



INSIGHT ON CANCER

news and information on *nutrition and cancer prevention*
volume two – supplement one: vegetable and fruit intake

HIGHLIGHTS

- ▶ 45% of Ontario men aged 18–64 and 36% of women do not eat 5 or more servings of vegetables and fruit per day
- ▶ Ontarians who eat fewer than 5 servings of vegetables and fruit daily are *more* likely to be:
 - male
 - less educated (high school graduate or less)
 - a current smoker
 - physically inactive (<1 hour/week)Further, they are *less* likely to believe they personally need this many servings, and to agree that vegetables and fruit were an important part of their diet since childhood
- ▶ Women who eat fewer than 5 servings are more likely to think vegetables and fruit are too expensive
- ▶ Men who eat fewer than 5 servings are more likely to think that vegetables and fruit require too much preparation
- ▶ Action is needed to promote *individual* change in eating and physical activity practices, and to foster *societal* changes to the environment and policies to support healthy eating
- ▶ Co-ordinated multi-level interventions need to be directed to a variety of settings



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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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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HIGHLIGHTS

The Ontario Nutrition and Cancer Prevention Survey (ONCPS) results present a unique opportunity for Ontario policy makers, health professionals, educators, employers, the food industry and the media to work collaboratively to promote healthy eating and to increase vegetable and fruit intake in Ontario, a key strategy to decrease cancer risk and promote wellness.

What did the survey find?

- Men who participated in the ONCPS consumed fewer vegetables and less fruit than women.
- Experiences set in childhood had a key influence on vegetable and fruit intake as adults. This finding is corroborated by research. As well, children's behaviour is a significant influence of parents' dietary behaviour.
- Adults who have less than high school education, who are physically active less than 1 hour per week, and do not believe they personally need to eat 5 or more servings per day had increased odds of consuming fewer than 5 servings of vegetables and fruit per day.
- Women who thought vegetables and fruit were too expensive were more likely to consume fewer than the recommended intake.
- Men who agreed vegetables and fruit required too much preparation also had elevated odds of eating fewer than 5 servings of vegetables and fruit daily.
- Certain groups had very low (0–2 servings per day) intakes of vegetables and fruit putting them at increased risk of cancer. This included men aged 18–34 years, men with high school or less than high school education, adults with low household income, and women who smoked.

What action is required?

- Action is needed on two fronts: at the individual level to promote changes in behaviour and to address risk factors such as unhealthy eating practices and low physical activity; and, at the level of society to foster changes in the environment and policies to support vegetable and fruit intake, and physical activity.
- Co-ordinated, multi-level interventions are needed to create supportive environments for healthy choices. Programs and policies are required in numerous settings such as in schools and child care centres, workplaces, community settings such as community centres, sports and recreation facilities, restaurants and food outlets, and in the media.
- Strategies designed to reduce smoking and increase physical activity can also inform people about the importance of eating vegetables and fruit.

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

A large body of research confirms that 30%–35% of cancers could be prevented with increased vegetable and fruit consumption, increased physical activity, and maintenance of a healthy body weight. Some of the strongest evidence of the relationship between diet and cancer has found that diets high in vegetables and fruit provide protection against cancer. For this reason, health agencies consistently recommend that adults eat at least 5 servings of vegetables and fruit per day.♦

To get a better understanding of how Ontario residents are faring when it comes to meeting these recommendations, Cancer Care Ontario and several partners conducted the Ontario Nutrition and Cancer Prevention Survey (ONCPS) in 2001–2002. The focus of the survey was to solicit information about vegetable and fruit intake, physical activity, and body weight as these factors are linked to cancer prevention.

Diet and nutrition are important factors in the prevention of disease and the promotion and maintenance of good health throughout life. The World Health Organization reports that diet and nutrition practices influence an individual's present quality of life—a healthy diet may determine whether or not a person will develop a chronic disease. The economic burden of poor diets is estimated to be \$6.6-billion annually in Canada, including direct health care costs of \$1.8-billion, according to Health Canada.

Methodology

The telephone survey was conducted with a random sample of Ontario residents aged 18–64 from Cancer Care Ontario's eight planning regions. The data was analyzed to allow researchers to identify the most important characteristics and their association with vegetable and fruit intake. The report includes both descriptive and multivariate analysis of the responses.

♦ See Glossary of Terms, Appendix 4

Key findings

The survey found that Ontario residents are eating too few vegetables and fruit and missing out on their cancer fighting benefits. The key findings of the survey are:

- Men who participated in the survey consumed fewer vegetables and less fruit than women.
- Adults who have less than high school education, who are physically active less than 1 hour per week, and do not believe they personally need to eat 5 or more servings per day had increased odds of consuming fewer than 5 servings of vegetables and fruit per day.
- Women who thought vegetables and fruit were too expensive were more likely to consume fewer than the recommended intake.
- Men who agreed vegetables and fruit required too much preparation also had elevated odds of eating fewer than 5 servings of vegetables and fruit daily.
- There was a significant difference in the prevalence of vegetable and fruit intake for women across the 6 regions.♦ In descending order by region, women reported eating fewer than the recommended 5 or more servings as follows: 42% in the Northwest, 39% in the South/Southwest, 37% in the Northeast, 36% in the East/Southeast, 35% in the Central West and 34% in the Central East.
- Certain groups had very low (0–2 servings per day) intakes of vegetables and fruit putting them at increased risk of cancer. This included men aged 18–34 years, men with high school or less than high school education, adults with low household income, and women who smoked.



The results of the survey reinforce the view that food choices are the result of a complex interplay between socio-economic, psychosocial and environmental factors. The determinants of healthy eating are a component of the broader context of individual and collective determinants of health.

Where do we go from here?

Currently, there is limited information on food consumption and nutrition surveillance. The results of the Ontario Nutrition and Cancer Prevention Survey provide valuable insight into the eating habits of Ontario adults, as well as their physical activity and weight levels. Using this information as a foundation, the ONCPS recommends:

- Action is needed on two fronts: at the individual level to promote changes in behaviour and to address risk factors such as unhealthy eating practices and low physical activity; and, at the level of society to foster changes in the environment and policies to support vegetable and fruit intake, and physical activity.
- Co-ordinated, multi-level interventions are needed to create supportive environments for healthy choices. Programs and policies are required in numerous settings such as in schools and child care centres, workplaces, community settings such as community centres, sports and recreation facilities, restaurants and food outlets, and in the media.
- Strategies designed to reduce smoking and increase physical activity can also inform people about the importance of eating vegetables and fruit.

Conclusion

The findings of the survey provide a unique opportunity for Ontario policy makers, health professionals, educators, employers, the food industry and the media to work collaboratively to promote increased vegetable and fruit intake and help individuals and families to make healthful food choices and reduce the risk of cancer. Comprehensive programs and policies are required in settings such as schools and child care centres, in workplaces, and in community settings such as community centres and sports and recreation facilities to achieve the goal of making Ontarians healthy.

WHY ARE VEGETABLES AND FRUIT IMPORTANT?

Diet and nutrition are important factors in the prevention of disease and the promotion and maintenance of good health throughout life.

A healthy diet is important to healthy human development and, most importantly, dietary practices may not only influence present health, but may determine whether or not a person will develop a chronic disease such as cancer, heart disease or diabetes later in life.^{3,4} The economic burden of poor diets is estimated to be \$6.6-billion annually in Canada, including direct health care costs of \$1.8-billion.⁴

Cancer is one of the major chronic diseases affecting the health of Canadians today and is related to diet, physical activity and obesity. These in turn affect the risk of other chronic diseases such as diabetes, cardiovascular disease, osteoporosis and dental disease. Collectively these chronic diseases present the greatest public health burden, both in terms of their direct cost to society and in terms of disability-adjusted life years. Unhealthy diets, physical inactivity and smoking are confirmed risk behaviours for these chronic diseases.³

It is estimated that 30%–35% of all cancers can be prevented by eating well, being active and staying at a healthy weight.⁵ Cancer Care Ontario summarizes the evidence for prevention of cancer as shown in Table 1.^{1,6}

Table 1. Cancers with convincing or probable evidence for prevention by vegetable and fruit intake, healthy body weight and physical activity

Cancer	Vegetables and Fruit	Healthy Body Weight	Physical Activity
Mouth, throat	✓		
Esophagus	✓	✓	
Stomach	✓		
Colon, rectum	✓	✓	✓
Pancreas	✓		
Larynx	✓		
Lung	✓		
Breast		✓	✓
Endometrium*		✓	✓
Prostate			✓
Kidney		✓	
Bladder	✓		

* uterus, excluding cervix

Sources: Institute of Medicine. Curry SJ, Byers T, Hewitt M, Eds. Fulfilling the potential of cancer prevention and early detection. Washington, DC: The National Academy Press, 2003.⁷; Friedenreich CM. Physical activity and cancer prevention: from observation to intervention research. *Cancer Epidemiol Biomarkers Prev* 2001;10:287–301.⁸

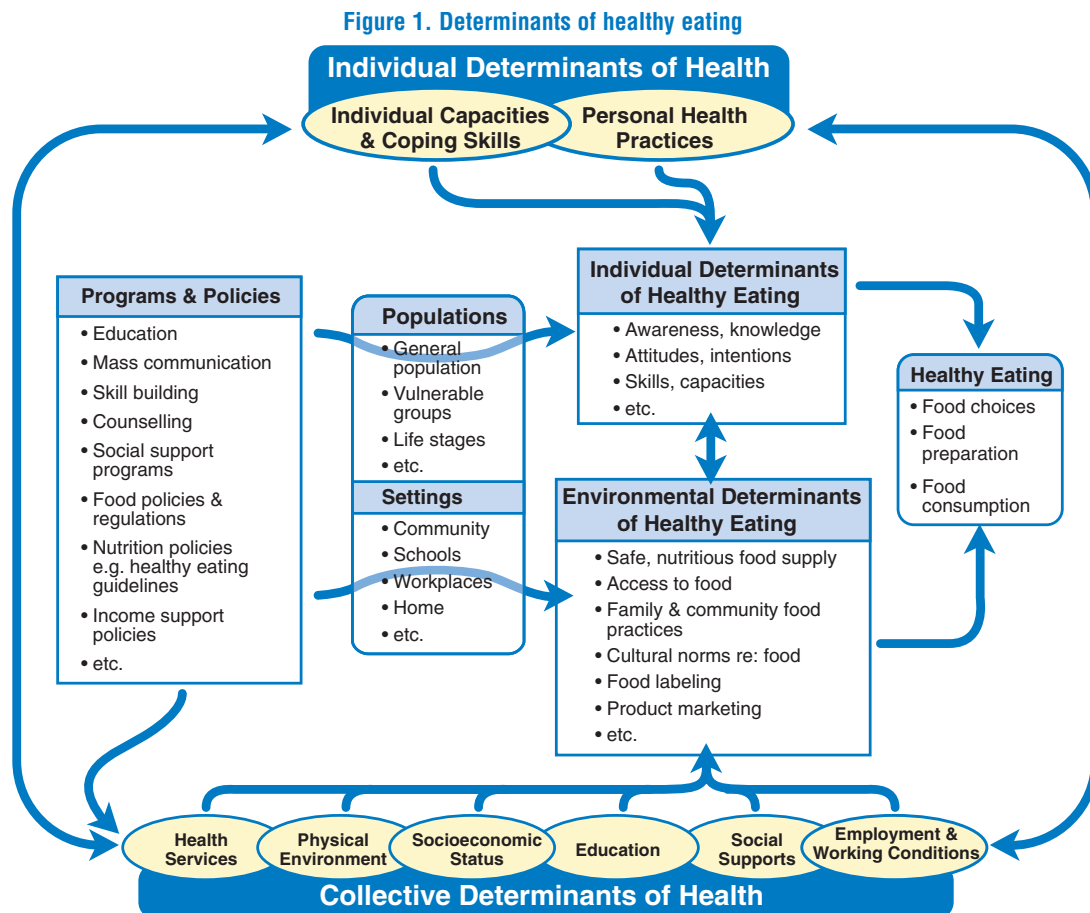
The co-existence of each of these risk factors—vegetable and fruit intake, healthy body weight and physical inactivity—as well as smoking, puts people at greater risk for cancer because of the interactive nature of these risk behaviours and their association with a large number of cancers.⁹

The strongest evidence of the relationship between diet and cancer has been the benefit of consuming at least 5 servings of fruit and vegetables per day.^{7,10,11} Diets high in vegetables and fruit are high in many



dietary constituents including vitamins, minerals and fibre. Because vegetables and fruit are bulky and low in energy, such diets may also protect against obesity, which is itself a risk factor for some cancers.^{12,13} Evidence shows that incorporating vegetables and fruit in the diet can reduce energy density, promote satiety, and decrease energy intake.⁷ Some research also indicates that coupling suggestions to increase intake of whole vegetables and fruit with suggestions to decrease energy intake is a particularly effective strategy for weight management.¹⁴

Food choices are the result of a complex interplay between socio-economic, psychosocial and environmental factors.¹⁵ The determinants of healthy eating are situated within a broad context of individual and collective determinants of health, which influence overall health status. Determinants of healthy eating include the social environment such as the home/family; the physical environment such as the food supply; socio-economic status which affects food access; education; social and family supports; and employment and working conditions (see Figure 1). Biological and genetic factors, which are not illustrated in the figure, also come into play.



Source: McAmmond D. Promotion and Support of Healthy Eating: An Initial Overview of Knowledge Gaps and Research Needs. Ottawa, ON: Health Canada. Office of Nutrition Policy and Promotion, 2001.¹⁶

WHAT DO CURRENT HEALTHY EATING GUIDELINES RECOMMEND?

The importance of vegetables and fruit as part of a healthy diet is recognized throughout the world.^{3,12} The evidence of dietary protection against cancer is strongest and most consistent for diets high in vegetables and fruit.^{12,17} For this reason, there is consistency among health agencies about recommendations to eat 5 or more servings of vegetables and fruit per day.

- Health Canada publishes both *Canada's Guidelines for Healthy Eating* and *Canada's Food Guide to Healthy Eating*, which provide guidance on vegetables and fruit intake.¹⁸

Canada's Guidelines for Healthy Eating

1. Enjoy a variety of foods,
2. Emphasize cereals, breads, other grain products, vegetables and fruit,
3. Choose lower-fat dairy products, leaner meats and foods prepared with little or no fat,
4. Achieve and maintain a healthy body weight by enjoying regular physical activity and healthy eating, and
5. Limit salt, alcohol and caffeine.

Canada's Food Guide to Healthy Eating recommends that adults eat 5–10 servings of vegetables and fruit each day. The number of servings needed varies with age, body size, activity level, sex and other lifecycle issues such as pregnancy and breastfeeding. The food guide advises adults to choose dark green and orange vegetables—such as salads, broccoli, spinach, squash, sweet potatoes, carrots—and orange fruit—such as, cantaloupes or oranges and orange juice—more often because these foods are higher than other vegetables and fruit in certain key nutrients like vitamin A and folacin.

- Health Canada also publishes *The Canadian Guidelines for Body Weight Classification in Adults* to

provide advice regarding healthy body weight. The guidelines for body weight classification are a system to identify weight-related health risks in populations and in individuals, and is intended for use among adults aged 18 years or older.¹⁹ In addition, *Canada's Physical Activity Guide to Healthy Active Living*, also published by Health Canada, provides advice regarding physical activity.²⁰

- The Canadian Cancer Society, as part of their Seven Steps to Health program, recommends that adults eat 5–10 servings of vegetables and fruit a day as part of a healthy diet. This is based on Health Canada's recommendations as outlined above.²¹
- The *5 to 10 a day for better health* campaign is a joint initiative of the Canadian Cancer Society, Heart and Stroke Foundation of Canada, the Canadian Produce Marketing Association and public health practitioners. It is designed to create awareness of the importance of eating vegetables and fruit, and to change people's eating habits.²²
- The National Cancer Institute and the Produce for Better Health Foundation, a non-profit consumer education foundation representing the vegetable and fruit industry, co-sponsor a national 5 A Day for Better Health Program in the United States. The program gives Americans a simple, positive message to eat 5 or more servings of vegetables and fruit every day for better health. Another initiative, the 9 A Day program, is targeted to men because they need to eat more vegetables and fruit and they are lagging behind women.²³
- This supplement's recommendations are consistent with those of the American Institute for Cancer Research and the World Cancer Research Fund, which recommend 5 or more servings a day of a variety of vegetables and fruit, all year round.¹²



How well are Canadians doing in meeting these guidelines?

Despite the importance of nutrition to good health, information on national food consumption patterns and national nutrition surveillance efforts has been scarce since the early 1970s. Some provincial nutrition surveys of adults were done in the 1990s and data are available from food disappearance statistics, but the results of these surveys are conflicting because of the different methods used.²⁴

The British Columbia Nutrition Survey results, which were released in March 2004, asked adults about their eating and physical activity habits, measured their height and weight and recorded their use of supplements. This study found that over half of adults were overweight or obese, many adults were not active enough to achieve the necessary health benefits, including weight control, and about two-thirds of British Columbians did not obtain the minimum 5 servings recommended for vegetables and fruit on a daily basis.²⁵

In 2000/2001, the Canadian Community Health Survey (CCHS) began to collect some information on the frequency at which people are eating vegetables and fruit.²⁶ Results from a CCHS survey currently out in the field, which focuses on nutrition, will become available in early 2005 and are expected to shed new light on eating practices of Canadians.²⁷ Similarly, the Canadian Health Measures Survey, which is under development at Statistics Canada, will gather new information through direct physical measurement of such measures as height and weight; information about nutrition, physical activity and current health status; demographics; and socio-economic variables.²⁸

In the interim, Health Canada, Statistics Canada and Agri-Food Canada are conducting an investigation of changes in Canada's food supply between 1992 and 2002. This study provides information about overall changes in apparent per capita consumption of major commodities, including vegetables and fruit from food disappearance data. Preliminary results of the study have shown that, between 1992 and 2002, apparent per capita consumption of vegetables increased by approximately 5% and total consumption of fruit increased by 15%. Fresh vegetables continued to be the major contributor to overall vegetable consumption but the largest increase in consumption was frozen vegetables. Vegetable juice consumption decreased. Fresh fruit continued to be the major contributor to overall fruit consumption and fruit juice consumption made a large increase of 24%.²⁹

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. Details of the questions can be found in Appendix 1.

A random sample of Ontarians aged 18–64 years were telephoned and invited to participate. The final sample of 3,183 men and women (63% of invited adults) were from 6 geographic areas of the province (see Appendix 2 for a description of the sample). These 6 areas, as outlined in Figure 2, 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 2. Key map of Ontario regions



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

◆ See Glossary of Terms, Appendix 4



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.³⁰ 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.

How was vegetable and fruit intake measured?

The ONCPS measured vegetable and fruit intake of adults using a food frequency questionnaire. The respondents were asked how often and how much they ate vegetables, fruit or drank juice over a certain time period (daily, weekly, or monthly). A validation study comparing ONCPS questions to 24-hour total recalls[♦] found that survey questions slightly overestimated daily servings of vegetables and fruit.³¹ As a result, ONCPS estimates of population proportions not meeting the recommended daily vegetable and fruit intake are conservative.

Overview of the Data Analysis

The data and a detailed description of the statistical analysis (as well as definitions for selected terms, data sources and methods) for this report can be found in Appendices 3 and 4. Briefly, descriptive cross-tabulations were used to estimate the prevalence of vegetable and fruit consumption in relation to the sample’s sociodemographic characteristics, and health-related and consumption-related psychosocial factors. 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 sex-specific associations between low (i.e., <5 servings/day) vegetable and fruit consumption and these variables. This approach allowed us to identify the most important characteristics and their association with vegetable and fruit intake. All analyses were conducted on weighted data to account for the nature of the survey design. Standard errors were estimated for test statistics and confidence intervals[♦] using the `svy` commands in Stata (version 7).

[♦] See Glossary of Terms, Appendix 4

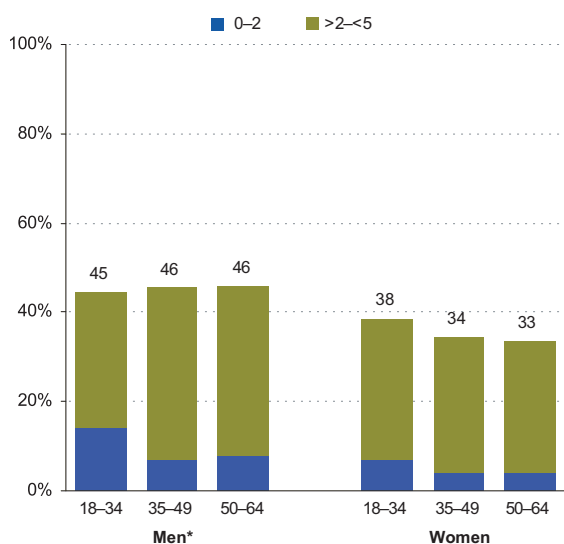
FINDINGS FROM THE ONCPS

DESCRIPTIVE ANALYSIS

Sex and Age

The ONCPS found both sex and age differences in vegetable and fruit consumption (Figure 3). The prevalence of vegetable and fruit intake at the recommended level of 5 or more was lower for men than women.

Figure 3. Vegetable and fruit intake by age group and sex: proportion eating 0–2 or >2–<5 servings/day



* Significant differences between age groups for 0–2 servings/day ($p < .05$)

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

Overall, 55% of men between 18–64 years met the recommended 5 or more servings of vegetables and fruit compared with 64% of women in that age group. These results are consistent with an analysis of the CCHS 2000/2001 data, which also found that women consumed fruit and vegetables more times per day than men did.²⁶

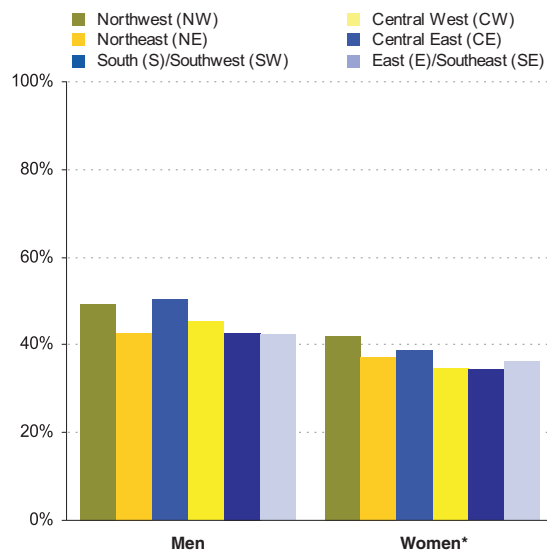
However, when examining vegetable and fruit intake at the lowest level (0–2 servings), men consistently reported a prevalence at twice that of women of

comparable age. Fourteen percent of men aged 18–34 years reported eating 0–2 servings of vegetables and fruit compared with 7% of women in this age group. Women aged 35–49 years had the lowest prevalence (4%) of eating 0–2 servings of vegetables and fruit. An intake of 0–2 servings of vegetables and fruit per day is of concern because research shows that an intake this low doubles the risk of certain cancers.³²

Geographic Characteristics - Region

Although the variation in prevalence of vegetable and fruit intake across the 6 regions of Ontario was not significant for men, there was a significant difference in the prevalence for women across the 6 regions (Figure 4). In descending order by region, women reported eating fewer than the recommended 5 or more servings (i.e. 0–<5) as follows: 42% in the Northwest, 39% in the South/Southwest, 37% in the Northeast, 36% in the East/Southeast, 35% in the Central West, and 34% in the Central East.

Figure 4. Vegetable and fruit intake by region and sex: proportion eating <5 servings/day



* Significant differences between regions ($p < .05$)

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

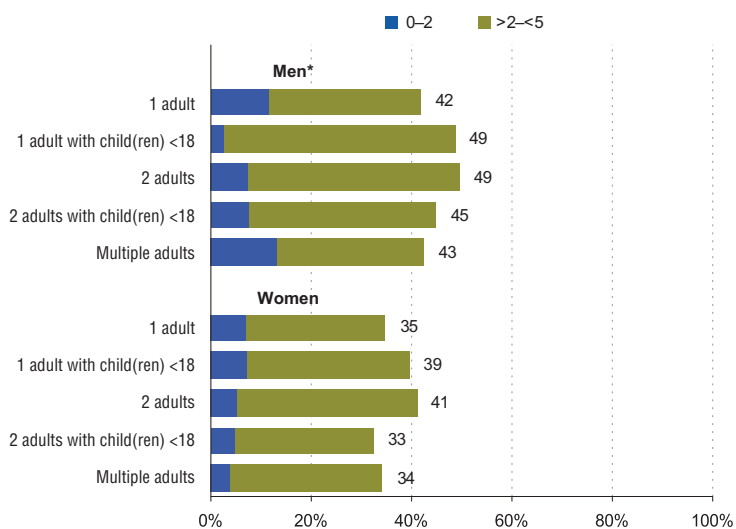


Household Composition

The ONCPS collected information about the household composition of respondents based on 6 household types: ♦ 1 adult (aged 18 years and older), 1 adult with child(ren) younger than 18 years, 2 adults, 2 adults with child(ren) younger than 18 years, and more than 2 adults.

A higher proportion of adults living alone reported eating 0–2 servings of vegetables and fruit per day (Figure 5). About 12% of men living alone reported eating 0–2 servings of vegetables and fruit per day. Moreover, 13% of men living in multiple adult households also ate 0–2 servings a day. Seven percent of women living alone and 8% of women with children younger than 18 years reported eating 0–2 servings of vegetables and fruit per day.

Figure 5. Vegetable and fruit intake by household type and sex: proportion eating 0–2 or >2–<5 servings/day



* Significant differences between households (p<.05)

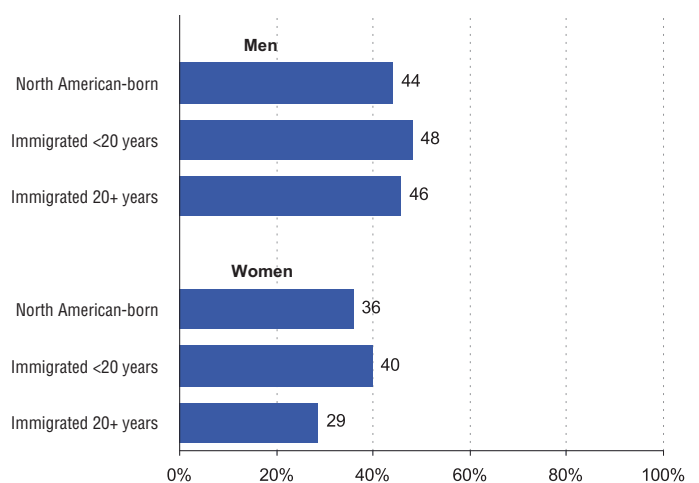
Source: Cancer Care Ontario, Ontario Nutrition and Cancer Prevention Survey, 2003

The prevalence of eating fewer than 5 servings per day of vegetables and fruit was significantly higher for men in 2 adult households (49%) compared with 2 adult households with children younger than 18 years (45%), in households with more than 2 adults (43%), and for men living alone (42%). No significant difference between households was observed for women.

Immigrant Status♦

A (non-significant) greater proportion of men who immigrated to Canada less than 20 years ago (48%) ate fewer than the recommended 5 or more servings a day, while 44% of North American-born men and 46% of men who have been in Canada 20 years or longer ate fewer than 5 servings daily. Women who immigrated to Canada in the past 20 years or more ate fewer than the recommended number of 5 or more servings a day compared with North American-born women (36%) or women who immigrated to Canada less than 20 years ago (40%) (Figure 6). However, these differences were not statistically significant.

Figure 6. Vegetable and fruit intake by immigrant status and sex: proportion eating <5 servings/day



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

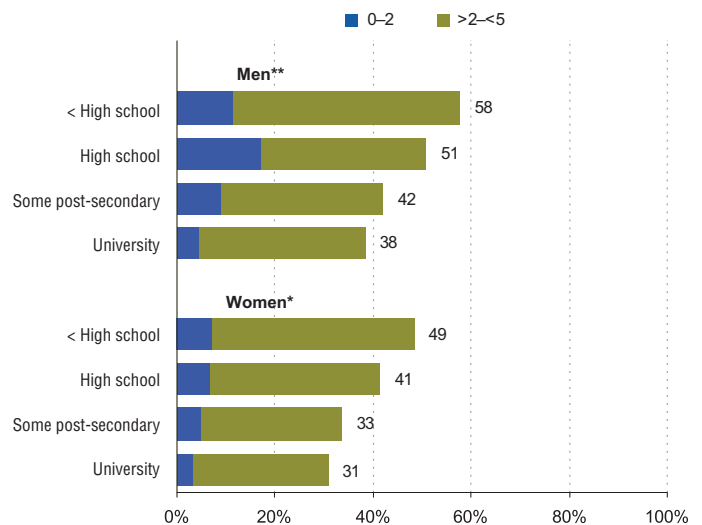
♦ See Glossary of Terms, Appendix 4

These findings differ from those of a study examining health behaviours among immigrants in Canada.³³ That study reported immigrants as a whole consumed more vegetables and fruit than their Canadian-born counterparts, especially recent male immigrants (i.e., those immigrating <10 years ago). The conflicting results from these studies are at least partly due to differences in categorizing and measuring the variables in question. Data from the CCHS 2000/2001 measured frequency of consumption rather than amount, which was assessed in this study. Furthermore, the CCHS study was able to use finer categories for describing the number of years since immigration than was possible in the present study. Lastly, the difference may also be because the CCHS data were based on a national-level sample, whereas this analysis was drawn from a single province, which may reflect a difference in immigrant composition within both samples.

Education

There were significant differences in the levels of vegetable and fruit intake of men and women associated with education level[♦] (Figure 7). About 58% of men and 49% of women with less than high school education reported eating fewer than 5 servings of vegetables and fruit per day. It is of concern that 17% of men with high school education and 11% with less than high school education reported eating 0–2 servings of vegetables and fruit per day. Among men, those with a university education ate the most vegetables and fruit per day; only 38% of men ate fewer than 5 servings a day.

Figure 7. Vegetable and fruit intake by level of education and sex: proportion eating 0–2 or >2–<5 servings/day



Significant differences between education level (* p<.05; ** p <.001)

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

The analysis found that 41% of women with high school education reported eating fewer than 5 or more servings per day. The prevalence of eating fewer than 5 servings of vegetables and fruit per day was lowest for women with a university education (31%).

These results are similar to those reported from the CCHS 2000/2001, which found that people with post-secondary graduation reported higher frequency of the number of times per day that vegetables and fruit were consumed than did people with less than high school graduation.²⁶ A similar pattern of vegetable and fruit intake related to education was reported in Alberta.³⁴ These results were also similar to findings of a study of the social determinants of dietary habits in Denmark. Education was found to be the most important social variable to explain social differences in dietary habits, including fruit and vegetable consumption, particularly for men.³⁵

♦ See Glossary of Terms, Appendix 4



Household Income Adequacy♦

Respondents were asked about their household income, which was reclassified as a four-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 4.

The ONCPS found differences for vegetable and fruit intake among adults of lower income who eat fewer vegetables and fruit compared with adults of higher income, although the differences were significant only among women.

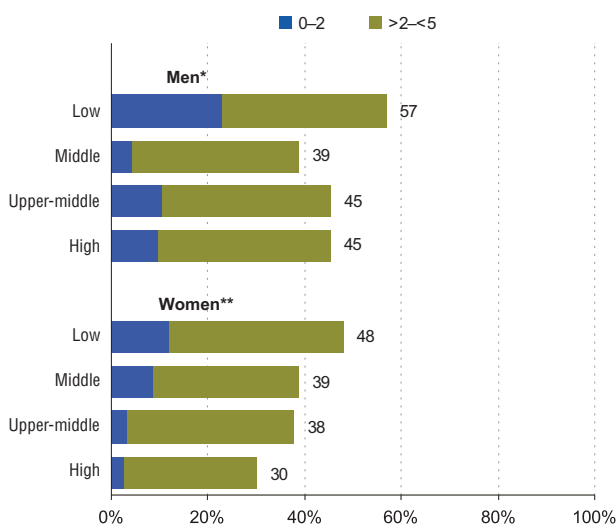
Twenty three percent of men in low-income households reported eating 0–2 servings of vegetables and fruit per day, compared with men in upper-middle-income households (11%), high-income households (10%), and middle-income households (4%) (Figure 8).

Vegetable and fruit intake of women also varied according to household income (Figure 8). Twelve percent of women from low-income households reported eating 0–2 servings, compared with 9% in middle-income households, and 3% in both upper-middle-income and high-income households.

These results are consistent with results reported from the CCHS 2000/2001, which found that the number of times per day that vegetables and fruit were consumed was higher for people in the middle, upper-middle and highest income categories, compared with those in the lowest category.²⁶

These results are also comparable to the results of the Nutrition Canada survey, which provided evidence on food consumption patterns in Canada between 1970 and 1972. In the Nutrition Canada survey, vegetable and fruit intake was consistently inversely related to income for both men and women, with the exception of women aged 20–39.³⁶

Figure 8. Vegetable and fruit intake by household income adequacy and sex: proportion eating 0–2 or >2–<5 servings/day



* Significant differences between household income adequacy for 0–2 servings/day (p<.05)
 ** Significant differences between household income adequacy (p<.001)

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

♦ See Glossary of Terms, Appendix 4

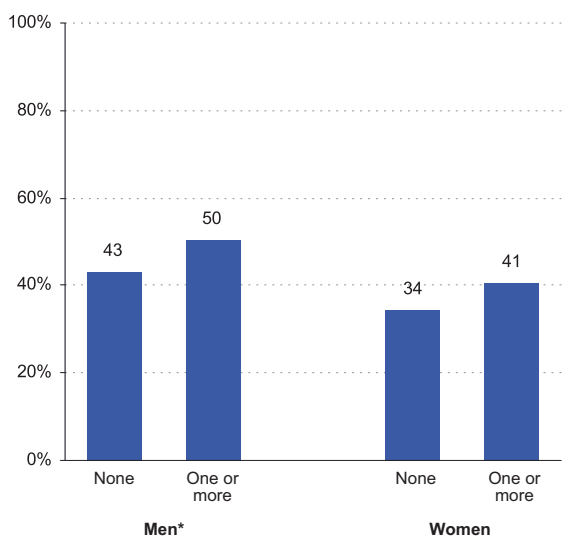
Self-Reported Health Status

The ONCPS results showed that there was no significant relationship between self-reported health status and vegetable and fruit consumption for both men and women. This differs from results from an analysis on the CCHS 2000/2001, in which variation among the five health classifications was examined.²⁶ This discrepancy in the two studies may be at least partly explained by differences in categorization of this variable. Here, self-reported health was dichotomized (excellent/very good/good versus fair/poor) whereas the analysis of the CCHS kept these categories separate. Therefore, the present study is less likely to find a significant difference with only 2 categories compared with the 5 used in the CCHS analysis.

Chronic Conditions

Men with one or more chronic conditions that required dietary management (i.e. diabetes, heart disease, high cholesterol, hypertension, diverticulitis or bowel disease, kidney disease) consumed significantly fewer vegetables and fruit than adults with no chronic conditions (Figure 9). Fifty percent of men with one or more chronic conditions did not meet the recommended 5 or more servings per day compared with 43% of men with no chronic conditions. Eight percent of men with one or more chronic conditions reported eating 0–2 servings of vegetables and fruit.

Figure 9. Vegetable and fruit intake by number of chronic conditions requiring dietary management and sex: proportion eating <5 servings/day



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

* Significant differences between categories ($p < .05$)

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

The results were similar for women, but the differences were statistically significant. Forty-one percent of women with one or more chronic conditions ate fewer than the recommended 5 or more servings per day compared with 34% with no chronic conditions. Only

◆ See Glossary of Terms, Appendix 4

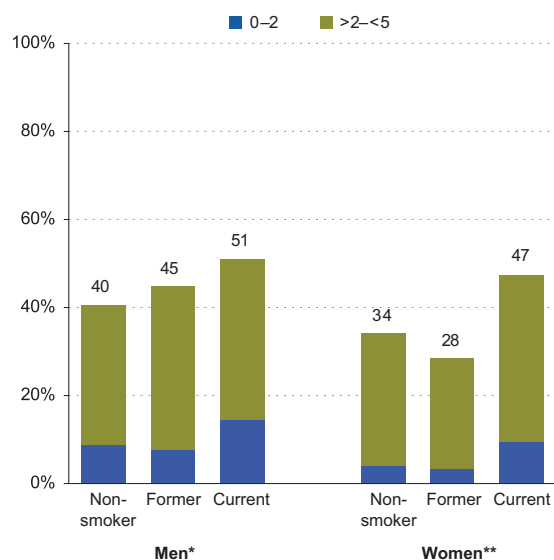
5% of women with one or more chronic conditions reported eating 0–2 servings, while 36% reported eating more than 2 and fewer than 5 servings per day.

Smoking Status

The proportion of current, former and non-smokers sampled in the ONCPS closely resemble estimates for the province.³⁷ Twenty six percent of ONCPS participants were current smokers, 27% were former smokers, and 47% were non-smokers. The comparable estimates for the province are 22%, 27%, 50% respectively.³⁷

The ONCPS provides important evidence on the association between smoking and vegetable and fruit consumption. Consumption of fewer than 5 servings per day was most prevalent among current smokers (Figure 10). This finding is consistent with an analysis of CCHS 2000/2001 data, which found that non-smokers ate vegetables and fruit more frequently than daily smokers for both men and women.²⁶

Figure 10. Vegetable and fruit intake by smoking status and sex: proportion eating 0–2 or >2–<5 servings/day



Significant differences between smoking status (* $p < .05$; ** $p < .001$)

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



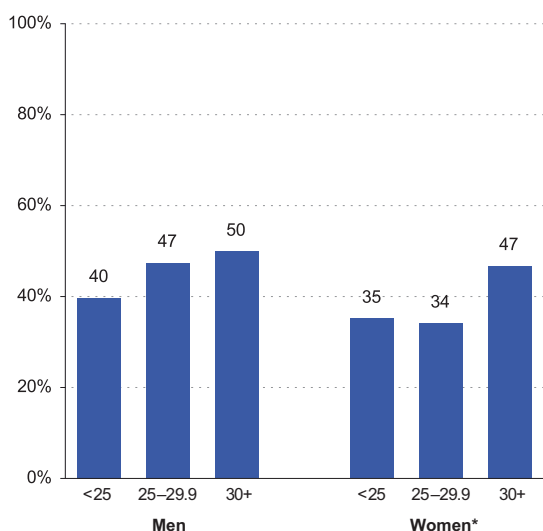
In the ONCPS, the prevalence of current smokers consuming 0–2 servings per day was of particular concern, with 15% of men and 9% of women eating this amount.

Forty percent of men who were non-smokers ate fewer than 5 servings per day compared with 45% who were former smokers and 51% who were current smokers. Women who were former smokers ate the most vegetables and fruit with only 28% consuming fewer than 5 servings daily. Conversely, 47% of women who were current smokers and 34% who were non-smokers ate fewer than the recommended value.

Overweight and Obesity

There is ample evidence linking obesity (BMI [◆] 30+) with major preventable chronic diseases including common cancers, Type 2 diabetes, cardiovascular diseases, hypertension, stroke and gallbladder disease.²⁴ The ONCPS examined the relationship between vegetable and fruit consumption and body weight (Figure 11).

Figure 11. Vegetable and fruit intake by body weight (BMI in kg/m²) and sex: proportion eating <5 servings/day



* Significant differences between categories (p<.05)

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

The highest proportion of individuals eating fewer than the recommended servings of vegetables and fruit per day was found among Ontarians who were obese. Fifty percent of men who were obese consumed fewer than 5 servings of vegetables and fruit per day and of these men, 12% consumed 0–2 servings per day. For women who were obese, 47% consumed fewer than 5 servings of vegetables and fruit per day, of which 3% consumed 0–2 servings per day.

The picture for overweight men was as follows: 47% reported eating fewer than 5 servings of vegetables and fruit per day, while 10% consumed 0–2 servings. However, fewer overweight women (34%) than men reported consuming fewer than 5 servings, and 4% of overweight women consumed 0–2 servings.

Differences in proportions across consumption and weight categories were significant for women, but not for men.

These results are not surprising, as vegetables and fruit are high in nutrients and are generally low in calories (if simply prepared). Thus, the results of the survey suggest that the excess energy in the diets of Ontarians comes from other food sources and/or that energy output is less than optimal. High energy dense foods, which often contain fat, sugar or both, are more palatable than low energy dense foods.^{38,39} Studies have shown that an increase in consumption of vegetables and fruit is a beneficial component of weight loss and weight maintenance programs.¹⁴

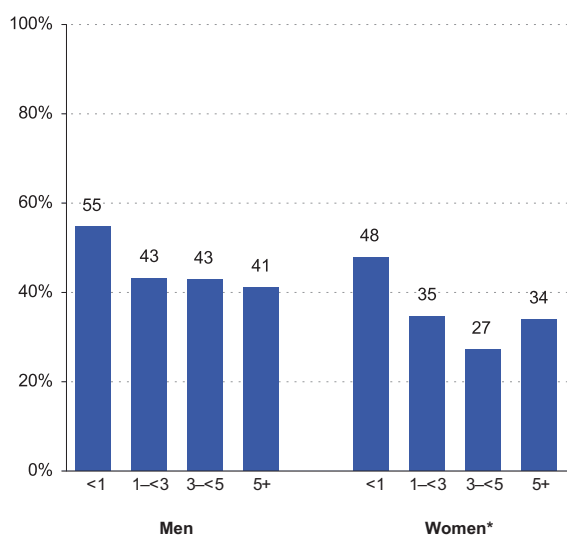
More in-depth analysis of overweight and obesity will be published in a subsequent *Insight on Cancer* supplement.

[◆] See Glossary of Terms, Appendix 4

Weekly Hours of Physical Activity♦

The consumption of vegetables and fruit was generally higher among physically active adults than physically inactive adults (Figure 12). In the case of men who were physically active for less than 1 hour per week, 55% reported eating fewer than 5 servings of vegetables and fruit compared with 43% who were physically active 1 or more hours per week. However, these differences were not significant.

Figure 12. Vegetable and fruit intake by level of physical activity (hours/week) and sex: proportion eating <5 servings/day



* Significant differences between categories (p<.01)

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

Of the women who were physically active less than 1 hour per week, significantly more women (48%) reported eating fewer than the recommended 5 or more servings of vegetables and fruit per day, whereas 32% of women who were physically active 1 or more hours per week ate this amount.

More in-depth analysis of physical activity will be published in a subsequent *Insight on Cancer* supplement.

Knowledge, Attitudes and Beliefs

The survey asked respondents questions regarding their knowledge, attitudes and beliefs about eating vegetables and fruit to ascertain what factors influence their behaviour. Knowledge, beliefs and self-efficacy,♦ which is a person's belief in their ability to overcome difficulties inherent in performing a task in a particular situation, all have a positive association with diet and health. A person's stage of dietary change also influences vegetable and fruit consumption.¹⁵

The associations between self-efficacy and consumption, and stages of change and consumption will be examined in a subsequent *Insight on Cancer* supplement.

Knowledge and Attitudes about the Recommendation of 5 or More Servings per Day

Seventy percent of men who had knowledge of the recommendation to eat at least 5 servings of vegetables and fruit a day consumed this amount compared with 47% who did not know about the recommendation. The results were similar for women. Sixty-eight percent of women who had knowledge of the recommendation consumed 5 or more servings per day compared with 55% who did not know the recommended amount.

Similarly, individuals with a positive attitude about the 5 or more recommendation had a higher vegetable and fruit intake. In the case of men, 76% with an optimal attitude about the 5 or more recommendation consumed this amount compared with 47% of men with a less than optimal attitude. The same was observed for women, of whom 72% with an optimal attitude consumed 5 or more servings per day compared with 54% of those with a less than optimal attitude.

♦ See Glossary of Terms, Appendix 4



Motivators and Barriers

In the ONCPS, factors that were identified as motivators (having a positive influence) on vegetable and fruit intake included: makes a person feel better, helps to lose weight, helps a person stay healthy, helps to prevent cancer, is a part of one's childhood, or they taste good. Factors that were identified as barriers (having a negative influence) to adequate intake included: cost, spoilage, availability, preparation, lack of information on preparation and storage, and concern about pesticides or genetically modified foods.

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

Beliefs as Motivators

A higher proportion of men and women ate the recommended number of 5 or more servings of vegetables and fruit per day if they reported that eating vegetables and fruit helped them stay healthy and had been part of their childhood (Table 2). These results are similar to a Washington State study, which found that intrinsic motives for eating a healthy diet were associated with higher intakes of vegetables and fruit, but extrinsic motives were not.¹⁵

Table 2. Proportion eating the recommended (5+) servings of vegetables and fruit a day by selected facilitators to consumption

Facilitators	% eating 5+ servings/day	
	Men	Women
Feel better (very important)	61	68**
Lose weight (very important)	57	66**
Part of childhood (very important)	61***	68***
Stay healthy (very important)	59**	67***
Prevent cancer (very important)	58	66
Taste good (agree)	57	65

* p<.05; ** p<.01; *** p<.001 indicates value is significantly different from other categories for that facilitator (see Table 1, Appendix 3)

Women who indicated that eating vegetables and fruit made them feel better, or helped them control their weight, tended to meet the recommended 5 or more servings than women who did not believe that these were important. Neither men nor women considered eating vegetables and fruit important to prevent cancer.

Beliefs as Barriers

There were fewer similarities between men and women in their responses to questions about barriers to eating vegetables and fruit. They both reported that vegetables and fruit spoil too quickly; however women reported that vegetables and fruit are too expensive and that good quality ones are not available in their area, while a greater proportion of men claimed that vegetables and fruit require too much preparation and that there is not enough information on how to prepare them (Table 3).

Table 3. Proportion eating the recommended (5+) servings of vegetables and fruit a day by selected barriers to consumption

Barriers	% eating 5+ servings/day	
	Men	Women
Too expensive (agree)	55	58***
Spoil too quickly (agree)	50*	58***
Too much preparation (agree)	39***	57
No information on preparation (agree)	52*	58
No information on storage (agree)	53	59
Good quality isn't available (agree)	52	54**
Concern about genetic modification (agree)	51	63

* p<.05; ** p<.01; *** p<.001 indicates value is significantly different from other categories for that barrier (see Table 1, Appendix 3)

Summary of Findings from the Descriptive Analysis

- Men who participated in the survey consumed fewer vegetables and less fruit than women.
- Fourteen percent of men and 7% of women 18–34 years of age reported eating 0–2 servings of vegetables and fruit per day.
- There was a significant difference in the prevalence of vegetable and fruit intake for women across the 6 regions. In descending order by region, women reported eating fewer than the recommended 5 or more servings as follows: 42% in the Northwest, 39% in the South/Southwest, 37% in the Northeast, 36% in

the East/Southeast, 35% in the Central West and 34% in the Central East.

- Seventeen percent of men with high school and 11% with less than high school reported eating 0–2 servings of vegetables and fruit per day.
- Twelve percent of men and 7% of women living alone reported eating 0–2 servings of vegetables and fruit per day.
- Only 43% of men and 52% of women in low-income households met the recommended number of 5 or more servings per day.
- Men with one or more chronic conditions that required dietary management (i.e. diabetes, heart disease, high cholesterol, hypertension, diverticulitis or bowel disease, kidney disease) consumed fewer vegetables and fruit than men with no chronic conditions.
- Fifteen percent of men and 9% of women who were current smokers consumed 0–2 servings of vegetables and fruit per day.
- The prevalence of eating 5 or more servings of vegetables and fruit per day was lower for women who were obese (54%) compared with women who were at a healthy weight (65%) or overweight (67%).
- Knowledge about health agencies' recommendations to eat at least 5 servings of vegetables and fruit a day had a positive influence on vegetable and fruit intake of both men and women.
- A positive attitude about the 5 or more recommendation had a positive influence on vegetable and fruit intake.



- Men and women were more likely to meet the recommended number of 5 or more servings of vegetables and fruit per day if they reported that eating vegetables and fruit helped them stay healthy or had been part of their childhood.
- Women who indicated that eating vegetables and fruit made them feel better or helped them lose weight ate the recommended 5 or more servings compared with women who believed that these were not important.
- Eating vegetables and fruit to prevent cancer was not found to be a motivator for either men or women.
- Both men and women reported quick spoilage as a barrier to eating vegetables and fruit.
- Women reported two additional barriers to eating vegetables and fruit: expensive and lack of availability. Two additional barriers reported by men, but not by women, were effort in and lack of information about vegetable and fruit preparation.

Table 4. Summary of the characteristics of individuals with lower vegetable and fruit intake^a

Characteristic	Group with low vegetable and fruit intake	Men	Women
Sex	Men	✓	
Age group	18–34 years	✓	
Geography (Region)	NW > S/SW > NE > E/SE > CW > CE		✓
Household composition	Living alone ^b	✓	
	Multiple adults	✓	
Education	Less than High school	✓	✓
	High school	✓	
Income	Low-income	✓	
Smoking status	Current	✓	✓
Chronic conditions	One or more	✓	
BMI	Obese	✓	
Weekly hours of physical activity	< 1 hour		✓
Knowledge of 5+ recommendation	Lack of	✓	✓
Attitude about 5+ recommendation	Less than optimal	✓	✓
Facilitators ^c	Feel better		✓
	Lose weight		✓
	Part of childhood	✓	✓
Barriers ^d	Stay healthy	✓	✓
	Too expensive		✓
	Spoil too quickly	✓	✓
	Too much preparation	✓	
	No information on preparation	✓	
	Good quality not available		✓

a Significant chi square (p<.05)

b Small numbers

c Factor is not/somewhat important to the respondent

d Respondent is neutral/agrees that the factor is important

MULTIVARIATE ANALYSIS

The ONCPS study also included a multivariate analysis to gain a more in-depth understanding about the associations between the factors examined in the previous section and vegetable and fruit consumption. This more complex analysis was done to determine which of the factors were significantly associated with low vegetable and fruit intake (<5 servings/day). The regression analysis calculated both crude and adjusted odds ratios[◆] (AORs) for associations between low consumption and the selected sociodemographic, health-related and psychosocial-dependent variables. Stepwise logistic regression, based on the likelihood ratio method, was used to determine the final multivariate models (see Appendix 4 for more detail).

Education

The multivariate analysis confirmed that education has a significant association with vegetable and fruit intake. Men with less than high school education were more likely to eat fewer than 5 servings per day than men with a university education (AOR 1.8; 95% CI 1.1–3.2). Similarly, women with less than high school education and women with high school education had twice the odds of eating fewer than 5 servings per day compared with women with a university education (AOR 2.0; 95% CI 1.1–3.4 and AOR 1.9; 95% CI 1.3–2.9, respectively).

Household Income Adequacy

After adjusting for the influence of other important variables in the multivariate regression analysis, household income was not found to be significantly associated with vegetable and fruit intake. This finding differs from what was expected based on the results of the bivariate analysis above and the literature to date. Other analyses, such as those from the CCHS

2000/2001, found that consumption of vegetables and fruit increased with increasing income levels.²⁶ A possible explanation for this discrepancy is that, because income and education are highly correlated, it is unlikely that both would emerge as significant correlates in this analysis. However, education emerged as the more significant correlate during the modelling procedure, while household income was deleted.

Chronic Conditions

The number of chronic conditions[◆] that required dietary management was not associated with vegetable and fruit intake of either men or women. These results differ from an analysis done of the CCHS 2000/2001 data which examined the relationship between vegetable and fruit consumption and the diagnosis of one or more chronic conditions—heart disease, high blood pressure, diabetes and cancer.²⁶ The CCHS analysis found that, when the effects of other influences on food choices were considered, a positive relationship between vegetable and fruit consumption (measured by number of times per day), and chronic disease persisted for men. No significant association emerged for women between vegetable and fruit intake and chronic disease or disability. In the ONCPS, the lack of a significant association between these variables is likely due to heightened awareness by the respondent of the importance of diet after a diagnosis of such a chronic condition. Therefore, these respondents are likely more sensitive to their health situation and thus more compliant with eating in a healthful manner in order to prevent further deterioration of their health.

Smoking Status

As expected from the bivariate results, women who were former smokers were less likely to eat fewer than 5 servings of vegetables and fruit per day compared with

[◆] See Glossary of Terms, Appendix 4



women who were non-smokers (AOR 0.6; 95% CI 0.5–0.9). Women who were current smokers had 1.2 (95% CI 0.9–1.8) times higher odds than non-smokers of eating fewer than 5 servings of vegetables and fruit per day, however this estimate was not statistically significant. This association among former smokers may be indicative of further changes in health behaviour once smoking behaviour has changed; however, due to the limitations of a cross-sectional study, this relationship cannot be inferred and requires further study.

Overweight and Obesity

After adjusting for other factors, being overweight or obese, compared with being underweight or healthy weight, were not found to be significantly associated with low vegetable and fruit consumption.

Weekly Hours of Physical Activity

The multivariate analysis confirmed that less than 1 hour of physical activity per week was associated with eating fewer than 5 servings of vegetables and fruit daily. Men with this level of physical activity had almost twice the odds (AOR 1.8; 95% CI 1.2–2.9) of eating fewer than 5 servings of vegetables and fruit per day, compared with men who were physically active 5 or more hours per week. Similarly, women who were physically active less than 1 hour per week were almost 1.5 times more likely than women who were physically active 5 or more hours per week to consume amounts below the recommended level (AOR 1.4; 95% CI 0.9–2.2). The association between regular physical activity and vegetable and fruit intake has been confirmed by other studies.¹⁵

Knowledge, Attitudes and Beliefs

Vegetable and fruit consumption was lower among individuals who did not believe that they needed 5 or

more servings daily. When the effects of other influences on vegetable and fruit consumption were considered, both men and women who did not believe that they needed 5 or more servings per day had higher odds of eating fewer than 5 servings a day (AOR 2.8; 95% CI 2.0–4.0 and 2.3; 95% CI 1.7–3.1, respectively).

This finding is not surprising, and is consistent with basic health behaviour theoretical constructs. A person's attitude is determined by his or her individual beliefs about the outcomes or attributes of performing any health behaviour (known as behavioural beliefs), which is also evaluated by the person in terms of those outcomes or attributes.⁴⁰ Therefore it is not surprising that a significant association was found among adults in the survey who believed they don't personally need to consume 5 or more servings per day, with their actual behaviour of not consuming 5 servings per day.

Beliefs as Motivators

Consistent with other research showing an association between intrinsic motivators (or facilitators) and vegetable and fruit intake,¹⁵ individuals who reported that eating vegetables and fruit did not make them feel better or was not part of their childhood were more likely to eat fewer than 5 servings a day. The association between childhood consumption as a motivator for adult consumption appeared as particularly important after adjusting for other factors. Men who responded that it was not important or somewhat important in childhood had 1.5 times higher odds of eating fewer than 5 servings per day compared with men who reported that it was very important in childhood (AOR 1.5; 95% CI 1.1–2.1). Similarly, women who responded that it was not important or somewhat important in childhood were more likely to eat fewer than 5 servings per day compared with women who reported that it was important in childhood (AOR 1.7; 95% CI 1.2–2.4).

Beliefs as Barriers

The multivariate analysis confirmed that a belief that vegetables and fruit are too expensive was associated with eating fewer than 5 servings of vegetables and fruit per day among women (AOR 1.5; 95% CI 1.1–1.9). This finding is of interest given that the study also found that, for women, 49% with less than high school education and 48% in low-income households ate fewer than 5 servings per day. This finding is similar to previously published results.^{41,42} More in-depth analysis of food security will be published in a subsequent *Insight on Cancer* supplement.

The multivariate analysis also confirmed that, for men, the belief that vegetables and fruit require too much preparation was a predictor of men eating fewer than 5 servings per day (AOR 1.7 CI 1.2–2.4). Unlike women, men did not identify cost as a barrier to eating vegetables and fruit.

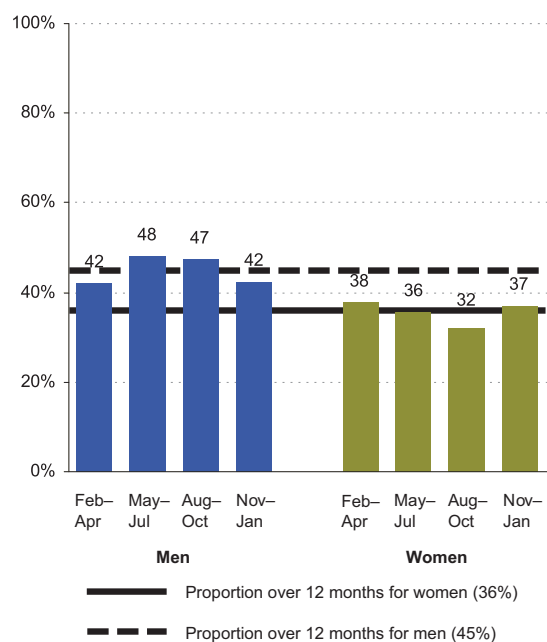
Seasonal Variation in Consumption

The fact that the survey was conducted over a 12-month period with about equal numbers of participants each month allowed for analysis of seasonal differences in eating behaviours.

As illustrated in Figure 13, there was little variation in consumption from season to season for both men and women. The lowest consumptions for men occurred between May and October, while the lowest intakes for women were between November and April.

The observed pattern for women coincides more closely with the growing season of vegetables and fruit in Ontario (June to November)⁴³ than the seasonal variation observed for men.

Figure 13. Vegetable and fruit intake by season and sex: proportion eating <5 servings/day



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

After adjusting for other factors (i.e., age group, region, education level and household income), no significant association between season and sub-optimal consumption (i.e., <5 servings per day) was observed for either sex (see Table 3 in Appendix 3). This indicates that, despite seeing sex differences in the bivariate analysis, these effects do not hold when modeling for other factors.

Summary of Findings from the Multivariate Analysis

- Men with less than high school education had almost 2 times the odds of eating fewer than 5 servings per day than men with university education. Similarly, women with high school education or less had twice the odds of eating fewer than 5 servings per day compared with women with university education.



- Women who were former smokers had half the odds of eating fewer than 5 servings of vegetables and fruit per day compared with women who never smoked.
- Men and women who were physically active less than 1 hour per week were less likely to eat fewer than 5 servings of vegetables and fruit per day than men who were physically active 5 or more per week.
- A belief that 5 or more servings of vegetables and fruit per day were needed was significantly associated with vegetable and fruit intake of both men and women.
- Men and women consumed more vegetables and fruit if eating vegetables and fruit was important in their childhood.
- A belief that vegetables and fruit are too expensive was associated with women eating fewer than 5 servings of vegetables and fruit per day.
- A belief that vegetables and fruit require too much preparation was associated with men eating fewer than 5 servings of vegetables and fruit per day.
- No significant seasonal pattern was evident in consumption.

Table 5. Summary of characteristics associated with eating fewer than 5 servings of vegetables and fruit per day

Characteristics	Risk groups	Men	Women
Education	Less than high school	✓	✓
	High school		✓
Smoking status	Not a former smoker		✓
Physical activity	<1 hour/week	✓	✓
Attitude about 5+ recommendation	Less than optimal	✓	✓
Facilitators ^a	Part of childhood	✓	✓
Barriers ^b	Too expensive		✓
	Too much preparation	✓	

a Factor is not/somewhat important to the respondent

b Respondent neutral/agrees that the factor is important

IMPLICATIONS OF ONCPS RESULTS FOR POLICY AND PROGRAMS

There is ample evidence that identifies the importance of applying a life-course approach to the prevention and control of chronic disease, including cancer.³ It is also well known that co-ordinated, multi-level interventions (i.e. influence at the individual, interpersonal, institutional, community and policy levels) are needed to ensure that environments enable healthy choices to be the right choices.^{44,45} Comprehensive programs and policies are required in settings such as schools and child care centres, in workplaces, and in community settings such as community centres and sports and recreation facilities.

Particular attention needs to be paid to increasing the consumption of vegetables and fruit by men, especially men aged 18–34 years, adults living alone either with or without children, smokers, and inactive adults. Strategies designed to reduce smoking and to increase physical activity should also give priority to informing people about the importance of eating vegetables and fruit.

A review of nutrition and cancer prevention interventions conducted by CCO identified some best practices for nutrition strategies.⁴⁶ The authors looked at education, media and policy interventions. They found that the most effective interventions:

- Used participatory models for planning and implementing interventions;
- Were grounded in theory, most notably Social Learning Theory;[♦]
- Incorporated multiple strategies;
- Provided essential training and support;
- Were designed to target a person's stage of change;

- Involved the family as an important source of support;
- Were of adequate intensity and duration rather than time-limited events;
- Gave clear, strongly worded, simple messages;
- Considered the political climate in which the intervention was being implemented; and,
- Kept the lines of communication open between the implementing body and the other organizations.

The authors recommended that comprehensive, multi-component interventions be implemented using a participatory model at all stages of development, implementation and evaluation. They provided advice regarding the 3 types of interventions for all 3 stages as shown in Table 6.

[♦] See Glossary of Terms, Appendix 4



Table 6. Summary of Best Practices - Nutrition Interventions for Cancer Prevention

Intervention	Development	Implementation	Evaluation
Education	<p>Education/skill development in groups combined with environmental supports</p> <p>Messages tailored for language and reading level, cultural foods and terminology, and peer education</p> <p>Environmental supports should have wide reach</p>	<p>Training for paraprofessionals, peer educators, teachers, food service staff, employees, health providers</p> <p>Support by projects staff to personnel implementing program</p>	<p>Extensive pretesting and process evaluation</p> <p>Funding provided to evaluate interventions in control trials following pilot phase</p> <p>Measures – participant observation, self-report</p>
Media	<p>Complex messages should be broken down into practical ones, easy to understand, clearly and strongly worded</p>	<p>Paid advertising along with public service announcements for greater reach for the cost</p>	<p>Evaluation should be rigorous with focus on behaviour change</p> <p>Pre/post test surveys are an effective method to gather information</p>
Policy	<p>Funding should be provided for epidemiological surveys and data used to target strategies for particular groups</p>	<p>Adequate attention should be paid to resources and supports to sustain implementation</p> <p>An administrative body to provide oversight and take leadership to carry out mandate</p> <p>Key stakeholders (e.g. retailers, food industry) involved from the outset</p>	<p>Use a combination of methods to measure – extent of adoption of policy components, sales data to access food choices, use of food subsidies, household surveys to assess consumption</p> <p>A strategy of reduced pricing has potential and should be investigated in properly designed trials</p>

Source: Sahay TB, Rootman I, Asbury FD. Review of Nutrition Interventions for Cancer Prevention [online]. Available from: <http://www.cancercare.on.ca/pdf/ReportFinalNutritionReview.pdf> [cited 15 April 2004].⁴⁶

STRATEGIES TO PROMOTE VEGETABLE AND FRUIT CONSUMPTION

The results of the ONCPS provide important new evidence on vegetable and fruit intake of adults in the province. To reduce the risk of cancer in Ontario, nutrition action is needed on two fronts: at the individual level by promoting changes in behaviour and addressing risk factors such as unhealthy eating and low physical activity, and at the level of society by promoting social, environmental and other policy changes to support increased vegetable and fruit intake.¹⁰ *Nutrition for Health: An Agenda for Action* describes such a broad action plan for Canada.⁴⁷ The ONCPS study presents a unique opportunity for Ontario policy makers, health professionals, educators, employers, the food industry and the media to work collaboratively to increase vegetable and fruit intake in Ontario, a key strategy to decrease cancer risk and promote health and well-being across the life-course.

Early Life and Childhood

The evidence from the ONCPS points to the importance of childhood experiences of eating vegetables and fruit as a key influencer of adult behaviour. Research shows that children's exposure to a range of vegetables and fruit in the home is important for the development of preferences for these foods and that parental knowledge, attitudes and behaviours related to healthy diet and physical activity are important in creating role models.⁴⁸ There is also evidence that children act as a positive influence for adult dietary behaviours.⁴⁹

Since early life and childhood is a time when many food preferences and behaviours are established and shaped/influenced by the social environments in which we live, play and learn, it is an important period for dietary intervention. Effective childhood interventions concerning vegetables and fruit should result in both increased immediate consumption of vegetables and fruit and, through various mediating mechanisms and with continued reinforcement, should persist into

adulthood. It has also been found that factors which are most likely to increase vegetable and fruit intake of children include: increasing availability of vegetables and fruit in the home, enhancing preference for vegetables through exposure at home and in the community (e.g. food establishments), and developing both the skills to make vegetables and fruit acceptable, and the skills to prepare them.¹³

In addition to parents, child care workers and educators play an important role in helping children learn and adopt behaviours. Their involvement in helping children to enjoy eating vegetables and fruit is necessary to increase vegetable and fruit intake in the province. Research shows that changing the opportunities, role models and social support for vegetables and fruit in school cafeterias can make a difference in children's eating patterns. These changes are more potent when implemented with classroom curricula and parental involvement.⁵⁰

U.K. National School Fruit Scheme

The importance of encouraging vegetable and fruit consumption early in life is being recognized by the United Kingdom. As part of their vision to improve public health, the Health Secretary in the United Kingdom announced in January 2004 that a free piece of fruit will be provided each school day to children as part of the National School Fruit Scheme. The initiative was launched to promote healthy eating and to help tackle obesity. A pilot study of the initiative reported that children who regularly eat fruit at school as part of the scheme consume more fruit outside school hours. The National School Fruit Scheme is tied to the FIS (Food in School Program), the 5 A Day Program, and other diet and nutrition priorities set out in the National Health Services Plan and the cross-Government Food and Health Action Plan on sustainable farming and food.⁵¹



Adults

Availability of and accessibility to vegetables and fruit were barriers for some adults in the ONCPS. (More in-depth analysis of the influence of availability and accessibility on the intake of vegetables and fruit of adults in Ontario will be published in a subsequent *Insight on Cancer* supplement.) This finding raises an important question about the factors that contribute to the low intake of vegetables and fruit. Perhaps this is due to practices such as eating out or to the time crunch experienced by many adults today. An analysis of the California Dietary Practices Surveys between 1989 and 1999 reported that, in 1999, the most common reasons that Californians gave for not eating vegetables and fruit were that they were: hard to buy in fast food restaurants (88%), hard to get at work (62%), hard to get at restaurants (35%), and too expensive (27%). Participants in the California study identified that eating in fast food establishments was a barrier to eating vegetables and fruit.⁴²

The California analysis also pointed out that the percentage of eating out that occurred in fast food venues compared with other restaurants rose in the state from one-third in 1989 to nearly half in 1999. The authors identified this as significant because California surveys have consistently found that eating at restaurants—particularly fast food venues—was associated with lower daily vegetable and fruit consumption. During the 1990s, fast food use in the state increased most significantly, as follows: 40% for men, almost 50% for high school graduates, 50% for very low-income Californians, 60% for those earning \$35,000–\$50,000 (U.S.) and 75% for adults with less than high school education. The authors concluded that the trend to eat fast food more often appears to be an increasingly significant factor contributing to low vegetable and fruit intake.⁴² It would be an interesting research agenda to determine whether these findings would hold true in Ontario.

The food industry can play a role by ensuring that healthy choices of vegetables and fruit are available in grocery stores, restaurants, school and workplace cafeterias, and vending machines. Ontario's Healthy Restaurant Program, **Eat Smart!**, offers recognition to restaurants that meet exceptional standards in nutrition, food safety and non-smoking seating. The goal of the program is to contribute to the reduction of chronic diseases (such as heart disease and cancer) and food borne illness in Ontario. In addition to establishing and maintaining the program standards at restaurants, **Eat Smart!** achieves its goal through social marketing, education and training.⁵² It is noteworthy that in California surveys, a strong positive association was found between gardening, and fruit and vegetable intake.⁵³

Lack of information about the importance of vegetables and fruit, or knowledge and skills on their preparation and storage, were factors that influenced behaviour among Ontario adults. The media and the food industry can be partners in helping to promote the benefits of vegetable and fruit intake and providing information on preparation and storage.

The **Take Five: 5-10 a day...your way!** community-based behavioural intervention is designed to inform, educate, and stimulate behavior change related to vegetable and fruit acquisition, preparation, and storage in Ontario women aged 25–45 and their families, in order to support them to consume 5 to 10 servings of vegetables and fruit every day. **Take Five** incorporates behaviour change strategies and interactive educational activities in small group settings that also promote social support and increase personal capabilities.⁵⁴

Although it is important to promote vegetable and fruit intake to everyone in Ontario, this study identified certain groups who are at increased risk of cancer due to very low vegetable and fruit intake. This includes men aged 18–34 years, adults with high school or less education, adults living alone, smokers, and adults who

are not physically active. These groups are known to experience socio-economic circumstances that create disparities in health and chronic disease risk.^{24,55,56}

What is happening in Ontario?

The ONCPS points to the importance of continued investment in diet and nutrition policies, programs and strategies to prevent cancer and to promote health and well-being in Ontario. There have been a number of developments in Ontario that are supportive of action to increase vegetable and fruit intake and promote healthy eating. These include proposed priorities and new directions identified by the provincial government to strengthen public health, as well as action plans and strategies of coalitions and non-government organizations.

Provincial Government

The Ontario government has demonstrated a new commitment to public health and appointed a Chief Medical Officer of Health and Assistant Deputy Minister of Public Health. In this role, the government will be developing more effective health promotion strategies and programs to deliver measurable results.⁵⁷ The intent is to revitalize public health in the province and address the following:

- Public health leadership and accountability;
- Creation of a health protection and promotion agency for Ontario;
- Legislative changes to increase the independence and strengthen the role of the Chief Medical Officer of Health;
- Health emergency preparedness; and
- Expanded health human resources.⁵⁸

The inclusion of nutrition services by dietitians in family practice settings is another positive development towards helping Ontarians improve their eating practices.⁵⁹ The Ministry of Health and Long-Term Care's Mandatory Health Programs and Services Guidelines currently in place in the province are an important foundation for this work. It is critical that other investments be made to strengthen nutrition and healthy eating strategies as integral to the new public health agenda in Ontario. A strong public health system is essential to promote healthy eating and overall health of Ontarians.

Through its plan to make all of Ontario's schools healthier places for students to learn, the Ontario government has directed school boards to ensure that all elementary schools restrict the sale of food and beverage items in vending machines to healthy choices.⁶⁰

Non-Government Organizational Action

The **Ontario Collaborative Group on Healthy Eating** is a newly created group for interested organizations and individuals to advocate for healthy eating initiatives, and to provide advice and recommendations to government. The group provides a forum for discussion on issues related to healthy eating, healthy body weights, and the role of physical activity as it relates to weight and the determinants of healthy eating—including food access, availability and adequacy. The group will address areas of research, surveillance, intervention planning and development, public policy and knowledge exchange. Membership is inclusive and is open to organizations with demonstrated provincial influence/scope. The secretariat is the Canadian Cancer Society (Ontario Division).⁶¹

The Ontario Chronic Disease Prevention Alliance (OCDPA) was formed in February 2003. The aim of the alliance is to develop a chronic disease prevention coalition in Ontario with a common frame of reference



and common purpose. OCDPA's mission is to improve the health of Ontarians through leadership that supports collaborative action to promote healthy living and to address the determinants of health necessary for chronic disease prevention. The group has identified a set of common risk factors for chronic disease, including physical inactivity, smoking, unhealthy eating, excessive alcohol consumption and overweight/obesity.⁶²

What is happening nationally?

In September 2000, Federal/Provincial/Territorial (F/P/T) Ministers of Health agreed to work together to develop an **Integrated Pan-Canadian Healthy Living Strategy**. In the fall of 2003, the F/P/T Ministers of Health endorsed the Healthy Living Strategy Framework and the five key actions,⁶³ and reaffirmed their endorsement at the September 2004 Federal Ministers Meeting.

In March 2004, the federal budget announced reallocation of resources from Health Canada (\$400-million) and new investments (\$665-million over 3 years) to **increase public health capacity**, which has led to the creation of a National Public Health Agency with a mandate inclusive of chronic disease, and the appointment of Canada's first Chief Public Health Officer.⁶⁴

The **Office of Nutrition Policy and Promotion, Health Canada**, is conducting a review of *Canada's Food Guide to Healthy Eating*, which was last released in 1992, to assess it in relation to updated scientific information, changes to the food supply and food use patterns, and use and understanding by consumers and intermediaries.⁶⁵

The **Primary Prevention Action Group (PP-AG)** is an initiative within the Canadian Strategy for Cancer Control that was established in 2003 to promote the creation of a national, provincial/territorial, and local community primary prevention system to address

population-based risk factors for cancer and other chronic diseases, by collaboration with chronic disease constituencies. The vision of the PP-AG is a reduction of harmful exposures and risk factors, and thereby a reduction in cancer incidence and mortality. Members include provincial cancer agencies, national and provincial non-government organizations and the Canadian Cancer Advocacy Network.⁶⁶

The Chronic Disease Prevention Alliance of Canada (CDPAC) is a networked community of organizations and individuals with a common vision to create an integrated system of chronic disease prevention in Canada. CDPAC's mission is to foster a co-ordinated countrywide movement for the adoption of an integrated population health approach to prevent chronic diseases in Canada through leadership, advocacy and capacity building. Its role is to:

- Advocate for integrated research, surveillance, policies and programs, and the necessary resources, to positively influence the determinants of health and reduce the incidence of chronic diseases;
- Promote chronic disease prevention efforts that have been shown to increase physical activity, reduce unhealthy nutrition practices and reduce exposure to tobacco smoke;
- Support learning by facilitating information sharing and dialogue among researchers, practitioners, policy planners, and others who can contribute to greater understanding of needed systems changes and how to achieve them; and
- Facilitate access to resources to build awareness and improve understanding of the burden of chronic disease and the systems changes needed to reduce chronic disease in Canada.⁶⁷

WHERE TO GO FROM HERE

Provincially

Cancer 2020 is a call for action against the impact of cancer in Ontario, co-led by Cancer Care Ontario and the Canadian Cancer Society (Ontario Division). The Cancer 2020 goals are aggressive and its action plan is a long-term provincial plan for cancer prevention and detection with measurable goals and targets to be achieved within a reasonable timeframe. It is also a framework to monitor progress in reducing cancer incidence and mortality. Increasing vegetable and fruit consumption is one of the key priorities and the goal of Cancer 2020 is to increase the percentage of Ontarians who consume 5 or more servings of vegetables and fruit daily from 32% of adults and 44% of children over 12 years old, to 90% of all of Ontario's adults and children.²

Cancer 2020 has identified long-term priorities and enhancements that are needed to develop the necessary infrastructure to support change:

- Long-term priorities for Ontario that involve many different stakeholders include:
 - Development of a Nutrition and Healthy Body Weight Strategy as soon as possible, modeled after the Ontario Tobacco Strategy and with parallel investment; and
 - Increased investments in the Active Ontario Strategy.
- Priorities for infrastructure development include:
 - Integration of Cancer 2020 targets into the Public Health Mandatory Core Programs and Services Guidelines;
 - Investment in prevention research;
 - Enhancement of risk factor surveillance activities; and
 - Establishment of mechanisms to coordinate and plan regional cancer prevention activities.²

A comprehensive nutrition strategy is needed to implement evidenced-based interventions that are accessible, intensive and long-term to bring about necessary changes. One example of such an intervention is Ontario's **Take Five: 5-10 a day...your way!** program.⁵² A Comprehensive School Health Program^{68,69} is needed in Ontario to foster individual and environmental change in schools to promote healthy eating and other healthy behaviours.

Nationally

As part of a national public health strategy, the federal government must invest in chronic disease prevention and support the development of innovative approaches to nutrition and physical activity. Leadership, coordination and resources are needed to:

- Develop and maintain pan-Canadian strategies and guidelines;
- Fund and support innovative community interventions; and
- Fund and support research, evaluation and surveillance.

At the national level, priority should be also given to the ongoing review and maintenance of dietary guidelines and recommendations to ensure that these are kept in step with the latest available evidence. Adequate resources are required to support broad and multiple strategies in communities, delivered over a long period of time to produce the necessary changes at the individual and societal levels. New funding is needed to support the Integrated Pan-Canadian Healthy Living Strategy. In addition, support for research, evaluation and surveillance is critical to measure progress and fill gaps in knowledge and understanding of what works, does not work and why.



Conclusion

There are numerous and encouraging new developments that are moving in the right direction. However, much more remains to be done to build capacity, develop infrastructure, foster integrated approaches, sustain efforts over long periods of time and measure and report on progress. Investments are needed to support comprehensive and accessible community-based strategies that deliver co-ordinated multiple interventions in homes, schools, child care centres, workplaces, community centres, and sports and recreation facilities in both urban and rural communities to achieve the goal of making Ontarians healthy and to build a healthy Canada.

APPENDIX 1: ONCPS QUESTIONS APPLICABLE TO THE VEGETABLE AND FRUIT SUPPLEMENT

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

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

Attitude

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: would you say this is very important, somewhat important or not important to why you eat fruit?
- Eating fruit helps you control your weight. Is this is very important, somewhat important or not important to why you eat fruit?
- Eating fruit has been part of your diet since childhood. Is this is very important, somewhat important or not important to why you eat fruit?

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

- Fruit is expensive. Do you agree, neither agree nor disagree, or disagree?
- Fruit spoils too quickly. Do you agree, neither agree nor disagree, or disagree?
- Concern about pesticides prevents you from eating more fruit. Do you agree, neither agree nor disagree, or disagree?
- Preparing fruit takes too much time and planning. Do you agree, neither agree nor disagree, or disagree?
- There is not enough information about how to prepare fruit. Do you agree, neither agree nor disagree, or disagree?
- There is not enough information about how to store fruit. Do you agree, neither agree nor disagree, or disagree?
- Concern about genetically modified foods prevents you from eating more fruit. Do you agree, neither agree nor disagree, or disagree?

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 very important, somewhat important or not important to why you eat fruit?
- Eating fruits and vegetables helps you prevent cancer. Is this 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?

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?

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 with 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?



APPENDIX 2: 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 to 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
High school	M	Z	0.1705	-0.0061	0.0427	0.6895	0.1874	0.8899	-2.4927
		% difference	0.65	3.17	-0.72	-1.73	-1.84	3.56	-3.10
	F	Z	0.1208	0.5679	-0.1321	-0.3254	-0.3475	0.6833	-0.5791
Some post-secondary	M	% 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
	F	% difference	-1.16	-2.15	0.20	0.80	0.29	0.09	1.94
University	M	Z	-0.2608	-0.4789	0.0445	0.1782	0.0637	0.0211	0.4259
		% difference	0.90	-1.90	1.42	1.25	-1.30	0.35	-0.73
	F	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 ($Z > \pm 1.96$); 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 ($Z > \pm 1.96$); 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 ($Z > \pm 1.96$); a positive statistic indicates the sample is under-representative and a negative statistic indicates the sample is over-representative compared with the Census

APPENDIX 3: DATA TABLES



Table 1. Weighted prevalence (%) of vegetable and fruit consumption (servings/day) by selected characteristics

Variable	Men				Women			
	n ^a	0-2 (n=125)	>2-<5 (n=470)	5+ (n=729)	n ^a	0-2 (n=87)	>2-<5 (n=519)	5+ (n=1066)
Age group								
18-34	480	14.0	30.5	55.5	531	6.7	31.5	61.8
35-49	538	6.9	38.6	54.6	656	3.8	30.6	65.6
50-64	294	8.0	37.8	54.2	444	4.1	29.2	66.8
Region								
NW	161	11.9	37.5	50.6	191	7.3	34.6	58.1
NE	149	5.4	37.2	57.4	205	2.9	34.3	62.8
S/SW	167	13.2	37.1	49.7	189	10.6	28.0	61.4
CW	150	12.0	33.3	54.7	204	4.4	30.4	65.2
CE	551	8.5	34.3	57.2	675	4.9	29.3	65.8
E/SE	151	6.0	36.4	57.6	211	3.3	32.7	64.0
Area of residence								
Urban	997	9.1	35.3	55.6	1209	5.4	30.0	64.6
Rural	181	9.5	36.6	54.0	263	6.0	32.0	62.0
Household type								
1 Adult	261	11.8	29.9	58.3	345	7.0	27.7	65.3
1 Adult with child(ren) <18	28	2.8	46.0	51.2	129	7.5	32.1	60.3
2 Adults	358	7.3	42.1	50.6	415	5.3	35.9	58.8
2 Adults with child(ren) <18	373	7.7	37.1	55.1	485	4.9	27.7	67.4
Multiple adults	306	13.1	29.4	57.5	298	4.1	30.1	65.8
Immigrant status								
North American-born ^b	1000	10.6	33.6	55.7	1302	5.2	30.7	64.1
Immigrated <20 years	186	8.0	40.3	51.8	188	6.2	33.8	60.0
Immigrated 20+ years	137	9.5	36.3	54.2	174	2.8	26.0	71.2
Education level								
< High school	152	11.4	46.1	42.5	160	7.2	41.4	51.4
High school	326	17.3	33.6	49.2	383	6.9	34.6	58.5
Some post-secondary	448	9.1	32.9	58.0	605	5.0	28.4	66.6
University	390	4.5	33.9	61.6	521	3.2	27.7	69.1
Income								
Low	101	22.8	34.0	43.1	195	12.0	36.0	52.0
Middle	172	4.3	34.6	61.1	299	8.7	30.2	61.2
Upper-middle	405	10.5	34.8	54.7	488	3.3	34.3	62.4
High	633	9.7	35.5	54.8	662	2.8	27.3	69.9
Self-reported health status								
Excellent, very good, good	1188	10.1	33.8	56.1	1486	4.9	29.9	65.2
Fair, poor	138	9.9	42.7	47.5	183	6.4	36.8	56.8
Chronic conditions^b								
0	977	10.8	32.2	57.0	1231	5.2	29.1	65.7
1+	352	7.9	42.5	49.7	444	4.7	35.9	59.4
Smoking status								
Non	546	8.8	31.7	59.6	863	4.0	30.2	65.7
Former	392	7.5	37.1	55.5	418	3.1	25.1	71.8
Current	386	14.8	36.3	48.9	387	9.3	37.9	52.8
Body weight (BMI)								
<25.0	497	9.0	30.7	60.2	989	5.7	29.5	64.9
25.0-29.9	627	10.3	36.9	52.8	415	3.7	30.1	66.9
30.0+	193	11.5	38.3	50.2	169	2.8	43.8	53.5
Weekly hours physical activity								
<1	217	12.0	42.6	45.4	297	7.1	40.7	52.1
1-<3	339	7.1	36.2	56.8	541	4.2	30.6	65.2
3-<5	240	12.3	30.7	57.0	337	3.1	24.0	72.8
5+	511	9.8	31.4	58.8	462	5.9	28.2	65.9
Know 5+ servings recommended								
No	561	14.7	38.6	46.7	363	8.6	36.8	54.7
Yes	453	4.7	26.4	68.9	1013	3.7	28.1	68.2
Think personally need 5+ servings								
No	876	13.3	39.6	47.1	642	8.4	37.4	54.2
Yes	343	1.9	22.1	76.0	917	2.8	25.4	71.8

a Unweighted sample size; sample sizes vary due to missing data

b Chronic conditions requiring significant dietary change (See Glossary of Terms, Appendix 4)

A box around a group of numbers signifies that the differences within the group are statistically significant. Chi square: * p<.05; ** p<.01; *** p<.001

Table 1. Weighted prevalence (%) of vegetable and fruit consumption (servings/day) by selected characteristics (continued)

Variable	Men				Women			
	n ^a	0-2 (n=126)	>2-<6 (n=470)	6+ (n=729)	n ^a	0-2 (n=87)	>2-<6 (n=519)	6+ (n=1066)
Facilitators of consumption								
Feel better								
Very important	705	9.0	30.1	60.9	1095	3.8	28.0	68.2
Somewhat important	427	11.1	39.7	49.3	419	7.3	36.5	56.2
Not important	195	11.2	40.0	48.8	159	7.4	33.6	59.0
Lose weight								
Very important	613	10.8	31.9	57.3	957	3.3	30.8	66.0
Somewhat important	345	10.9	39.7	49.4	422	5.3	30.1	64.6
Not important	366	7.8	33.3	58.9	292	10.7	32.1	57.3
Part of childhood								
Very important	836	8.4	30.9	60.7	1237	4.0	27.8	68.2
Somewhat important	361	9.9	42.6	47.5	319	8.1	37.7	54.2
Not important	129	21.9	39.2	38.9	112	8.1	39.9	52.0
Stay healthy								
Very important	948	8.4	32.4	59.2	1403	3.6	29.4	67.0
Somewhat important	321	13.8	39.4	46.8	236	12.5	39.0	48.5
Not important	59	17.4	48.4	34.2	34	11.4	25.4	63.2
Prevent cancer								
Very important	683	9.7	31.9	58.4	1042	3.8	30.2	65.9
Somewhat important	332	9.5	38.4	52.1	404	7.3	29.1	63.6
Not important	227	9.1	40.6	50.3	143	4.4	37.5	58.1
Taste good								
Agree	1192	9.1	34.1	56.8	1540	4.9	29.7	65.4
Neither agree nor disagree	74	15.5	45.4	39.0	85	8.0	39.2	52.8
Disagree	60	19.4	36.6	44.0	50	4.7	46.0	49.3
Barriers to consumption								
Too expensive								
Agree	500	10.5	34.6	54.9	718	6.3	36.2	57.5
Neither agree nor disagree	140	8.6	32.8	58.6	179	7.7	26.8	65.4
Disagree	680	10.1	34.5	55.4	776	3.3	26.3	70.4
Spoil too quickly								
Agree	657	12.7	37.0	50.3	832	6.8	35.5	57.8
Neither agree nor disagree	125	10.6	27.6	61.8	156	6.4	21.1	72.5
Disagree	542	6.6	33.1	52.0	682	2.6	26.4	71.1
Too much preparation								
Agree	209	22.6	38.6	38.8	326	4.7	38.3	57.0
Neither agree nor disagree	103	5.8	35.1	59.1	99	7.1	28.2	64.8
Disagree	1016	7.9	33.8	58.3	1250	5.0	28.9	66.1
No information on preparation								
Agree	300	16.2	31.5	52.3	309	5.1	37.0	57.8
Neither agree nor disagree	59	6.2	43.5	50.3	82	10.3	29.6	60.1
Disagree	963	8.4	35.1	56.5	1281	4.7	29.0	66.2
No information on storage								
Agree	423	12.2	35.3	52.5	499	5.8	35.5	58.8
Neither agree nor disagree	63	3.4	28.8	67.9	82	8.0	35.4	56.6
Disagree	835	9.7	35.0	55.4	1090	4.5	28.1	67.3
Good quality isn't available								
Agree	202	11.2	37.1	51.8	43	7.8	38.0	54.2
Neither agree nor disagree	77	10.6	26.5	62.9	100	12.3	34.2	53.5
Disagree	1045	9.9	35.0	55.1	1322	4.1	29.3	66.7
Concern about pesticides								
Agree	433	12.6	28.8	58.6	488	5.1	32.3	62.6
Neither agree nor disagree	76	9.0	19.3	71.7	134	10.6	25.4	64.0
Disagree	813	8.5	39.5	52.0	1043	4.5	30.3	65.3
Concern about genetic modification								
Agree	350	11.7	37.0	51.3	413	5.4	32.5	62.1
Neither agree nor disagree	81	13.0	18.4	68.6	137	6.44	30.7	62.8
Disagree	871	9.0	35.3	55.7	1101	4.8	30.1	65.1

a Unweighted sample size; sample sizes vary due to missing data

A box around a group of numbers signifies that the differences within the group are statistically significant. Chi square: * p<.05; ** p<.01; *** p<.001



Table 2. Crude and adjusted^a odds ratios (95% confidence limits) for Ontarians eating fewer than 5 servings of vegetables and fruit per day

Variable	Men			Women		
	Crude OR	Adjusted OR		Crude OR	Adjusted OR	
		Full Model	Final Model		Full Model	Final Model
Age group						
18–34	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
35–49	1.0 (0.8–1.4)	1.0 (0.6–1.6)	1.1 (0.8–1.5)	0.8 (0.6–1.2)	1.0 (0.6–1.5)	0.8 (0.6–1.1)
50–64	1.1 (0.7–1.5)	1.1 (0.6–2.0)	1.2 (0.7–1.7)	0.8 (0.6–1.1)	0.9 (0.5–1.5)	0.8 (0.5–1.2)
Region						
NW	1.3 (0.9–1.9)	1.6 (0.8–3.0)		1.4 (1.0–2.0)	1.8 (1.0–3.2)	
NE	1.0 (0.7–1.5)	1.0 (0.5–1.8)		1.1 (0.8–1.6)	1.6 (0.9–2.7)	
S/SW	1.4 (0.9–1.9)	1.3 (0.8–2.4)		1.2 (0.9–1.7)	1.5 (0.9–2.5)	
CW	1.1 (0.8–1.6)	1.2 (0.7–2.2)		1.0 (0.7–1.5)	1.2 (0.7–2.2)	
CE	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
E/SE	1.0 (0.7–1.4)	1.0 (0.6–1.8)		1.1 (0.8–1.5)	1.2 (0.7–2.0)	
Area of residence						
Urban	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
Rural	1.1 (0.7–1.6)	1.0 (0.6–1.8)		1.1 (0.8–1.6)	1.0 (0.6–1.5)	
Household type						
1 Adult	0.9 (0.6–1.3)	0.9 (0.5–1.6)		1.1 (0.8–1.5)	0.7 (0.4–1.2)	
1 Adult with child(ren) <18	1.2 (0.5–2.8)	1.4 (0.4–4.7)		1.4 (0.8–2.2)	0.9 (0.5–1.8)	
2 Adults	1.2 (0.9–1.7)	1.1 (0.7–2.0)		1.4 (1.1–2.0)	1.5 (0.9–2.5)	
2 Adults with child(ren) <18	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
Multiple adults	0.9 (0.6–1.3)	0.7 (0.4–1.2)		1.1 (0.7–1.5)	0.9 (0.5–1.5)	
Immigrant status						
North American-born ^b	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
Immigrated <20 years, Europe	0.7 (0.3–1.7)	1.9 (0.5–7.7)		1.0 (0.4–2.7)	0.8 (0.2–2.8)	
Immigrated <20 years, Other	1.3 (0.8–2.1)	1.2 (0.6–2.5)		1.1 (0.7–1.8)	1.9 (0.8–4.3)	
Immigrated 20+ years, Europe	0.9 (0.5–1.5)	1.6 (0.6–4.0)		0.6 (0.4–1.0)	0.7 (0.3–1.5)	
Immigrated 20+ years, Other	1.3 (0.6–2.9)	2.3 (0.9–6.0)		1.0 (0.5–2.1)	2.1 (0.9–5.3)	
Education level						
< High school	2.2 (1.3–3.6)	1.3 (0.6–2.8)	1.8 (1.1–3.2) *	2.1 (1.3–3.5)	1.8 (0.8–3.8)	2.0 (1.1–3.4) **
High school	1.7 (1.1–2.5)	1.1 (0.6–2.0)	1.4 (0.9–2.1)	1.6 (1.1–2.3)	1.3 (0.8–2.3)	1.9 (1.3–2.9)
Some post-secondary	1.2 (0.8–1.7)	0.9 (0.5–1.5)	0.9 (0.6–1.3)	1.1 (0.8–1.6)	1.1 (0.7–1.6)	1.3 (0.9–1.8)
University	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Income						
Low	1.6 (0.9–3.0)	1.1 (0.5–2.4)		2.1 (1.4–3.3)	1.7 (0.9–3.3)	
Middle	0.8 (0.5–1.2)	0.8 (0.4–1.4)		1.5 (1.0–2.1)	1.3 (0.8–2.3)	
Upper-middle	1.0 (0.7–1.4)	0.9 (0.6–1.4)		1.4 (1.0–1.9)	1.4 (0.9–2.2)	
High	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	

^a Adjusted for all other variables in the model, as well as respondents' perceived: association between diet and cancer; relative risk of developing cancer; and concern about pesticides (to be described further in a future *Insight on Cancer* supplement). Refer to Methodology, Appendix 4 for a complete description of the regression procedures.

^b Also includes respondents born in Australia and New Zealand

A box around a group of ORs signifies that the approximate likelihood ratio test for the variable is statistically significant. Chi square: * p<.05; ** p<.01; *** p<.001

Table 2. Crude and adjusted^a odds ratios (95% confidence limits) for Ontarians eating fewer than 5 servings of vegetables and fruit per day (continued)

Variable	Men			Women		
	Crude OR	Adjusted OR		Crude OR	Adjusted OR	
		Full Model	Final Model		Full Model	Final Model
Self-reported health status						
Excellent, very good, good	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
Fair, poor	1.4 (0.9–2.3)	1.3 (0.7–2.8)		1.4 (1.0–2.1)	1.3 (0.8–2.4)	
Chronic conditions ^b						
0	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
1+	1.3 (1.0–1.8)	1.0 (0.6–1.6)		1.3 (1.0–1.8)	1.1 (0.7–1.7)	
Smoking status ^c						
Non	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference) **
Former	1.2 (0.8–1.7)	1.3 (0.8–2.0)	1.2 (0.8–1.7)	0.8 (0.5–1.0)	0.7 (0.5–1.1)	0.6 (0.5–0.9)
Current	1.5 (1.1–2.2)	1.2 (0.8–1.9)	1.2 (0.8–1.7)	1.7 (1.2–2.4)	1.3 (0.8–2.1)	1.2 (0.9–1.8)
BMI						
<25.0	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
25.0–29.9	1.4 (1.0–1.9)	1.1 (0.7–1.6)		0.9 (0.7–1.3)	0.7 (0.4–1.1)	
30+	1.5 (1.0–2.3)	1.0 (0.5–1.9)		1.6 (1.1–2.4)	1.0 (0.5–1.8)	
Weekly hours physical activity						
<1	1.7 (1.1–2.6)	1.4 (0.8–2.5)	1.8 (1.2–2.9)	1.8 (1.2–2.6)	1.5 (0.8–2.5)	1.4 (0.9–2.2) *
1–<3	1.1 (0.8–1.6)	0.9 (0.6–1.5)	1.2 (0.8–1.7)	1.0 (0.7–1.4)	1.1 (0.7–1.7)	1.1 (0.8–1.5)
3–<5	1.1 (0.7–1.6)	1.2 (0.7–2.0)	1.1 (0.7–1.7)	0.7 (0.5–1.1)	0.6 (0.4–1.0)	0.7 (0.4–1.0)
5+	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Know 5+ servings recommended						
No	2.5 (1.8–3.6)	1.4 (0.9–2.3)		1.8 (1.3–2.4)	1.4 (0.9–2.2)	
Yes	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
Think personally need 5+ servings						
No	3.6 (2.5–5.0)	2.4 (1.4–4.1)	2.8 (2.0–4.0) ***	2.2 (0.6–2.8)	2.0 (1.3–3.0)	2.3 (1.7–3.1) ***
Yes	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Facilitators						
Feel better						
Very important	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Not/Somewhat important	1.6 (1.2–2.2)	1.4 (0.9–2.2)	1.3 (1.0–1.8)	1.6 (1.2–2.1)	1.3 (0.9–1.9)	1.3 (0.9–1.7)
Lose weight						
Very important	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
Not/Somewhat important	1.1 (0.9–1.5)	0.7 (0.5–1.2)		1.2 (0.9–1.6)	1.0 (0.7–1.5)	
Part of childhood						
Very important	1.0 (Reference)	1.0 (Reference)	1.0 (Reference) *	1.0 (Reference)	1.0 (Reference)	1.0 (Reference) ***
Not/Somewhat important	1.9 (1.4–2.6)	1.5 (1.0–2.3)	1.5 (1.1–2.1)	1.9 (1.4–2.5)	1.9 (1.3–2.8)	1.7 (1.2–2.4)

a Adjusted for all other variables in the model, as well as respondents' perceived: association between diet and cancer; relative risk of developing cancer; and concern about pesticides (to be described further in a future *Insight on Cancer* supplement). Refer to Methodology, Appendix 4 for a complete description of the regression procedures

b Chronic conditions requiring significant dietary change (See Glossary of Terms, Appendix 4)

c Interaction between smoking status and sex was significant ($p < .05$)

A box around a group of ORs signifies that the approximate likelihood ratio test for the variable is statistically significant. Chi square: * $p < .05$; ** $p < .01$; *** $p < .001$



Table 2. Crude and adjusted^a odds ratios (95% confidence limits) for Ontarians eating fewer than 5 servings of vegetables and fruit per day (continued)

Variable	Men			Women		
	Crude OR	Adjusted OR		Crude OR	Adjusted OR	
		Full Model	Final Model		Full Model	Final Model
Facilitators (continued)						
Stay healthy						
Very important	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
Not/Somewhat important	1.8 (1.3–2.5)	1.5 (0.9–2.6)		2.0 (1.4–2.8)	1.5 (0.9–2.5)	
Prevent cancer						
Very important	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
Not/Somewhat important	1.3 (1.0–1.8)	0.8 (0.5–1.2)		1.2 (0.9–1.6)	0.6 (0.4–0.9)	
Taste good						
Agree	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Disagree/Neither agree nor disagree	1.8 (1.1–3.0)	2.0 (1.1–3.7)	1.5 (0.9–2.6)	1.8 (1.2–2.4)	2.2 (1.1–4.3)	1.4 (0.8–2.4)
Barriers						
Too expensive						
Agree/Neither agree nor disagree	1.0 (0.7–1.3)	0.8 (0.5–1.2)	1.0 (0.7–1.4)	1.6 (1.3–2.1)	1.6 (1.1–2.3)	1.5 (1.1–1.9) *
Disagree	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Spoil too quickly						
Agree/Neither agree nor disagree	1.4 (1.0–1.9)	1.4 (1.0–2.2)		1.6 (1.2–2.1)	1.4 (0.9–2.0)	
Disagree	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
Too much preparation						
Agree/Neither agree nor disagree	1.7 (1.2–2.4)	1.8 (1.1–2.9)	1.7 (1.2–2.4) **	1.4 (1.0–1.8)	1.2 (0.8–1.9)	1.2 (0.9–1.7)
Disagree	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
No information on preparation						
Agree/Neither agree nor disagree	1.2 (0.9–1.7)	1.1 (0.7–1.8)		1.4 (1.0–1.9)	1.0 (0.6–1.7)	
Disagree	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
No information on storage						
Agree/Neither agree nor disagree	1.0 (0.8–1.4)	0.9 (0.6–1.4)		1.5 (1.1–1.9)	0.8 (0.5–1.3)	
Disagree	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
Good quality isn't available						
Agree/Neither agree nor disagree	1.0 (0.7–1.4)	0.9 (0.5–1.4)		1.7 (1.0–2.9)	1.1 (0.7–1.8)	
Disagree	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	
Concern about pesticides						
Agree/Neither agree nor disagree	0.7 (0.5–1.0)	0.5 (0.3–0.8)	0.6 (0.4–0.8) **	1.1 (0.8–1.4)	0.5 (0.3–0.8)	0.9 (0.6–1.2)
Disagree	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Concern about genetic modification						
Agree/Neither agree nor disagree	1.1 (0.8–1.4)	1.3 (0.8–2.2)		1.7 (1.2–2.4)	1.2 (0.8–2.0)	
Disagree	1.0 (Reference)	1.0 (Reference)		1.0 (Reference)	1.0 (Reference)	

^a Adjusted for all other variables in the model, as well as respondents' perceived: association between diet and cancer; relative risk of developing cancer; and concern about pesticides (to be described further in a future *Insight on Cancer* supplement). Refer to Methodology, Appendix 4 for a complete description of the regression procedures. A box around a group of ORs signifies that the approximate likelihood ratio test for the variable is statistically significant. Chi square: * p<.05; ** p<.01; *** p<.001

Table 3. Sex-specific prevalence of and adjusted* odds ratios for vegetable and fruit intake <5 servings/day, by month group

Months	Men				Women			
	Prevalence (%)		Crude OR (95% CI)	Adjusted OR (95% CI)	Prevalence (%)		Crude OR (95% CI)	Adjusted OR (95% CI)
	0-2 (n=125)	>2-<5 (n=470)			0-2 (n=87)	>2-<5 (n=519)		
Feb-Apr	10.0	32.0	1.0 (0.7-1.5)	1.0 (0.7-1.4)	3.6	34.3	1.0 (0.7-1.5)	0.9 (0.6-1.1)
May-Jul	11.4	36.7	1.3 (0.9-1.9)	1.1 (0.8-1.5)	5.5	30.1	0.9 (0.7-1.3)	0.8 (0.6-1.1)
Aug-Oct	10.1	37.1	1.2 (0.8-1.8)	1.2 (0.8-1.7)	4.5	27.5	0.8 (0.6-1.1)	0.7 (0.5-1.0)
Nov-Jan	8.8	33.4	1.0 (Reference)	1.0 (Reference)	6.7	30.4	1.0 (Reference)	1.0 (Reference)

OR = odds ratio; 95% CI = 95% confidence interval

* Adjusted for age group, region, education level and household income



APPENDIX 4: GLOSSARY OF TERMS, DATA SOURCES AND METHODS

Glossary of Terms

Attitude(s)

Determined by an individual's beliefs about the attributes of performing a health behaviour, weighted by their evaluation of those attributes.⁴⁰

BMI (Body mass index)

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.

Hot-deck imputation

Process by which a respondent's valid value for a specific variable is assigned to another respondent who does not have a valid value for this variable. The respondent with the valid value is called a "donor" and a person with a missing value is called a "recipient."

Household income adequacy

A four-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.⁷⁰ 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.

Household type

Based on the relationship of each respondent to other household members. Six household types were defined: 1 adult, 1 adult with child(ren) younger than 18, 2 adults, 2 adults with child(ren) younger than 18, and multiple adults.

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.⁴⁰

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 did not (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.

Potential years of life lost (PYLL)

A measure of the relative impact of various diseases resulting in premature death. It is calculated by summing, over all persons dying from a given disease, the years that these persons would have lived had they experienced normal life expectation.

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

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.⁷¹

Social learning theory

This theory suggests that most human behaviour is learned observationally from others. Social learning theory emphasizes the importance of observing and modelling the behaviours, attitudes, and emotional reactions of others. It explains human behaviour in terms of continuous reciprocal interaction between cognitive, behavioural, and environmental influences. The underlying component processes are attention, retention, motor reproduction, and motivation.⁷²

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).⁷³

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.¹⁸

Data Sources

Target Population

The target population for the ONCPS was Ontario adults aged 18–64 years. The survey sample was based on the eight 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 2002.⁷⁴ 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. The analysis was performed on the remaining 3,004 respondents.

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.^{75–78} 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 (see Appendix 2). 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 towards 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 SAS⁷⁹ 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.⁸⁰ 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 Scott⁸¹ 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.^{82,83}

Respondents were asked a series of questions related to the frequency and amount of vegetables and fruit they consume in a day, week, or month using a validated food frequency screener. Each person was asked first about the number of times they ate a selected source of vegetables or fruit (see Appendix 1 for questions), then using 1/2 a cup size as reference, how many portions they ate per day, week, or month. Servings were then calculated according to *Canada's Food Guide to Healthy Eating*¹⁸ (see Glossary for more detail). Servings per day were used to quantify vegetable and fruit consumption for all analyses. The data were right-skewed, so based on data from the calibration study, the data were capped at 20 servings per day and outliers were reassigned the maximum value. Five percent of men and 4.5% of women were reassigned a value of 20 for their total servings per day.

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 percents 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 low (<5 servings/day) vegetable and fruit consumption and the survey sociodemographic, health-related, and psychosocial variables. Stepwise backward-elimination⁸⁴ 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. All models were stratified by sex. Models were determined independently for each sex, then a final model that included only the significant 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, physical inactivity (<1 hour/week) was found to be a significant “predictor” of low vegetable and fruit intake, 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 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.⁸⁵

Other studies using various dietary intake measures have demonstrated a social desirability bias and under-reporting of caloric intake.^{86–89} One recent study compared 10 survey instruments measuring vegetable and fruit intake in adults. This review 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.⁹⁰ 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 with three repeat 24-hour recalls for dietary assessment. The screener measured both the daily frequency and portion size of vegetable and fruit consumption. The sample for the calibration study consisted of individuals who had participated in the ONCPS who volunteered to be contacted again about nutrition. A



total of 184 individuals participated in 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.⁹¹ 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.^{92,93} 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.⁹⁴⁻⁹⁶ 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.¹⁹ BMI does not account for weight variation due to differences in body build and body proportion in individuals, between sexes and across ethnic groups.^{19,97-99} Moreover, BMI is not appropriate for use with pregnant and lactating women, which 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.⁸⁵ 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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