Primary Prevention of Cancer.[85]

Despite these reports drawing attention to the issue, there was never a clear policy direction set in the subsequent years. More than a decade of provincial and national deficit cutting has resulted in social policy that has produced a set of conditions where Ontario's rates of adult hunger and the risk of going hungry are comparable to the nationwide estimates found in the United States for the same time period. In particular, low income is the strongest predictor for adult hunger in Ontario, and certain household types and groups—such as lone males, single parents with children under 18, and those who have immigrated to the province within the past 20 years—are at much higher risk for this outcome, compared with the rest of the population.

In a recent survey of Canadian federal and provincial policy makers, 45% of those civil servants surveyed from finance departments did not believe that they should consider the health consequences of policy alternatives.[86] This is not to imply that socio-economic

program and policy directives were developed with the intention to force Ontario citizens to go hungry, but rather that the trade-offs of health costs and their implications were not fully considered when these policy objectives were designed and implemented. Consequently, the province is experiencing unprecedented health outcomes due to the policy directions and imperatives made over the past decade.

Recently, the provincial government announced in its budget speech a 3% increase to basic allowance and shelter allowance (the first time there has been an increase in the program in 11 years), as well as no reduction in social assistance benefits for those receiving the federal government's increase to the National Child Benefit Supplement.[87] This builds on earlier announcements of an increase to the minimum wage (the first increase in 8 years) and ending 60-hour workweeks.[88] Furthermore, there will be an initial $9.5-million investment toward speeding the integration of foreign trained workers into the workforce.[87]

While this shows a clear signal in the reversal of social policy, much more will be required to assist those vulnerable Ontario adults who cannot even meet the most fundamental of basic human needs: food. In particular, interventions are needed to assist those who may be at much greater risk of developing cancer and other chronic diseases because of their inadequate vegetable and fruit consumption due to being hungry or at risk of being hungry (i.e. food insufficient households defined by lone-parenthood or single adults). However, responses to hunger and inadequate nutrition in Canadian children and families will need to engage and involve many actors—parents and children, governments, community organizations, schools, private business, charitable organizations, and so on—to ensure success.[89] This study suggests that women in food insufficient households had greater prevalence of obesity and inadequate vegetable and fruit consumption. However, how the relationships are mediated by other factors cannot be ignored. A preliminary analysis of these data using a causal modelling approach indicated that the association between food insufficiency and obesity among women is significantly mediated by total vegetable and fruit intake.[90] This result has important implications for further research, especially given the highly correlated nature of the variables of interest. Further analysis using techniques such as path analysis may help further quantify the importance of each factor and their complex relationships.

Smoking

The Ontario Tobacco Research Unit produces annual monitoring reports, which show stable trends of higher prevalence of smoking among individuals with lower socioeconomic status (SES) compared with the rest of the population.[49,91,92] The ONCPS also confirms this finding, and indicates that Ontario smokers with low SES also have inadequate vegetable and fruit intake. This finding is consistent with other international observations, and as John Potter, cancer epidemiologist notes, "perversely, as smokers have a greater need (given the intake of toxic and carcinogenic compounds) of the micronutrients that such foods provide, it may be that poorer members of society are at significantly elevated risk of cancer both because of the interactive nature of the poor diet and smoking combination and because of the large number of cancers that are related to both exposures."[93]

The Cessation Sub-committee of the Ontario Tobacco Strategy Steering Committee recently commissioned a paper on the efficaciousness of Nicotine Replacement Therapy (NRT) as part of developing comprehensive cessation services for the province, including higher risk populations where smoking prevalence is much greater than the province-wide population estimate. There was

a recommendation to fund, through the Ontario Drug Benefit (a reimbursement program for individuals 65 years or older and individuals on social assistance), NRT and other pharmacotherapies as part of improving access and services to groups with higher smoking rates consistent with those outlined in the Ontario Tobacco Strategy's Cessation Program Logic Model.[94]

IMPLICATIONS FOR FURTHER MONITORING AND SURVEILLANCE

Eighty years ago, Bertrand Russell noted that "science enables the holders of power to realize their purposes more fully, than they would otherwise do, but science is no substitute for virtue."[95]

And this suggests making a meaningful commitment to immediate action, while at the same time trying to evaluate the results of new provincial policy and program directives geared toward alleviating all three aspects of food insecurity—availability, adequacy and access—throughout the province.

In addition to recommendations for the ongoing surveillance of food insecurity issues of the general population of Ontario in order to examine trends over time, monitoring must be initiated related to higher risk populations, which would include those living in Northern regions or isolated communities, families (with special attention to lone-parent families with children under the age of 18), single men and households that have immigrated to Ontario within the past two decades.[96] The results of this monitoring should be compiled annually, and a set of indicators should be developed and reported on to both the general public and decision makers (elected and government policy makers) to inform the strategy and set performance standards and accountability for social and health policy decisions and programs.[97]

Conclusion

To be a source of knowledge means, literally, to be a cause of knowledge. Causes are of a double kind, informative and productive. If knowledge simply informs us, it does not imply action. However if knowledge is a productive cause, it compels us to produce successful human action.[98] The authors hope that the knowledge presented in this report will stimulate dialogue among key stakeholders and produce purposeful action on the important issue of food security.

APPENDIX 1:
WHAT WERE THE PRIMARY OBJECTIVES OF THE SURVEY RELEVANT TO FOOD INSECURITY, DIETARY RISK FACTORS AND CANCER PREVENTION IN THE ADULT POPULATION OF ONTARIO?

1. Does perception of vegetable and fruit prices modify consumption? Are there any regions of Ontario that are at increased risk? Does perception of cost have an impact on the risk of being food insecure?

2. Does vegetable and fruit availability modify consumption? Are there any regions of Ontario that are at increased risk? Does availability have an influence on the risk of being food insufficient?

3. What is the prevalence of food insufficiency (with and without hunger) among adults aged 18–64 in Ontario? Are there any regions of Ontario or differences among rural and urban communities that influence the risk? How does this compare to other jurisdictions? Are there any periods during the year or during the month where food insufficiency and hunger are more likely to occur?

4. What sociodemographic factors affect the risk of being food insufficient (age, ethnicity, geographic region, education, income, number of children, etc)?

5. Does smoking behaviour link to being at risk for household food insufficiency?

6. Does being food insufficient (with/without hunger) reduce consumption of vegetables and fruit in Ontario adults?

7. Does being food insufficient (with/without hunger) modify BMI (both below and above healthy weight range of 18.5–24.9)?

8. Does being food insufficient (with/without hunger) modify physical inactivity?

9. What is the role of food insufficiency on knowledge, attitudes and beliefs (KAB) and self-efficacy (SE)?

APPENDIX 2:
ONCPS QUESTIONS APPLICABLE TO THE FOOD SECURITY SUPPLEMENT

*Food security**

Sometimes people cannot afford to eat the food they would like to eat. The next questions are about the food eaten in your household in the last 12 months and whether you were able to afford the food you need. I'm going to read you two statements that some people have made about their food situation.

Note: Respondents whose house or roommates do not share food or food costs were not asked the following questions.

The first statement is "The food that I/we bought just didn't last, and I/we didn't have money to get more." Was that often, sometimes, or never true for you in the last 12 months?

I/We couldn't afford to eat balanced meals: was that often, sometimes, or never true for you in the last 12 months?

In the last 12 months did you ever cut the size of your meals or skip meals because there wasn't enough money for food? (Yes, No)

(If Yes) How often did this happen – almost every month, some months but not every month, or in only 1 or 2 months?

In the last 12 months, did you personally ever eat less than you felt you should because there wasn't enough money to buy food? (Yes, No)

In the last 12 months, were you personally ever hungry but did not eat because you couldn't afford enough food? (Yes, No)

Age

In what year were you born?And in what month was that?

Birthplace, immigrant status

In what country were you born?

For how many years have you lived in Canada?

Ethnic group

To what ethnic or cultural group do you belong? *[Respondents can provide up to 5 groups]*

Language

What language do you speak most often at home?

Education level

What is the highest level of education you have obtained?

Household income

Could you please tell me how much you and other members of your household received in the year ending December 31st 2000, before taxes? Please include income from all sources such as savings, pensions, rent, as well as wages.

To the nearest thousand dollars, what was your total household income?

* Adapted from the United States 6-item food security module[26]

We don't need the exact amount; could you tell me which of these broad categories it falls into:

1. Less than $10,000
2. Between $10,000 and $20,000
3. Between $20,000 and $30,000
4. Between $30,000 and $40,000
5. Between $40,000 and $50,000
6. Between $50,000 and $60,000
7. Between $60,000 and $70,000
8. Between $70,000 and $80,000
9. Between $80,000 and $90,000
10. Between $90,000 and $100,000
11. More than $100,000?
12. Don't know
13. Refused

Household size

Including yourself, how many people live in your household?

How many are children under 18?

Self-reported health

In general, compared to other people your age, would you say your health is excellent, very good, good, fair or poor?

Chronic conditions

Have you ever been told by a doctor or other health professional that you have:

1. diabetes
2. heart disease
3. high cholesterol
4. hypertension or high blood pressure
5. diverticulitis or bowel disease (e.g., Crohns, inflammatory disease, ulcerative colitis, celiac disease)
6. kidney disease?

Smoking status

Next, questions about smoking.

At the present time do you smoke cigarettes daily, occasionally, or not at all?

Have you smoked at least 100 cigarettes in your life?

[If subject is not currently smoking and has never smoked 100 cigarettes, skip this question]
How long ago was it that you last smoked cigarettes. Was it less than one week ago, more than one week but less than a month ago, 1 to 6 months ago, 7 to 11 months ago, 1 to 5 years ago, or more than 5 years ago?

Physical activity

Please think about physical activities or exercises that you do during your normal day, including at work, at school, doing chores and in your leisure time.

On how many days, in a usual week, do you exercise or participate for 10 minutes or more in activities that increase your breathing or make your heart beat faster?

For how long do you do these types of activities in a typical day?

Body measurements

How tall are you without shoes?

How much do you weigh?

Vegetable and fruit intake

Please think about the foods you have eaten over the past month including foods and beverages that were part of meals and snacks, at home and away from home.

Over the past month, how many times per day, per week, or per month did you eat/drink:

- french fries, hash browns or poutine?
- other potatoes, such as baked potatoes, boiled potatoes, mashed potatoes or potato salad?
- lettuce salads with or without other vegetables in them?
- 100% vegetable juices like tomato or V-8?
- other vegetables including raw, cooked, canned or frozen?
- soups made mostly with vegetables?
- tomato sauces with foods such as spaghetti or pasta?
- fresh, frozen or canned fruit?
- 100% fruit juices?

For each food item consumed:
If one portion of [food item] is about ? cup, each time you ate [food item] how many portions did you usually eat?

Knowledge about vegetables and fruit

How many servings of fruits and vegetables do you think government and health agencies recommend that adults eat every day?

Attitude toward vegetables and fruit

For yourself, how many servings of fruits and vegetables do you think you need to eat every day to stay healthy?

Facilitators and barriers of consumption

People eat fruit for different reasons. Please tell me if each of the following reasons are very important, somewhat important or not important to why you personally eat fruit:

- eating fruit makes you feel better
- eating fruit helps you control your weight
- eating fruit has been part of your diet since childhood

For each of the following, please tell me if you agree, neither agree nor disagree, or disagree.

- fruit is expensive
- fruit spoils too quickly
- concern about pesticides prevents you from eating more fruit
- preparing fruit takes too much time and planning
- there is not enough information about how to prepare fruit
- there is not enough information about how to store fruit
- concern about genetically modified foods prevents you from eating more fruit

Now please think about vegetables.
[Questions repeated for vegetables].

Now please think about both fruits and vegetables.

- Eating fruits and vegetables helps you stay healthy. Is this is very important, somewhat important or not important to why you eat fruit?
- Eating fruits and vegetables helps you prevent cancer. Is this is very important, somewhat important or not important to why you eat fruit?
- Most fruits and vegetables taste good. Do you agree, neither agree nor disagree, or disagree?
- Good quality fruits and vegetables are not available where you shop or get food. Do you agree, neither agree nor disagree, or disagree?

Self-efficacy

Are you seriously thinking of eating more fruit and vegetables starting sometime in the next 6 months? (Yes, No)

(If Yes) During the next month, are you planning to eat more fruit and vegetables? (Yes, No)

(If Yes) On a scale from 0 to 10, where 0 means that you are not at all confident and 10 means that you are totally confident, how confident are you that you will eat more fruits and vegetables in the next month?

APPENDIX 3:
DEMOGRAPHIC PROFILE OF THE SURVEY SAMPLE

Table 1. Selected characteristics of the sample

Characteristics	Total (n = 3,004)	Men (n = 1,329)	Women (n = 1,675)
Age group			
18–34	33.7	36.1	31.7
35–49	39.8	40.5	39.2
50–64	24.6	22.1	26.5
Missing	2.0	1.3	2.6
Region			
Northwest	11.7	12.1	11.4
Northeast	11.8	11.1	12.2
South/Southwest	11.9	12.6	11.3
Central West	11.8	11.3	12.2
Central East	40.8	41.5	40.3
East/Southeast	12.1	11.4	12.6
Area of residence			
Urban	75.6	75.0	76.1
Rural	14.8	13.6	15.7
Missing	9.6	11.4	8.2
Household type			
1 Adult	20.2	19.6	20.6
1 Adult with child(ren) <18	5.2	2.1	7.7
2 Adults	25.7	26.9	24.8
2 Adults with child(ren) <18	28.6	28.1	29.0
Multiple adults with/without child(ren) <18	20.1	23.0	17.8
Missing	0.2	0.2	0.2
Immigrant status			
North American-born	76.6	75.4	77.7
Immigrated <20 years, Europe	12.5	14.0	11.3
Immigrated 20+ years, Europe	10.4	10.3	10.4
Missing	0.5	0.5	0.6
Ethnic group			
Canadian/European	81.2	78.7	83.2
South/Southeast Asian	8.7	9.3	8.3
Other	8.1	10.2	6.3
Missing	2.0	1.7	2.2
Language spoken most at home			
English	85.5	83.9	86.7
French, Italian, German, Portuguese, Spanish	4.7	4.4	5.0
Chinese	2.1	2.1	2.1
Other	7.4	9.3	5.9
Missing	0.4	0.3	0.4
Education level			
< High school	10.4	11.4	9.6
High school	23.6	24.5	22.9
Some post-secondary	35.1	33.7	36.1
University	30.2	29.4	31.1
Missing	0.6	1.0	0.4
Household income			
Low	9.9	7.6	11.6
Middle	15.7	12.9	17.9
Upper-middle	29.7	30.5	29.1
High	43.1	47.6	39.5
Missing	1.6	1.4	1.9

Table 1. Selected characteristics of the sample (continued)

Characteristics	Total (n = 3,004)	Men (n = 1,329)	Women (n = 1,675)
Self-reported health			
Excellent	22.3	21.6	22.9
Very good	36.4	35.0	37.5
Good	30.3	32.8	28.4
Fair	8.5	8.2	8.7
Poor	2.2	2.2	2.2
Missing	0.3	0.2	0.4
Number of chronic conditions			
0	72.7	73.0	72.5
1	26.1	26.2	26.1
Missing	1.1	0.8	1.4
Specific conditions			
Diabetes			
No	95.7	95.3	95.9
Yes	4.1	4.6	3.8
Missing	0.2	0.08	0.3
Heart disease			
No	96.9	96.1	97.5
Yes	3.0	3.8	2.3
Missing	0.2	0.08	0.2
High cholesterol			
No	86.6	85.8	87.3
Yes	13.0	13.9	12.3
Missing	0.4	0.3	0.4
Hypertension			
No	86.9	87.7	86.2
Yes	13.0	12.3	13.5
Missing	0.2	0	0.3
Bowel disease			
No	96.0	97.4	94.8
Yes	3.7	2.3	4.8
Missing	0.3	0.2	0.4
Kidney disease			
No	98.6	98.4	98.8
Yes	1.2	1.4	1.1
Missing	0.2	0.2	0.2
Smoking status			
Non	46.9	41.1	51.5
Former	27.0	29.5	25.0
Current	25.7	29.0	23.1
Missing	0.4	0.4	0.4

Comparison with the 2001 Census Data

The ONCPS over-represents women (56%) compared with the general population of adults in Ontario (51%); however it is representative of the provincial age distribution (Table 2) and region (Table 3). The sample is also comparable with the 2001 Census data with respect to the highest level of education attained (Table 4). Overall the sample is comparable for total household income, however it under-represents adults from households with a reported income of $10,000–$19,999 per year (Table 5).

The ONCPS sample was also compared with the 2001 Census for country of birth and ethnicity (Table 6 and Table 7). The sample is representative of adults who were born in the United States, Europe, Australia and New Zealand, Africa, and those born in Central or South America and the Caribbean. However, the sample over-represents Canadian-born males and females aged 25–44 years and 45–64 years, while it under-represents males and females aged 15–24 years. The latter may be because the ONCPS did not include individuals under the age of 18 years. Furthermore, adult males aged 25–44 years who were born in Asia were over-represented in the sample compared with the 2001 Census (Table 6).

A similar pattern was observed for ethnic group. Ethnically Canadian males and females older than 24 years were over-represented in the sample, whereas those aged 15–24 years were under-represented. Men aged 25–44 claiming East Asian, Southeast Asian, or South Asian ancestry, as well as females of the same age with African heritage, were over-represented in the sample (Table 7).

As a consequence of reporting methods, it is not possible to accurately compare this sample with the 2001 Census data for household composition, especially for single person and single parent households. This is a limitation given household composition is an important variable alone and when considering household income levels.

Table 2. 2001 Census comparison for age group

Sex	Statistic	Age group								
		20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64
M	% difference	0.02	-0.72	-0.58	-0.55	-0.24	-1.19	1.48	0.55	1.23
	Z	0.0069	-0.2716	-0.2210	-0.2090	-0.0913	-0.4509	0.5500	0.2022	0.4494
F	% difference	1.47	-0.54	1.16	-1.21	0.13	0.52	-0.14	0.46	-1.83
	Z	0.6085	-0.2265	0.4886	-0.5220	0.0560	0.2186	-0.0608	0.1891	-0.7605

Table 3. 2001 Census comparison for region by sex and age group

Region	Sex	Statistic	Age Group								
			20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64
Northwest	M	% difference	-1.47	0.53	1.15	-0.16	4.82	-4.24	-1.13	0.05	0.45
		Z	-0.1907	0.0682	0.1480	-0.0208	0.6205	-0.5725	-0.1482	0.0067	0.0570
	F	% difference	2.92	1.57	1.31	1.72	-4.99	3.02	-0.77	-1.27	-3.51
		Z	0.4116	0.2229	0.1881	0.2491	-0.7593	0.4334	-0.1122	-0.1817	-0.5051
Northeast	M	% difference	1.90	-0.76	-0.28	-1.04	-2.01	-5.29	4.90	2.42	0.18
		Z	0.2345	-0.0949	-0.0355	-0.1339	-0.2610	-0.6954	0.6062	0.2993	0.0225
	F	% difference	0.22	1.58	-1.58	-4.33	4.70	2.40	-1.20	1.20	-2.97
		Z	0.0318	0.2295	-0.2353	-0.6696	0.6927	0.3563	-0.1796	0.1758	-0.4429
South/Southwest	M	% difference	3.34	2.59	-6.35	1.18	-1.35	3.23	0.12	-4.48	1.75
		Z	0.4289	0.3324	-0.8639	0.1550	-0.1801	0.4178	0.0161	-0.5924	0.2212
	F	% difference	-0.70	-2.39	-0.92	-1.83	2.20	-0.78	3.56	2.03	-1.17
		Z	-0.0994	-0.3439	-0.1318	-0.2672	0.3133	-0.1123	0.4976	0.2815	-0.1646
Central West	M	% difference	-3.29	3.97	-3.08	-4.66	-1.60	0.34	2.12	0.42	5.78
		Z	-0.4169	0.4823	-0.3926	-0.6098	-0.2053	0.0425	0.2623	0.0512	0.6856
	F	% difference	0.91	-1.91	2.49	-1.01	-1.49	1.43	-1.93	0.16	1.35
		Z	0.1329	-0.2835	0.3629	-0.1530	-0.2257	0.2113	-0.2885	0.0238	0.1944
Central East	M	% difference	-0.78	-2.59	0.28	-1.54	-0.90	-0.23	3.15	2.19	0.42
		Z	-0.1886	-0.6375	0.0678	-0.3856	-0.2221	-0.0571	0.7506	0.5159	0.0985
	F	% difference	2.00	-2.19	0.66	-1.97	-0.76	0.43	0.79	1.42	-0.39
		Z	0.5204	-0.5871	0.1768	-0.5369	-0.2038	0.1147	0.2082	0.3652	-0.1015
East/Southeast	M	% difference	0.83	-5.71	0.23	3.81	2.35	-1.66	-2.51	0.19	2.47
		Z	0.1059	-0.7534	0.0297	0.4876	0.3030	-0.2175	-0.3281	0.0244	0.3069
	F	% difference	1.34	1.35	3.53	0.81	4.08	-1.90	-1.89	-1.60	-5.73
		Z	0.1972	0.1980	0.5170	0.1221	0.6052	-0.2888	-0.2865	-0.2385	-0.8658

Table 4. 2001 Census comparison for highest education level

Education level	Sex	Statistic	Age Group						
			20–24	25–29	30–34	35–39	40–44	45–54	55–64
Less than high school	M	% difference	1.77	1.71	0.45	3.97	-1.77	-1.98	-4.17
		Z	0.2129	0.2043	0.0545	0.4809	-0.2238	-0.2688	-0.5776
	F	% difference	1.35	-0.05	0.33	5.44	1.43	6.44	-14.94
		Z	0.1705	-0.0061	0.0427	0.6895	0.1874	0.8899	-2.4927
High school	M	% difference	0.65	3.17	-0.72	-1.73	-1.84	3.56	-3.10
		Z	0.1208	0.5679	-0.1321	-0.3254	-0.3475	0.6833	-0.5791
	F	% difference	2.11	3.24	1.60	-5.80	1.35	1.58	-4.06
		Z	0.4026	0.6099	0.3079	-1.1952	0.2696	0.3409	-0.8345
Some post-secondary	M	% difference	-1.16	-2.15	0.20	0.80	0.29	0.09	1.94
		Z	-0.2608	-0.4789	0.0445	0.1782	0.0637	0.0211	0.4259
	F	% difference	0.90	-1.90	1.42	1.25	-1.30	0.35	-0.73
		Z	0.2301	-0.4874	0.3608	0.3232	-0.3377	0.0955	-0.1867
University	M	% difference	-0.28	-1.26	0.17	-2.25	1.12	-1.22	3.71
		Z	-0.0566	-0.2630	0.0354	-0.4826	0.2325	-0.2762	0.7602
	F	% difference	0.70	0.95	3.18	-1.67	1.32	-2.31	-2.17
		Z	0.1623	0.2321	0.7662	-0.4120	0.3148	-0.5923	-0.5141

Table 5. 2001 Census comparison for total household income

Statistic	Total Household Income Groups										
	< $10,000	$10,000 - $19,999	$20,000 - $29,999	$30,000 - $39,999	$40,000 - $49,999	$50,000 - $59,999	$60,000 - $69,999	$70,000 - $79,999	$80,000 - $89,999	$90,000 - $99,999	$100,000+
% difference	1.87	4.14	1.69	-1.58	-0.59	-1.32	-1.35	-0.53	-0.36	0.32	-2.30
Z	1.0104	2.2727	0.9408	-0.8953	-0.3335	-0.7420	-0.7558	-0.2939	-0.2000	0.1750	-1.3680

A box around a set of numbers indicates a significant difference (Z > ±1.96); a positive statistic indicates the sample is under-representative compared with the Census

Table 6. 2001 Census comparison for country of birth

Country of Birth	Sex	Statistic	Age Group		
			15–24[a]	25–44	45–64
Canada	M	% difference	11.72	-6.49	-5.24
		Z	3.7815	-2.8524	-1.9916
	F	% difference	12.77	-6.15	-6.62
		Z	4.6526	-3.0909	-2.9304
US, Europe, Australia, New Zealand	M	% difference	1.76	-7.60	5.83
		Z	0.2167	-1.1934	1.0180
	F	% difference	2.65	-2.05	-0.62
		Z	0.3764	-0.3592	-0.1331
East, Southeast, South Asia	M	% difference	7.50	-16.63	9.13
		Z	0.7051	-2.6741	0.9509
	F	% difference	4.64	-9.99	5.34
		Z	0.4705	-1.6098	0.6092
West, Central Asia, Middle East	M	% difference	4.58	-28.96	24.37
		Z	0.2459	-3.1082	1.2189
	F	% difference	-0.32	-15.49	15.80
		Z	-0.0107	-0.8047	0.5028
Africa	M	% difference	7.74	-17.63	9.89
		Z	0.4110	-1.6206	0.5747
	F	% difference	6.98	10.07	-17.04
		Z	0.2428	0.4524	-0.7654
Central Am, South Am, Caribbean[b]	M	% difference	2.47	0.07	-2.54
		Z	0.1877	0.0073	-0.2327
	F	% difference	-3.52	11.35	-7.83
		Z	-0.2858	1.2672	-0.7370

Abbreviations: US, United States; Am, America
a ONCPS only includes individuals aged 18–64
b Includes Bermuda
A box around a set of numbers indicates a significant difference (Z > ±1.96); a positive statistic indicates the sample is under-representative and a negative statistic indicates the sample is over-representative compared with the Census

Table 7. 2001 Census comparison for ethnic group

Ethnic Group	Sex	Statistic	Age Group		
			15–24[a]	25–44	45–64
North American, European[b]	M	% difference	12.21	-7.03	-5.18
		Z	4.0947	-3.1827	-2.1049
	F	% difference	12.73	-5.14	-7.59
		Z	4.8572	-2.6589	-3.6619
East, Southeast, South Asia	M	% difference	11.00	-15.48	4.48
		Z	1.2024	-2.6611	0.5307
	F	% difference	10.04	-10.10	0.06
		Z	1.1443	-1.6788	0.0073
West, Central Asian, Middle East	M	% difference	11.28	-6.87	-4.39
		Z	1.0491	-0.9113	-0.4526
	F	% difference	6.53	-11.44	4.92
		Z	0.4748	-1.2297	0.3575
African	M	% difference	17.69	-13.19	-4.50
		Z	0.9549	-1.1260	-0.2787
	F	% difference	4.06	-42.08	-14.98
		Z	0.1994	-2.8264	-0.7347
Central Am, South Am, Caribbean[c]	M	% difference	0.46	-2.26	1.80
		Z	0.0214	-0.1281	0.0832
	F	% difference	-1.58	8.27	-6.70
		Z	-0.0904	0.5340	-0.4185

Abbreviations: Am, American
a ONCPS only includes individuals aged 18–64
b Includes Australian and New Zealander
c Includes Bermudan
A box around a set of numbers indicates a significant difference (Z > ±1.96); a positive statistic indicates the sample is under-representative and a negative statistic indicates the sample is over-representative compared with the Census

APPENDIX 4: DATA TABLES

Table 1. Responses (weighted proportions) to individual items on the food security scale

	Total (n=2,997)
Affirmative responses to individual items, %	
Food didn't last and no money for more (often/sometimes)	15.3
Couldn't afford to eat balanced meals (often/sometimes)	12.7
Cut size of meals or skipped meals	5.1
If yes, how often (almost every month/some months)	3.6
Ate less because not enough money	4.4
Hungry but couldn't afford food	3.1
Summed affirmative responses, %	
0	80.7
1	7.9
2	5.4
3	2.1
4	1.4
5	1.5
6	1.0

Table 2. Weighted proportion of daily vegetable and fruit intake by sex, perceived cost and availability

	n[a] (n=2997)	Daily servings of vegetables and fruit			
		0–2 (n=212)	>2–<5 (n=986)	5 (n=1791)	
Sex					
Men	1323	10	35	55	*
Women	1674	5	31	64	
V/F too expensive					
Agree	1216	8.1	35.4	56.5	
Neither agree nor disagree	318	8.2	29.6	62.2	
Disagree	1463	6.8	30.9	62.3	
Good quality V/F aren't available					
Agree	444	9.3	37.7	53.0	
Neither agree nor disagree	177	11.5	30.4	58.1	
Disagree	2376	6.8	31.9	61.3	

Abbreviations: V/F, vegetables and fruit
a Unweighted sample size
Differences between numbers within the box are statistically significant. Chi square: * p<.001

Table 3. Weighted proportion of respondents who agree that good quality vegetables and fruit are not available in their area and are too expensive, by region

Region	Available		Expensive
Ontario	13.1		39.9
Northwest	24.5	*	49.3
Northeast	22.6		46.3
South/Southwest	12.1		42.1
Central West	11.3		39.3
Central East	12.3		38.1
East/Southeast	11.1		40.7

Differences between numbers within the box are statistically significant. Chi square: * p<.01

Table 4. Weighted prevalence (%) of food sufficiency status by selected characteristics

Variable	n[a] (n=2997)	Food sufficient (n=2644)	Food insufficient without hunger (n=271)	Hunger (n=82)	
Overall		88.6	8.9	2.5	
Sex					
Men	1323	89.9	8.5	1.6	
Women	1674	87.4	9.3	3.3	
Age group					
18–34	1007	85.4	11.4	3.2	**
35–49	1191	88.5	8.9	2.6	
50–64	738	93.4	5.2	1.4	
Region					
Northwest	351	87.8	9.1	3.1	*
Northeast	354	89.8	8.2	2.0	
South/Southwest	356	86.8	9.3	3.9	
Central West	354	85.8	10.5	3.7	
Central East	1221	87.2	10.6	2.2	
East/Southeast	361	92.8	4.7	2.5	
Area of residence					
Urban	2266	88.5	9.2	2.3	
Rural	444	92.2	6.4	1.4	
Household type					
1 Adult	604	84.7	10.7	4.6	*
1 Adult with child(ren) <18	157	76.0	17.3	6.7	
2 Adults	771	90.9	7.3	1.8	
2 Adults with child(ren) <18	858	89.5	8.6	1.9	
Multiple adults with/without child(ren) <18	601	88.0	9.3	2.7	
Immigrant status					
Canadian-born	2249	89.8	7.6	2.6	**
Immigrated <20 years	387	81.2	15.2	3.6	
Immigrated 20+ years	345	89.5	9.5	1.0	
Education level					
< High school	311	77.3	14.9	7.8	***
High school	709	86.1	10.1	3.8	
Some post-secondary	1051	89.0	9.1	1.9	
University	907	93.3	6.0	0.7	
Household income					
Low	292	72.5	18.6	8.9	***
Middle	471	79.7	14.6	5.7	
Upper-middle	892	89.2	9.9	0.9	
High	1293	93.6	5.0	1.4	
Self-reported health status					
Excellent, very good, good	2668	89.7	8.1	2.2	***
Fair, poor	320	79.9	15.4	4.7	
Chronic conditions[b]					
0	2179	88.9	9.1	2.0	
1+	784	87.6	8.3	4.1	
Smoking status					
Non	1405	90.4	7.8	1.8	**
Former	809	90.3	8.0	1.7	
Current	771	83.2	12.0	4.8	
V/F too expensive					
Agree	1216	80.5	14.7	4.8	***
Neither agree nor disagree	318	92.2	5.7	2.1	
Disagree	1463	94.3	4.9	0.8	
Good quality V/F aren't available					
Agree	444	77.4	16.8	5.8	***
Neither agree nor disagree	177	83.1	13.5	3.4	
Disagree	2376	90.8	7.3	1.9	

Abbreviations: V/F, vegetables and fruit
a Unweighted sample size; sample sizes vary due to missing data
b Chronic conditions requiring significant dietary change
Differences between numbers within the box are statistically significant. Chi square: * p<.05; ** p<.01; *** p<.001

Table 5. Sex-specific weighted prevalence (%) of food insufficiency by household type

Variable	n[a] (n=2997)	Food sufficient (n=2644)	Food insufficient without hunger (n=271)	Hunger (n=82)	
Men					
Household type					
1 Adult	260	83.2	13.2	3.6	*
1 Adult with child(ren) <18	28	87.4	11.9	0.7	
2 Adults	356	92.2	5.8	2.0	
2 Adults with child(ren) <18	373	92.4	6.4	1.2	
Multiple adults with/without child(ren) <18	303	88.4	10.4	1.2	
Women					
Household type					
1 Adult	344	85.7	8.9	5.4	**
1 Adult with child(ren) <18	129	73.7	18.4	7.9	
2 Adults	415	89.9	8.5	1.6	
2 Adults with child(ren) <18	485	87.4	10.2	2.4	
Multiple adults with/without child(ren) <18	298	87.7	8.1	4.2	

a Unweighted sample size; sample size does not sum to total due to missing data
Differences between numbers within the box are statistically significant. Chi square: * p<.05; ** p<.01

Table 6. Crude and adjusted[a] odds ratio estimates (95% confidence limits) for food insufficiency related to selected sociodemographic and health-related variables

Variable	Crude OR (95% CI)	Adjusted[a] OR (95% CI)	
		Full Model	Final Model[b]
Sex			
Men	0.8 (0.6–1.1)	0.8 (0.6–1.0)	0.8 (0.6–1.0)
Women	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Age group			
18–34	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
35–49	0.8 (0.6–1.1)	0.6 (0.4–0.8)	0.6 (0.5–0.9)
50–64	0.4 (0.3–0.7)	0.2 (0.1–0.4)	0.3 (0.2–0.4)
Region			
Northwest	1.0 (0.7–1.4)	0.7 (0.4–1.2)	NS
Northeast	0.8 (0.5–1.2)	0.7 (0.4–1.2)	
South/Southwest	1.0 (0.7–1.5)	0.8 (0.5–1.2)	
Central West	1.1 (0.8–1.6)	1.0 (0.6–1.5)	
Central East	1.0 (Reference)	1.0 (Reference)	
East/Southeast	0.5 (0.3–0.8)	0.5 (0.3–0.8)	
Area of residence			
Urban	1.0 (Reference)	1.0 (Reference)	NS
Rural	0.7 (0.4–1.1)	0.8 (0.5–1.3)	
Household type			
1 Adult	1.6 (1.1–2.2)	1.7 (1.1–2.6)	1.7 (1.1–2.6)
1 Adult with child(ren) <18	2.7 (1.6–4.5)	2.2 (1.2–4.0)	2.1 (1.2–3.7)
2 Adults	0.9 (0.6–1.3)	1.4 (0.8–2.2)	1.4 (0.9–2.1)
2 Adults with child(ren) <18	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Multiple adults with/without child(ren) <18	1.2 (0.8–1.8)	1.1 (0.7–1.7)	1.2 (0.8–1.9)
Immigrant status			
Canadian-born	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Immigrated <20 years	2.0 (1.4–3.0)	1.6 (1.1–2.5)	1.8 (1.2–2.7)
Immigrated 20+ years	1.0 (0.6–1.8)	1.3 (0.8–2.3)	1.7 (1.0–2.8)
Education level			
< High school	4.1 (2.4–7.0)	2.4 (1.3–4.5)	2.4 (1.4–4.2)
High school	2.2 (1.4–3.5)	1.6 (1.0–2.6)	1.6 (1.0–2.5)
Some post-secondary	1.7 (1.1–2.7)	1.2 (0.8–1.9)	1.3 (0.9–1.9)
University	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Household income			
Low	5.6 (3.6–8.9)	4.8 (2.9–7.9)	4.3 (2.8–6.8)
Middle	3.8 (2.4–5.9)	3.1 (1.9–4.8)	2.9 (1.9–4.4)
Upper-middle	1.8 (1.2–2.8)	1.9 (1.2–2.8)	1.7 (1.1–2.4)
High	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Self-reported health status			
Excellent, very good, good	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Fair, poor	2.2 (1.4–3.4)	1.4 (0.9–2.3)	1.6 (1.0–2.4)
Chronic conditions[c]			
0	1.0 (Reference)	1.0 (Reference)	NS
1+	1.1 (0.8–1.6)	1.3 (0.9–2.0)	
Smoking status			
Non	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Former	1.0 (0.7–1.6)	1.1 (0.7–1.7)	1.1 (0.8–1.7)
Current	1.9 (1.4–2.7)	1.7 (1.2–2.4)	1.8 (1.3–2.5)
V/F too expensive			
Agree	4.0 (2.9–5.7)	2.9 (2.1–4.1)	3.1 (2.2–4.2)
Neither agree nor disagree	1.4 (0.8–2.5)	1.3 (0.7–2.3)	1.4 (0.8–2.3)
Disagree	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Good quality V/F aren't available			
Agree	2.9 (2.0–4.2)	2.0 (1.3–2.8)	1.7 (1.2–2.4)
Neither agree nor disagree	2.0 (1.1–3.7)	1.5 (0.9–2.7)	1.6 (0.9–2.7)
Disagree	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)

Abbreviations: OR, odds ratio; CI, confidence interval; NS, not significant; V/F, vegetables and fruit

a Adjusted for all other variables in the model

b The final model was determined using backward elimination (refer to Methods, Appendix 5). Variables were eliminated in this order: area of residence, chronic conditions, and region

c Chronic conditions requiring significant dietary change

Table 7. Crude and adjusted odds ratios for selected outcomes related to knowledge, attitude, self-efficacy and behaviour around vegetable and fruit consumption, overweight and obesity and physical inactivity, by food sufficiency status, and perceived cost or availability of vegetables and fruit, stratified by sex

	Men				Women			
	%[a]	Crude OR (95% CI)	Adjusted OR (95% CI)		%[a]	Crude OR (95% CI)	Adjusted OR (95% CI)	
Does not know 5+ servings/day recommended								
Food sufficient	51.5	1.0 (Reference)	1.0 (Reference)		26.4	1.0 (Reference)	1.0 (Reference)	
Food insufficient[b]	61.7	1.5 (0.8–2.8)	1.0 (0.6–1.8)		33.8	1.4 (0.9–2.3)	1.2 (0.8–1.9)	
Does not personally believe the need 5+ servings/day								
Food sufficient	68.2	1.0 (Reference)	1.0 (Reference)		40.5	1.0 (Reference)	1.0 (Reference)	
Food insufficient[c]	78.4	1.7 (0.9–3.2)	1.2 (0.7–2.2)	*	52.4	1.6 (1.1–2.4)	2.0 (1.3–3.1)	
Ate <5 servings/day of vegetables and fruit								
Food sufficient	43.6	1.0 (Reference)	1.0 (Reference)		33.5	1.0 (Reference)	1.0 (Reference)	
Food insufficient[d]	55.8	1.6 (1.0–2.7)	1.3 (0.8–2.1)	***	52.0	2.2 (1.5–3.2)	1.7 (1.2–2.6)	
Agree/Neither agree nor disagree that vegetables and fruit are expensive[e]	44.2	1.0 (0.7–1.3)	1.0 (0.8–1.3)		40.9	1.6 (1.3–2.1)	1.7 (1.3–2.1)	
Disagree that vegetables and fruit are expensive	45.4	1.0 (Reference)	1.0 (Reference)	***	29.7	1.0 (Reference)	1.0 (Reference)	
Agree/Neither agree nor disagree that good quality vegetables and fruit are available[f]	44.8	1.0 (0.7–1.4)	1.1 (0.8–1.5)		46.0	1.7 (1.2–2.4)	1.5 (1.1–2.0)	
Disagree that good quality vegetables and fruit are available	43.7	1.0 (Reference)	1.0 (Reference)	***	33.4	1.0 (Reference)	1.0 (Reference)	
Overweight or obese (BMI 25+)								
Food sufficient	62.5	1.0 (Reference)	1.0 (Reference)		33.4	1.0 (Reference)	1.0 (Reference)	
Food insufficient[g]	56.3	0.8 (0.5–1.2)	0.6 (0.4–0.9)	*	43.2	1.5 (1.0–2.3)	1.8 (1.2–2.6)	
Physically active <3 hours/week								
Food sufficient	42.6	1.0 (Reference)	1.0 (Reference)		52.9	1.0 (Reference)	1.0 (Reference)	
Food insufficient[h]	44.3	1.1 (0.6–1.8)	1.0 (0.6–1.6)		53.1	1.0 (0.7–1.5)	0.9 (0.6–1.2)	

	%[a]	Crude OR		Adjusted OR
Low self-efficacy about eating more vegetables and fruit in the next month				
Food sufficient	15.5	1.0 (Reference)		1.0 (Reference)
Food insufficient[i]	24.1	1.7 (1.1–2.8)	*	2.2 (1.4–3.4)

Abbreviations: OR, odds ratio; CI, confidence interval
a Weighted proportion
b Adjusted for age group, education level, located in a rural community, and vegetable and fruit consumption
c Adjusted for age group, education level, immigrant status, located in a rural community, and eat vegetables and fruit to prevent cancer
d Adjusted for age group, education level, concern about pesticides on vegetables and fruit, cancer risk perception, and attitude toward eating vegetables and fruit
e Adjusted for age group, and concern about pesticides on vegetables and fruit
f Adjusted for age group, perception that vegetables and fruit take too much preparation, and concern about pesticides on vegetables and fruit
g Adjusted for age group, education level, and level of physical activity
h Adjusted for age group, education level, and immigrant status
i Adjusted for sex, age group, located in a rural community, and eat vegetables and fruit intake to prevent cancer [Note: Sample restricted to only those who were eligible to answer this item on the questionnaire (n=1408); sample too small for sex-specific analysis]
Differences between numbers within the box are statistically significant. Chi square: * p<.05; ** p<.01; *** p<.001

APPENDIX 5: GLOSSARY OF TERMS, DATA SOURCES AND METHODS

Glossary of Terms

Attitudes
Determined by an individual's beliefs about the attributes of performing a health behaviour, weighted by their evaluation of those attributes.[80]

Body mass index (BMI)
A measure of body weight adjusted for height, calculated as weight in kilograms/(height in metres squared). Generally categorized as underweight, healthy, overweight or obese.

Confidence interval (CI)
The computed range of plausible values for the measure of association between variables (e.g., an odds ratio) with a given probability (e.g., 95%) in which the true value will lie. A 95% CI for an odds ratio indicates that 95 times out of 100 the true value of the odds ratio is contained within the interval. When the 95% CI includes 1.0, the odds ratio is considered not to be different from 1.0 (i.e., the odds for those eating fewer than 5 servings per day is not significantly different from those eating 5+ servings per day). The observed difference between the odds ratio is therefore due to chance alone. If the CI does not include 1.0, then there is a statistically significant difference between the odds ratio and 1.0. If the upper limit of the CI is less than 1.0 then the odds ratio is significantly low and if the lower limit of the CI is above 1.0 then the odds ratio is significantly high.

Education level
Less than high school includes anyone who did not graduate from high school. *High school* refers to high school graduates, without any post-secondary training. *Some post-secondary* includes individuals who had some community college, technical school or university, or had completed community college or technical school. *University* refers to people who held at least a bachelor's degree.

Ethnic group
The social or cultural group to which respondents identified belonging to. Respondents had the opportunity to give up to 5 groups. *North American/European* includes anyone who identified him/herself ethnically as Canadian, American, or European (including Russian). This category also included ethnically Australian or New Zealand respondents. *South/Southeast Asian* includes individuals who identified themselves ethnically as South or Southeast Asian (e.g., Pakistani, Indian, Japanese, Chinese, Korean, Thai, Cambodian, Vietnamese, Filipino, etc.). *Other* includes anyone who did not identify with North American/European or South/Southeast Asian.

Household income adequacy
A 4-level categorical variable *(low, middle, upper-middle, high)* based on information about total household income (from all sources before taxes) in the past 12 months and household size.[41] The category definitions are presented below.

Table 1. Category definitions for household income level variable

Household income level	Number of persons in household		
	1–2	3–4	5+
Low	<$20,000	<$20,000	<$30,000
Middle	$20,000–29,999	$20,000–39,999	$30,000–59,999
Upper-middle	$30,000–59,999	$40,000–79,999	$60,000–79,999
High	$60,000+	$80,000+	$80,000+

Source: Statistics Canada, National Population Health Survey 1996–97; Household Component User's guide for the Public Use Microdata Files. Cat no. 82M0009GPE. Statistics Canada, Ottawa, 1998.

Immigrant status
Defined by place of birth. *North American-born* identifies all respondents who were born in North America (and Australia or New Zealand). *Europe* refers to anyone born in a European country (including Russia). *Other* includes those not born in North America or Europe. Respondents born in Europe or elsewhere were further categorized as to the years since immigrating to Canada: <20 years or 20+ years.

Knowledge
Factual and interpretive information leading to understanding, or useful for taking informed action.[80]

Median
The value of a variable for which 50% of the respondents have a lower value and 50% a higher value.

Number of chronic conditions
Respondents were asked if they had been told by a doctor or health professional that they have one of six chronic conditions: diabetes, heart disease, high cholesterol, hypertension, diverticulitis or bowel disease (e.g., Crohn's disease, inflammatory bowel disease, ulcerative colitis, celiac disease) and kidney disease. These specific conditions were considered because they may impact people's eating behaviours. Defined as none, or one or more of these six conditions.

Odds ratio (OR)
A measure of association between a particular outcome event and the presence of a certain factor(s). The OR is a relative measure of association; it is the ratio of the odds of an event in one group divided by the odds in another group. The odds of an event are the number of times it occurred (a) divided by the number of times it didn't (b), or a/b. In this report, an OR of 1.0 indicates there is no difference between the odds among those eating fewer than 5 servings per day and the odds among those eating 5 plus servings per day. An OR greater than 1.0 indicates the presence of a variable is more likely associated with eating fewer than 5 servings daily than with eating 5 or more per day, and an OR less than 1.0 signifies the variable is less likely associated with eating fewer than 5 per day compared with 5 or more servings daily. A crude OR describes the association between a single factor and the occurrence of the event of interest. An adjusted OR (AOR) is one that has been estimated after accounting for the simultaneous effect of other variables.

Physical activity hours per week

The product of the number of days per week respondents did 10 minutes or more of physical activity that increased breathing or made the heart beat faster, and the amount of time per day. Those with no days on which they did at least 10 minutes of activity were classified in the *<1 hour/week* group. Activity that increases breathing or heart rates is considered to be of moderate to vigorous intensity.

Regions

Cancer planning regions that correspond to aggregations of census divisions, and are to some extent defined by the locations of specialized cancer treatment centres.

Self-efficacy

The confidence of an individual in their ability to take action, including his/her confidence in overcoming the barriers to performing that behaviour.[80] In this case, it is an individual's confidence in the likelihood that s/he will eat more vegetables and fruit in the next month. Respondents were asked to rank their confidence on a scale from 0 (no confidence) to 10 (totally confident). They were then categorized as having low (<6), moderate (6–8) or high (9–10) self-efficacy.

Smoking status

A current smoker was defined as anyone who had smoked at least 100 cigarettes in their lifetime and had had a cigarette within the last month, while those who had not had a cigarette in the last month but had smoked at least 100 cigarettes were considered *former smokers. Non-smokers* were defined as those respondents who had not smoked 100 cigarettes in their lifetime.[99]

Stages of dietary change

Respondents were classified into 1 of the 5 stages: precontemplation (not considering changing behaviour), contemplation (thinking about changing), preparation (definitely planning to change, possible preliminary attempts), action (has changed behaviour in the short term) and maintenance (continuing with change).[100]

Respondents who reported eating fewer than 5 servings of vegetables and fruit per day were classified as being in: precontemplation if they were not seriously considering eating more servings in the next 6 months, or contemplation if they were considering eating more servings in the next 6 months, or preparation if they planned to eat more servings during the next month. Respondents who reported eating 5 or more servings per day were categorized into either: action (eating 5 a day for 6 months or less) or maintenance (eating 5 a day for longer than 6 months).

24-hour total diet recall

A method of determining a recent day's food intake. Often used as a "gold standard" for evaluating other methods of assessing food intake, it consists of an interview wherein a registered dietitian elicits a list of all food and beverage items, and their amounts, eaten over a recent 24-hour period.

Vegetable and fruit servings per day

The sum of the number of servings of each food item consumed each day (see ONCPS vegetable and fruit intake question). Fried potato products were excluded. A serving is 1/2 cup of potatoes, other vegetables, soups, fruit or juices or 1 cup of salad or tomato sauce. According to *Canada's Food Guide to Healthy Eating*, a serving is 1 medium size vegetable or fruit, 1/2 cup of prepared/cooked vegetables or fruit, 1 cup of salad or 1/2 cup of 100% fruit or vegetable juice.[25]

Data Sources

Target Population

The target population for the ONCPS was Ontario adults aged 18–64 years. The survey sample was based on the 8 regions used by Cancer Care Ontario for planning and programming purposes. The regions consist of Northwest, Northeast, South, Southwest, Central West, Central East (Toronto), East and Southeast. Less populated regions were combined (namely, South/Southwest and East/Southeast). Northwest and Northeast were over-sampled instead of being combined because of their potential differences from other regions with respect to the parameters of interest due to their more severe climate, sparse populations and relative remoteness. Toronto Public Health provided financial support for a larger sample in Toronto (within Central East region) in order to address specific questions of interest for the city. A minimum of 375 surveys were completed in each of these geographic areas to generate an adequate sample size for regional comparisons.

Sampling Strategy and Data Collection

The sampling and data collection were carried out by the Institute for Social Research (ISR), York University, between June 2001 and May 2002. Separate samples were drawn for each of the regions. Each region's sample was randomly divided into 12 months to allow for seasonal and between-month variation in eating and activity behaviours.

Random digit dialing (RDD) procedures were used to select households within each region. The randomly generated phone numbers included unlisted households, "not-in-service" and "non-residential" numbers. A minimum of 14 calls were made to each telephone number and calls were attempted during the day and evening on weekdays and weekends in order to maximize chances of getting a completed interview. Households that refused to participate were contacted at least once after the initial refusal. Approximately 12% of households that refused upon initial contact completed interviews on the second attempt.

Individual survey respondents were selected randomly from within each sampled household. In the case where a household had more than one eligible adult (aged 18–64), the person with the next birthday was selected.

All interviewing was completed from ISR's centralized telephone facilities using computer-assisted telephone interviews (CATI) techniques. Each interview ranged from 20 to 25 minutes in duration. ISR supervisors could monitor each interview to verify that interviewers recorded respondents' answers correctly. Approximately 265 interviews were completed each month, and were offered in a number of languages including English, French, Portuguese, Chinese and Vietnamese. A total of 3,214 interviews were completed out of 5,116 estimated number of eligible households, or a response rate of 63%.

Ethics approval for the conduct of the survey was received from the University of Toronto.

Methods

Sample population for the analysis

The ONCPS sample included 3,214 Ontarians. Of those, 31 were excluded because they did not fall within the age range of the survey (18–64 years) and 149 were excluded because they did not give a response to the food frequency portion of the survey. Thirty respondents were identified as "chronic non-responders" since they gave no response to more than 10 survey items. A further 7 respondents were excluded from the analysis because they and their house or roommates do not share food or food costs. The remaining sample size for the analysis was 2,997.

Household size weights

All data analyses were performed on weighted data in order to compensate for the unequal probabilities of respondent selection within a household and disproportionate population samples within strata (region).

A respondent's probability of being selected varies inversely with the number of people living in that household. To compensate for these unequal probabilities of selection, household size weights were created for the complete data set and each region.

Likewise, because some regions were over-sampled and others were under-sampled relative to their population, region weights were created and used when regional analyses were conducted to more accurately reflect the population distribution of the province. For the overall provincial analysis, a province weight was calculated as the product of the household weight for a given region and the corresponding region weight.

Item non-response and imputation

As is frequently the case with survey data, there were several survey items with no response. For the purposes of this analysis, respondents who refused to answer a question or replied "don't know" were coded as missing and were excluded from any calculations, unless otherwise noted. However, when appropriate, missing values were imputed in order to provide a more complete data set for analytical purposes. In the analysis of the ONCPS, two variables that had missing data were imputed: total household income and total number of portions per day of vegetables and fruit.

To impute the ONCPS data we used hot-deck procedures. Hot-deck imputation is a frequently used method.[101–104] In this process, respondents are assigned values at random from respondents with the same set of characteristics. The record providing the value is known as the donor and the one receiving as the recipient. The process of selecting a donor is the most important component of the hot-deck procedure. Potential donors are sectioned into homogeneous groups called "cells" defined by many parameters (e.g., sex, age group, region, education, etc.). Recipients are matched to these homogeneous cells of donors based on their characteristics. The characteristics should be highly correlated with the variable being imputed. The basic underlying assumption is that the value of the variable being estimated is not conditional (i.e., moderated by) the missing data mechanism (e.g., all those with missing income data are not different from the respondents with reported income data). We implemented the hot-deck using a sequence of data steps created in SAS, employing the random selection capabilities of the program.

There were two separate questions on the survey asking respondents' total household income: a continuous income question and a categorical income question. If the continuous income question was refused (roughly 50%), the respondent was asked to put his or her income into a category. If they refused to categorize their income the data were completely missing (roughly 20%). Answers from the first question were incorporated into the categories of the second question and this categorical income variable was then imputed. The variables used to impute income are described below:

- Sex (1. Male, 5. Female)
- Age group (1. 18–34 years, 2. 35–49 years, 3. 50–64 years)
- Region (1. East/Southeast, 2. Central East, 3. Central West, 4. South/Southwest, 5. Northeast, 6. Northwest)
- Education level (1. Less than high school, 2. High school, 3. Some post-secondary, 4. University)

Household size was initially included in the variable list, but in the end was not used because the additional variable levels meant there were hot-deck cells with no donors.

The categorical income question was ordered in the following manner:

1. <10,000
2. 10,000–19,999
3. 20,000–29,999
4. 30,000–39,999
5. 40,000–49,999
6. 50,000–59,999
7. 60,000–69,999
8. 70,000–79,999
9. 80,000–89,999
10. 90,000–99,999
11. 100,000 or more

Missing vegetable and fruit portions were also imputed. Approximately 5% of respondents had missing portions data. The same procedure used to impute income was used for portions data. The variables used to impute portions were:

- Sex
- Age group
- Vegetable and fruit times/day (continuous)

Limitations of the hot-deck procedure are discussed in the Limitations section.

In addition to income and vegetable and fruit portions, several other variables had a high proportion (i.e., >5%) of non-response. Variables with missing levels of note are: knowledge about vegetable and fruit recommended intakes (20.9%); postal code (from which urban and rural categories were derived – 11.2%); attitude toward vegetable and fruit intake (8.7%); vegetables and fruit prevent cancer (5.2%); and BMI among women (6.8%) (largely due to missing weight data, although overall it was only 3.9%). None of these were imputed due to the specific nature of the variables.

It is possible that missingness among all of these variables is not random and likely is the result of unmeasured factors. Therefore the impact of missingness in these variables is difficult to quantify and this should be considered when evaluating the results around these variables.

Statistical Analysis

Survey data were converted into a SAS[105] dataset, which was used for managing the data and for generating the descriptive statistics, employing the appropriate sample weights to account for the sample design. The statistical program Stata (version 7.0) was used for calculating tests of independence (chi square) and for the logistic regression analyses.[106] Stata is capable of accounting for the survey design (weights, strata or clustering) and therefore produces unbiased standard error estimates. The svytab command was used to calculate chi square values and the svylogit procedure was used for the logistic regression analysis. The test of independence used in Stata for cross-tabulations is based on the Pearson chi square statistics. To account for the survey design, the statistic is converted into an F statistic with noninteger degrees of freedom using a second-order Rao and Scott[107] correction. Stata also uses pseudo-maximum-likelihood methods to calculate logistic regression point estimates (i.e., the estimates are those from a weighted "standard" maximum-likelihood estimates) and robust variance estimates to take account of the survey design. These adjustments effectively increase standard errors and represent the most conservative significance estimates.[107,108]

Initially descriptive univariate statistics for each variable were calculated. Sex-specific cross-tabulations were used to estimate the prevalence of vegetable and fruit intake (0–2, >2–<5, and 5+ servings per day). Variables that were dichotomous or categorical and summarized as proportions or percentages were examined for differences among demographic subgroups using chi square tests of independence.

Multiple logistic regression models were used to calculate adjusted odds ratios (ORs) for associations between food insufficiency and the survey sociodemographic, health-related, and psychosocial variables. Stepwise backward-elimination[56] was used to identify the most important variables associated with the primary outcome. Initially, crude ORs were obtained. Then, all independent variables were included in a "full model." Variables were then removed based on their significance to the model. As a consequence of the pseudo likelihoods used in Stata, the "standard" likelihood-ratio tests are not valid. Instead, Stata uses an approximation by calculating adjusted Wald tests in order to compare logistic regression models. Only those variables significant at the 5% level were kept in the model. The variable with the largest p-value with each run of the model was removed until only those variables that had a statistically significant impact on the model were kept (i.e., the most parsimonious model was attained). The variable for age group was forced into the model.

Multiple logistic regression was also used to estimate the odds that a food insufficient individual would report a poor diet attitude or behaviour [i.e., knowledge about vegetables and fruit (don't know 5+ recommended), attitudes about vegetables and fruit (personally don't need 5+ to stay healthy), (low) self-efficacy about eating more vegetables and fruit, and eat <5 servings of vegetables and fruit daily], or a health-related outcome [i.e., overweight or obesity (BMI ≥ 25), or physical inactivity (<3 hours per week)]. Individuals who were categorized as food sufficient were used as the reference group. Final models were derived using the stepwise backward-elimination change-in-estimate method.[109] In this approach, variables are selected based on their relative or absolute changes in the estimated "exposure" effect. Variables were kept in the model if their deletion resulted in a change in the OR for the outcome of interest and food insufficiency by 10% or more. Potential confounders were identified *a priori* based on a review of the literature. All models were stratified by sex, with the exception of self-efficacy as the outcome, where the sexes were combined because of small sample sizes. Models were determined independently for each sex. A final model that included only the significant variables (and/or significant confounding variables) for each sex was used to be able to make comparisons between the two.

In this report, two-tailed p-values less than 0.05 were considered significant and 95% confidence intervals (CIs) were calculated for all ORs. Caution should still be used when interpreting the results when significance of a given statistical comparison is significant at only p<.05. Results where p<.01 and p<.001 are less likely to be spurious.

The cut-points for diet, body weight and physical activity used in this analysis are based on the Health Canada recommendations. Interpretation of the distribution of responses may reflect the methodological choice of using these cut-points. From a public health perspective, however, it is important to measure people's behaviours as they relate to healthy lifestyle recommendations.

Limitations

The cross-sectional nature of this study makes it impossible to draw causal inferences about the associations observed. For example, current smoking status was found to be a significant "predictor" of food insufficiency, however the reverse could also be true. Without longitudinal data, no temporal or causal relationships among variables examined in the ONCPS can be inferred.

Attempting to survey only some and not all of the units in the survey population is a concern when conducting any survey. Since the ONCPS was conducted by telephone, only individuals living in households with a telephone were surveyed. The ONCPS therefore likely under-represents certain groups for which health-related behaviours are important to assess, such as members of First Nations groups and those living in poverty. Furthermore, although the sample is largely representative of the adult population of Ontario with respect to sex, age group, region, education and household income, the sample over-represents individuals older than 24 years born in Canada and who have North American or European ancestry. The sample also over-represents men aged 25–44 who were born in or identify ethnically as East, South East, or South Asian, men aged 25–44 who were born in the Middle East, and females aged 25–44 who consider themselves ethnically African.

Bias due to measurement error is another concern when conducting surveys. Data in the ONCPS are self-reported. The accuracy of results depends upon the willingness and ability of respondents to recall and report complete and accurate details regarding the diet- and health-related issues they were asked about. Therefore, some behaviours and health outcomes will be under-reported by individuals (likely those that are socially unacceptable) while others may be over-reported. This can then attenuate, inflate or moderate relationships between variables.[109]

Measurement error might also arise in this analysis since all members of food insufficient households may not necessarily be food insufficient. The person chosen to respond to the survey provided information on behalf of all members of the household. The amount of food insufficiency was applied to everyone in the household, whether or not they had the same experience. An attempt was made to minimize this possible bias by excluding those not sharing food expenses with other members of the household, thus increasing the likelihood that all members share the same experiences.

Limitations to the data about vegetable and fruit consumption and steps taken to overcome these have been noted elsewhere.[22] Briefly, social desirability bias and under-reporting of intake are well documented in food frequency surveys.[110–113] One recent review of survey

instruments measuring vegetable and fruit intake in adults demonstrated that instruments with more vegetable and fruit items, mixed vegetable dishes and questions on portion sizes were more closely associated with total vegetable and fruit intake.[114] The ONCPS did include more options for vegetables and fruits and measured portions, which should mitigate some of the bias of self-reported data.

In addition, to optimize the quality of data, a calibration study was conducted to determine how the food frequency screener used in the ONCPS compared to three repeat 24-hour recalls for dietary assessment. A total of 184 individuals who originally participated in the ONCPS completed the calibration study. There were correlation coefficients of 0.34 and 0.39 for frequency of consumption and estimated number of servings. The calibration study did determine that the screener overestimated the number of servings of vegetables and fruit consumed compared with 24-hour recalls with respect to portions.

Respondent recall regarding physical activity is also likely a source of inaccuracy. One validation study of the 7-day Physical Activity Recall (PAR) telephone interview survey indicated that participants over-reported their level of physical activity, in particular for moderate and high activities, as compared with accelerometer data.[115] Perhaps one of the challenges with these and other instruments is the limited number of options for physical activity available to respondents. The physical activity measures included in the ONCPS included a broader range of activities than has been used in other self-report surveys.

Respondents may also give socially desirable answers to questions on issues such as smoking and weight. For example, self-reported height and weight (used to calculate BMI) may underestimate the prevalence of overweight.[116,117] Furthermore, self-reported health status (assessed using a 5-point scale from poor to excellent) data may not be accurate, since the responses were not verified by an independent source. However, the reliability of such self-assessments has been found to be as good as or better than measures such as functional ability and psychological well-being.[118–120] Still, it is not possible to know if respondents who reported a diagnosed chronic condition had actually received a professional diagnosis, and this should be considered when interpreting the results.

Body mass index (BMI) is subject to measurement error in addition to inaccuracies arising from self-reported height and weight. First, BMI is measured at one point in time. Individuals who experience weight change, either gain or loss, within or between BMI categories, may also be at risk.[121] BMI does not account for weight variation due to differences in body build and body proportion in individuals, between sexes and across ethnic groups.[121–124] Moreover, BMI is not appropriate for use with pregnant and lactating women, who may have been included in the ONCPS sample.

Non-response error is another limitation for consideration. This results when people who respond to a survey are different from sampled individuals who did not respond, in a way relevant to the study.[109] If non-responders are less likely than responders to meet the recommended dietary guidelines our results may actually overestimate the proportion of Ontarians who meet these health goals. However, we do not have specific information on those individuals who did not respond regarding behavioural and psychosocial factors (e.g., vegetable and fruit intake, perception of cost and availability of vegetables and fruit, etc.), and therefore we cannot compare between responders and non-responders regarding these characteristics.

During data processing, imputation was used to complete data that was not obtained. Although imputation can alter basic distributional summary statistics from the statistics calculated using complete cases only, it should not transform the relationships among variables.

The hot-deck imputation method employed here has some limitations. First, if there are too many variable levels used in the hot-deck, then many of the cells will not be populated with donors. The more variable levels that are used (i.e., the more hot-deck cells), the more donors are needed for the hot-deck to work. Therefore, it may not be possible to use all correlated variables, which may attenuate the accuracy of the imputed value(s). Second, hot-deck imputation does not restore sampling variability, an important consequence when calculating standard errors and confidence limits around point estimates. Third, it assumes ignorable non-response. Often values are missing for items based on the nature of the item itself and/or for unmeasurable factors. In these instances, the accuracy of the hot-deck procedure may become attenuated.

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INSIGHT ON CANCER

news and information on nutrition and cancer prevention

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Cancer Care Ontario is dedicated to improving the quality of care for cancer patients by creating a seamless journey for them as they access the highest quality programs in cancer prevention, early detection, treatment, supportive care, palliative care and research. Working with partners, including the Cancer Quality Council of Ontario, CCO will measure, evaluate and report on quality improvement in the cancer system. Cancer Care Ontario is a policy, planning and research organization that advises government on all aspects of provincial cancer care.

Insight on Cancer can be found on both the Canadian Cancer Society's and Cancer Care Ontario's websites. Please visit the "library section" of the Ontario pages of the Canadian Cancer Society's website located at www.cancer.ca, or visit www.cancercare.on.ca.

Canadian Cancer Society | Société canadienne du cancer

The Canadian Cancer Society is a national, community-based organization of volunteers whose mission is the eradication of cancer and the enhancement of the quality of life of people living with cancer.

The Canadian Cancer Society, in partnership with the National Cancer Institute of Canada, achieves its mission through research, education, patient services and advocacy for healthy public policy. These efforts are supported by volunteers and staff and funds raised in communities across Canada.

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