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Cancer Risk Factors in Ontario

Healthy Weights, Healthy Eating and Active Living

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FOREWORD

Cancer Risk Factors in Ontario: Healthy Weights, Healthy Eating and Active Living is the fourth report in our Cancer Risk Factors in Ontario series. The first report in the series summarized the epidemiological evidence for a wide range of cancer risk factors, including body composition, diet and physical activity. The second and third reports provided information on the prevalence, distribution and related cancer risk of smoking and alcohol use, respectively, in the province. The report series supports one of Cancer Care Ontario's key strategic priorities to reduce chronic disease through prevention.

This report provides data related to three major risk modifiers associated with chronic diseases: healthy weights, healthy eating and active living. Maintaining a healthy weight, eating a diet rich in vegetables and fruit, and participating in regular physical activity, are associated with decreased risk for hypertension, stroke, cardiovascular disease, diabetes and certain cancers, and are protective against premature mortality. Obesity is a complex health issue with multiple causes and contributors. While eating a diet rich in vegetables and fruit, and participating in moderate to vigorous physical activity both contribute to maintaining a normal weight, each also confers independent health benefits for chronic disease prevention.

Cancer Risk Factors in Ontario: Healthy Weights, Healthy Eating and Active Living presents the prevalence and distribution of obesity and overweight, and some cancer-related aspects of diet and active living in Ontario; examines their geographic and socio-demographic variation; and estimates the cancer burden attributable to overweight and obesity in the province.

The data in this report highlight a considerable opportunity for cancer and chronic disease prevention efforts. The related domains of overweight and obesity, aspects of diet, physical inactivity and sedentary time are among the most directly modifiable chronic disease risk factors. Sustained change requires a collaborative commitment from individuals, communities and all levels of government. We hope the report will serve as a resource for public health and health professionals, policy-makers and planners.

Linda Rabeneck, MD MPH FRCPC
Vice President, Prevention and Cancer Control
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HIGHLIGHTS

HEALTHY WEIGHTS

- Approximately 2,640 new cancer cases diagnosed in Ontario (4.0% of all new cancers) were estimated as attributable to excess body weight (i.e., overweight and obesity) in 2010.
- Cancers of the endometrium, kidney and esophagus have the highest proportion of new cases attributable to overweight and obesity in Ontario, reflecting their relatively strong association with body fatness. Breast and colorectal cancers, because they are among the most common cancers in Ontario, account for the largest absolute numbers of attributable cases.
- Between 2003 and 2013, the proportion of overweight Ontario adults aged 18 years and older remained stable, while the proportion who were obese increased significantly. By 2013, 36.2% of adults were overweight and 24.7% were obese, representing roughly 6,150,900 people. The proportion of adults who were overweight or obese generally increased across older age groups.
- Significant variation in the proportion of overweight or obese adults exists across Ontario's 14 Local Health Integration Networks (LHINs), with particularly large variation for obesity. In 2012–2013, the prevalence of overweight and obesity combined ranged from 52.5% to 70.7%.
- The proportion of overweight or obese adults varies across levels of several socio-demographic factors. In 2012–2013, immigrants of both sexes were less likely to be overweight or obese than their Canadian-born counterparts. The relationship with other factors, including income and education, was less consistent between males and females.

HEALTHY EATING

- In 2013, 32.4% of Ontario adults aged 18 and older reported consuming vegetables (excluding potatoes) and fruit five or more times per day. The proportion was significantly higher among females (39.1%) than males (25.4%), and has shown no significant change since at least 2003.
- Significant socio-demographic disparities exist for consuming vegetables and fruit five or more times per day; in 2012–2013, prevalence was significantly higher among adults living in urban compared with rural areas, among adults who graduated from post-secondary education than adults with less education, and among the highest income group compared with all lower income groups.
- In 2007–2009, 25.1% of male and 13.7% of female Canadian adults consumed more red and processed meat than the cancer prevention recommendation of less than 500 g per week.
- In 2004, average total dietary fibre intake by Ontario males and females was well below age- and sex-specific levels recommended for general health; males younger than 50, in particular, consumed about half their recommended daily level.
- Ontario adults consumed more than the daily 2,300 mg of sodium recommended by Health Canada for general health. Consumption was higher among males and decreased across age groups; males younger than age 50 were most likely to exceed recommendations.

ACTIVE LIVING

- In 2013, 52.9% of Ontario adults aged 18 and older (55.6% males, 50.5% females) could be classified as at least moderately active during their leisure time and this had not changed significantly since 2003.
- In 2013, the proportion of adults classified as "moderately active" or "active" during leisure time and transportation (walking or cycling to and from work or school) ranged from just over 40% in females aged 65 and older to almost 70% in males aged 18–29.
- Significant regional variation in levels of physical activity existed across the province in 2012–2013, with prevalence of at least moderate activity ranging from 45.2% to 60.9% across Ontario's 14 LHINs.
- The prevalence of at least moderate activity during leisure time and transportation was significantly higher among post-secondary graduates than those with less than secondary school education, among the highest income group compared to other income groups, and among Canadian-born adults compared with immigrants.
- The prevalence of more than 14 hours of leisure screen time (television, computer and video games) per week was highest, at around 70%, in the 18–29 and 65 and older age groups.

IMPLICATIONS FOR CANCER CONTROL

- A substantial number of new cancers in Ontario can be attributed to excess body weight. With the proportion of overweight or obese Ontarians continuing to rise, the number of new cases will increase in the future unless effective prevention efforts are implemented.
- The rising prevalence of excess body weight and physical inactivity with advancing age suggests a critical need to intervene at earlier stages in life. Obese children are more likely to remain obese as adults; infants, children and youth are an important target population for prevention efforts related to achieving healthy weights, healthy eating and active living. Significant geographic and socio-demographic disparities in the prevalence of cancer risk modifiers in Ontario should be taken into account when developing related programs and policies.
- Addressing several gaps in the data available for monitoring and measuring overweight and obesity, healthy eating and physical activity in the Ontario population will be important for monitoring trends and evaluating outcomes of provincial and local interventions.
- Some initiatives are being implemented to address chronic disease prevention by reducing overweight and obesity, promoting healthy eating and increasing physical activity in the Ontario population. In particular, actions following from *Ontario's Action Plan for Health Care* and the Healthy Kids Panel aim to provide support for healthy, active communities.

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ABOUT THIS REPORT

- The focus of this report is three cancer risk modifiers: excess body weight (i.e., overweight and obesity), diet and physical activity. These factors are interrelated: excess body weight is caused by an energy imbalance whereby energy intake (diet) is greater than energy expenditure from physical activity and other processes. Physical activity and aspects of diet are, in addition, each independently related to the risk of cancer and other chronic diseases.
- The report presents the distribution of overweight and obesity, and of aspects of diet and physical activity, in Ontario. It features:
  - discussion of the complex relationship between excess body weight, diet and physical activity
  - estimates of the cancer burden attributable to excess body weight in Ontario
  - the prevalence of excess body weight, vegetable and fruit consumption, and physical activity during leisure time and transportation, according to Local Health Integration Networks and showing socio-demographic differences
  - implications for cancer control
- Data are presented for adults aged 18 years and older except for socio-demographic data, which include only those aged 30 and older.
- Data in this report are primarily from the Canadian Community Health Survey (CCHS), Ontario share files (full survey waves 2000/01, 2003 and 2005 and half-survey annual waves 2007–2013). The CCHS is a national cross-sectional survey conducted by Statistics Canada, with a large sample size considered representative of 98% of the Canadian population aged 12 years and older. The sampling frame excludes individuals who are homeless, residents of First Nations reserves and other Aboriginal settlements, institutional residents, full-time members of the Canadian Forces and residents of certain remote regions.
- This report is the fourth in Cancer Care Ontario's Cancer Risk Factors in Ontario series. The earlier reports summarized the epidemiologic evidence for a wide range of cancer risk factors, including body composition, diet and physical activity, and provided information on the prevalence, distribution and related cancer risk of smoking and of alcohol use in the population.
- Throughout this report, all indicators are examined in relation to the cancer prevention recommendations from the World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR). Canadian guidelines for healthy weights, healthy eating and active living pertain to a broad group of health effects and are more generally focused on maintaining overall good health and chronic disease prevention.
- Data tables for the figures in this report are available online, along with slides for presentation. Methods and indicator definitions are included in the appendices.

1. CONTEXT

1.1 WHY ARE HEALTHY WEIGHTS, HEALTHY EATING AND ACTIVE LIVING IMPORTANT FOR CANCER AND CHRONIC DISEASE PREVENTION AND CONTROL, AND WHAT ARE THE CURRENT RECOMMENDATIONS?

HEALTHY WEIGHTS

- Maintaining a healthy weight is an important factor for preventing the development of chronic diseases and avoiding premature death.[1] Excess body weight (i.e., overweight and obesity) increases the risk of type 2 diabetes, hypertension, cardiovascular disease, chronic kidney disease and musculoskeletal disorders (e.g., osteoarthritis, chronic back pain).[1] It is also an established cause of colorectal and post-menopausal breast cancer—two of the most common cancers diagnosed in Ontario—as well as several other types of cancer (Table 1).[2,3]
- The risk of most associated cancer types generally rises with increasing body fatness (as measured by the weight-based body mass index [BMI]), even within the range considered healthy or "normal." The risk of esophageal adenocarcinoma and endometrial cancer, for example, increases by 50% to 55% for every 5 kg/m^2 increase in BMI.[2] For a comparable increase in BMI, risk increases by roughly 30% for kidney cancer and 10% to 15% for colorectal, post-menopausal breast and pancreatic cancer.[2,4,5]
- In addition to overall body weight, cancer risk can be influenced by unhealthy patterns of weight gain and abdominal obesity (Table 1). Based on this evidence, the World Cancer Research Fund (WCRF) and the American Institute for Cancer Research's (AICR's) recommendations for cancer prevention are to "be as lean as possible within the normal range of body weight" and to "avoid increases in waist circumference throughout adulthood" (Table 1).[2]

HEALTHY EATING

- Eating a healthy diet may protect against chronic disease, including cancer. Consumption of non-starchy vegetables and fruit may reduce the risk of cardiovascular disease, while dietary fibre may additionally protect against type 2 diabetes.[1,2] Conversely, unhealthy eating habits may increase chronic disease risk. Consumption of energy-dense foods that are high in saturated and trans fats and/or refined sugars and carbohydrates can contribute to an increased risk of chronic disease through weight gain.[2] High consumption of red and processed meat may increase the risk of type 2 diabetes and cardiovascular disease,[6,7] while excess consumption of sodium results in higher blood pressure, which increases the risk of heart disease and stroke.[8]
- Several foods are risk modifiers for certain cancers (Table 1). In 2007, the WCRF and AICR developed several dietary recommendations at the individual level to reduce cancer risk (Table 1).[2]

- Individual diets are multidimensional in nature with combinations of energy contributing nutrients (e.g., proteins, fats, carbohydrates, micronutrients—such as vitamins and minerals—and other bioactive components from whole foods, processed foods and supplements).[3] Vegetables and fruit, for example, are complex and contain vitamins, minerals, other nutrients and bioactive compounds, such as phytochemicals.
- This report takes a food-based approach, which is the most useful from a prevention standpoint because people primarily consume whole foods rather than individual nutrients.[3] For example, vegetables and fruit may lower the risk of several cancers and contain a number of nutrients including vitamins and antioxidants.[2] While evidence exists to support the intake of some micronutrients (e.g., calcium, selenium) as risk modifiers for certain cancers, it is difficult to determine whether consuming any given constituent of a particular food is causally associated with a decreased or increased cancer risk, or whether it is simply a marker for some other constituent of the food or of the food as a whole.[3]

ACTIVE LIVING

- Regular moderate to vigorous physical activity has been shown to decrease risk for certain cancers (Table 1) and other chronic diseases, such as hypertension, diabetes, stroke and cardiovascular disease, and to reduce premature mortality.[9]
- Partaking in physical activity of all types (occupational, household, active transportation and recreational) has been shown to reduce cancer risk, with higher levels of physical activity associated with decreasing cancer risk. The evidence suggests that the relationship between physical activity and cancer is continuous, with no known minimum or maximum threshold associated with positive or adverse impacts on cancer risk.[2] As minimum guidance, however, WCRF and AICR cancer prevention recommendations for adults aged 18–64 are to "be moderately active, equivalent to brisk walking for at least 30 minutes every day. As fitness improves, aim for 60 minutes or more of moderate, or for 30 minutes or more of vigorous, physical activity every day."[2] The WCRF and AICR recommend limiting sedentary habits, such as watching television.
- There appears to be a positive association between sedentary behaviour and risk of colorectal, endometrial, ovarian and prostate cancers, and possibly lung cancer.[10-12]

- Sedentary behaviour, defined as prolonged periods of physical inactivity and/or low levels of physical activity, occurs in multiple domains of daily living, including recreation or leisure time (television, video games, computer use, reading), occupation (sitting at a desk or a counter), transportation (sitting in a bus, car or train) and as part of social activities (playing cards, eating meals).[10] Emerging evidence suggests a potential risk of cancer associated with sedentary behaviours independent of physical inactivity, of which screen time (in particular television viewing) has been most commonly studied.[10] Therefore, an individual may be physically active—during leisure time or at work, for instance—and still be sedentary for long periods of each day or evening. Limiting time spent being sedentary may play an important role in preventing cancer, even among those achieving the physical activity recommendations.[10]

TABLE 1.

Summary of cancer risk modifiers and recommendations for healthy weights, diet and physical activity related to cancer from the World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR)

RISK MODIFIER	ASSOCIATED CANCERS*	RECOMMENDATION FOR INDIVIDUALS
Body fatness	Esophagus (adenocarcinoma), colon and rectum, pancreas, breast (post-menopausal), endometrium, kidney, *gallbladder, ovary, breast (pre-menopausal)†, prostate (advanced)*	Be as lean as possible within the normal range of body weight (for Canada, within the World Health Organization body mass index [BMI] range of 18.50–24.99 kg/m^2). Avoid increases in waist circumference throughout adulthood. Consume energy-dense foods sparingly. Avoid sugary drinks and consume fast foods sparingly, if at all.
Plant foods‡	Colon and rectum, *oral cavity and pharynx, larynx, esophagus, stomach, lung§*	Eat at least five portions/servings (at least 400 g or 14 oz) of a variety of non-starchy vegetables and of fruit every day. Eat relatively unprocessed cereals (grains) and/or pulses (legumes) with every meal.
Red and processed meat	Colon and rectum	If red meat is consumed, limit consumption to less than 500 g (18 oz) a week, very little if any to be processed.
Salt and salted/ salty foods	*Stomach*	Avoid salt-preserved, salted or salty foods; preserve foods without using salt. Limit consumption of processed foods with added salt to ensure an intake of less than 6,000 mg of salt (2,400 mg sodium) a day.
Physical activity	Colon, *breast (post-menopausal), endometrium*	Be moderately active, equivalent to brisk walking for at least 30 minutes every day. As fitness improves, aim for 60 minutes or more of moderate, or for 30 minutes or more of vigorous, physical activity every day. Limit sedentary habits, such as watching television.

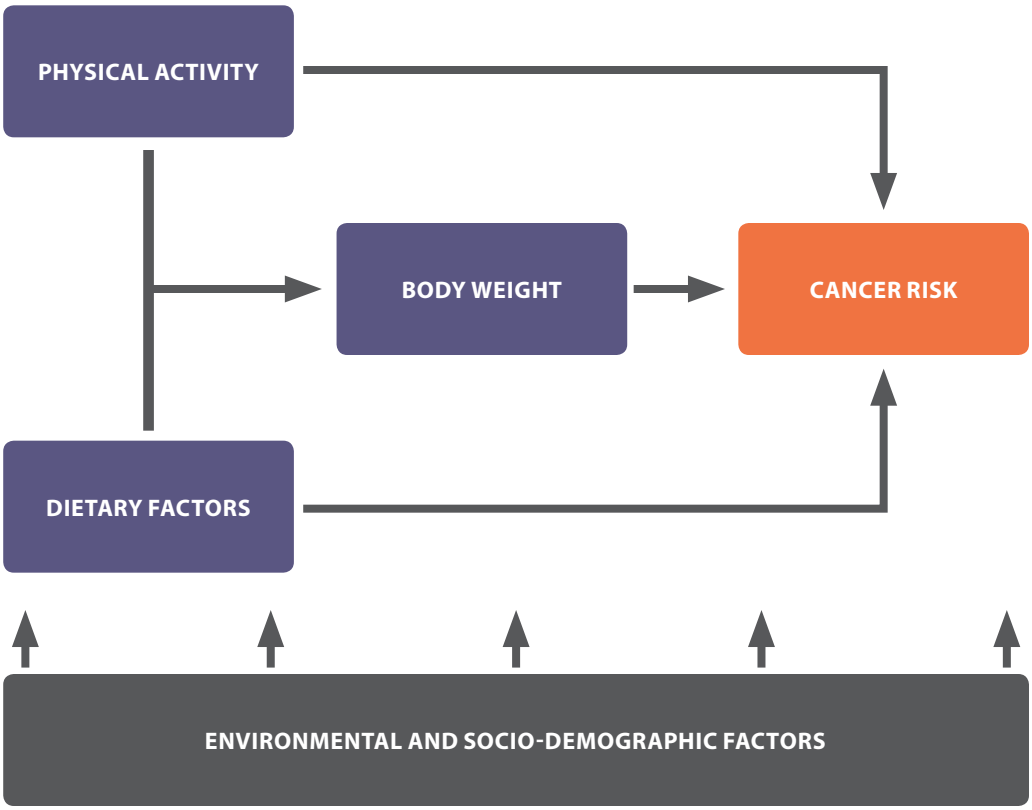
Sources: WCRF/AICR, 2007; WCRF/AICR, 2010; WCRF/AICR, 2011; WCRF/AICR, 2012; WCRF/AICR, 2013; WCRF/AICR, 2014

Notes: *These are cancers with convincing (standard font) or probable (italicized) evidence supporting an association.
† A protective association is seen between body fatness and pre-menopausal breast cancer.
‡ Dietary fibre has been established as a protective factor for cancers of the colon and rectum.
§Probable evidence supports only fruit (not vegetables) as protective for lung cancer.

1.2 WHAT ARE THE ROLES OF DIET AND PHYSICAL ACTIVITY IN ADULT WEIGHT GAIN AND EXCESS BODY WEIGHT?

- At a basic physiologic level, weight gain and excess body weight (overweight and obesity) are caused by an energy imbalance whereby energy intake exceeds energy expenditure. At a broader level, however, energy imbalance results from a complex web of socio-economic, environmental and individual factors, including but not limited to the cost and availability of and access to healthy foods and beverages, competing life concerns, available options for physical activity and active transportation, and personal biological constitution and mental health status.[13]
- In addition to acting as independent risk modifiers for cancer, physical activity and dietary factors are associated with weight gain, overweight and obesity through their influence on energy balance (Figure 1).
    - There is strong epidemiologic evidence that physical activity protects against weight gain, overweight and obesity.[2] Conversely, there is strong evidence that sedentary living causes and probable evidence that television viewing may cause weight gain, overweight and obesity.[2]
    - There is probable evidence that low energy-dense foods (foods with a low caloric content relative to serving weight), such as non-starchy vegetables, whole grain cereals and cereal products, and foods containing dietary fibre protect against weight gain, overweight and obesity. Energy-dense foods, such as animal fats, sugary beverages and fast food, in contrast, appear to increase risk.[2]
- Physical inactivity and any food-related factors that increase the risk of weight gain, overweight and obesity can therefore be considered indirect risk factors for cancers associated with excess body fatness.[2]
- For more information on the biological mechanism of these indicators, please refer to the 2013 report, *Cancer Risk Factors in Ontario: Evidence Summary*.[3]

FIGURE 1.
Relationship between body weight, diet and physical activity as cancer risk modifiers



2. HEALTHY WEIGHTS

Maintaining a healthy weight is important for preventing the development of several cancers. Excess body weight (i.e., overweight and obesity) increases the risk of cancers of the esophagus (adenocarcinoma), colon and rectum, pancreas, breast (post-menopausal), endometrium and kidney.[2,4,5,11,14] Evidence suggests that it may also cause cancer of the gallbladder, ovary and prostate (advanced), but may protect against pre-menopausal breast cancer.[2,4,11,14-16] Independent of overweight and obesity, abdominal fatness is an important risk factor for colorectal cancer and cancer of the pancreas and endometrium, and is associated with cancer of the breast (post-menopausal).[2,4,5,11,14] This section presents data, by sex, on time trends and on prevalence by age group, socio-demographic factors and Local Health Integration Network (LHIN) for overweight and obesity in Ontario. Overweight and obesity are measured in this report in two ways, using body mass index (BMI) and waist circumference. Ontario data are available for BMI from the Canadian Community Health Survey (CCHS), but not for waist circumference, for which national data are reported instead.

BOX 1.
Measuring body weight

- Body weight depends on a number of factors, including bone and organ mass, body fatness and lean muscle mass. Body fatness is the most variable determinant of weight and, together with body fat distribution (particularly abdominal fat distribution), is an important factor for maintaining health and well-being.
- **Body mass index (BMI):** BMI, a measure of weight adjusted for height, calculated as weight in kilograms divided by height in metres squared (kg/m^2), is the most common measure used to assess overall body fatness. Although the accuracy of BMI in measuring body fatness at an individual level varies depending on musculature, bone mass and ethnicity, it has been shown to be a valid measure of body fatness and the associated health risks at a population level.[17] Adult body fatness is categorized into four broad groupings according to the following international cut-offs for adult BMI:[17,18]

CLASSIFICATION	BMI (kg/m^2)
Underweight	<18.50
Normal weight	18.50–24.99
Overweight	25.00–29.99
Obese	≥30.00

- **Waist circumference:** Waist circumference is the predominant measure used to assess excess abdominal fat (subcutaneous and intra-abdominal). Compared with the waist to hip ratio (another measure of abdominal fatness), it has been shown to be a more practical single measure of abdominal fatness and the associated health risks.[19] According to the World Health Organization, the cut-offs for classifying waist circumferences associated with increased risk of health problems are 102 cm or higher for men and 88 cm or higher for women.[17,18] Similar to BMI, however, these cut-points are population-specific and differ for certain ethnic groups (e.g., South Asian populations).[17]

2.1 CANCERS ATTRIBUTABLE TO EXCESS BODY WEIGHT

- In 2010, an estimated 2,640 new cases of cancer diagnosed in Ontario (equivalent to about 4.0% of all new cancers and 11.9% of all cancer types associated with excess body weight) could be attributed to excess body weight (overweight and obesity) (Table 2).
- A larger number of cases in females (approximately 1,810) were attributable to overweight and obesity than in males (approximately 830). This reflects the fact that two of the six cancer types related to excess body weight are specific to females (endometrium and breast cancer) and of these two, breast cancer is the most common cancer diagnosed in females. The overall proportion of these six cancers that could be attributed to overweight and obesity, however, was similar in males and females (Table 2).
- Because of their relatively high risk associated with excess body weight, cancers of the endometrium, kidney and esophagus have the highest proportion of new cases attributable to overweight and obesity in Ontario (Figure 2b and Table 2). In 2010, overweight and obesity accounted for an estimated 33.0% of endometrial cancers in females, as well as 22.8% of kidney cancers and 20.1% of esophageal cancers in males and females combined.
- For most cancer types, the proportion of cases attributable to excess body weight was only slightly higher in males compared to females, reflecting a slightly higher prevalence of overweight and obesity in males (Table 2). The exception is cancer of the esophagus, for which nearly twice as many cases in males are attributable to overweight and obesity compared to females. The higher proportion of attributable cases of esophageal cancer in males is due to a higher proportion of cancers with an adenocarcinoma morphology—the only subtype for which excess body fatness is a risk factor—in males (63%) compared to females (32%).
- A relatively smaller proportion of new cases of female breast (8.0%) and colorectal (8.2%) cancer diagnosed in Ontario were attributable to excess body weight. As two of the most common cancers diagnosed in the province, however, these cancers accounted for the largest absolute number of cases attributable to this risk factor in 2010 (714 for breast and 625 for colorectal, Figure 2a and Table 2).
- The proportion of Ontario cancer cases attributable to excess body weight estimated in this report is similar to estimates, based on similar methods, for all of Canada[20] and for the United Kingdom.[21] These estimates may, however, be conservative because only cancer types with the highest level of evidence to support a causal association with overweight and obesity, as determined by the World Cancer Research Fund (WCRF), the American Institute for Cancer Research (AICR) and the International Agency for Research on Cancer (IARC), were considered; cancer of the gallbladder, ovary and prostate (advanced) were excluded because the WCRF/AICR has classified the evidence for an association between these cancers and excess weight as "probable."[2,15,16] Several other cancers (e.g., cancer of the thyroid, leukemia, malignant melanoma [men only], non-Hodgkin lymphoma, multiple myeloma) have been identified in other studies associated with excess body weight.[22] These cancers were not used in the estimates presented here because of the still suggestive nature of the evidence.

- Estimating the burden of cancer that can be attributed to various modifiable risk factors is important for assessing the potential impact of prevention efforts and interventions on a population. Of the three factors examined in this report (healthy weights, healthy eating and active living), maintaining a healthy weight is causally associated with the broadest range of cancer types and has the most robust population-based data available. For this reason, only the proportion of new cancers in Ontario that can be attributed to overweight and obesity is presented in this report. Although physical inactivity and unhealthy eating likely contribute to at least a portion of the cancers estimated here as attributable to excess body weight, because of the close relationship between healthy weights, healthy eating and active living, the cancer burden due to all three factors is likely much larger.

TABLE 2.
Number and proportion of new cancer cases in Ontario adults attributable to excess body weight (overweight and obesity), by sex and cancer type, 2010

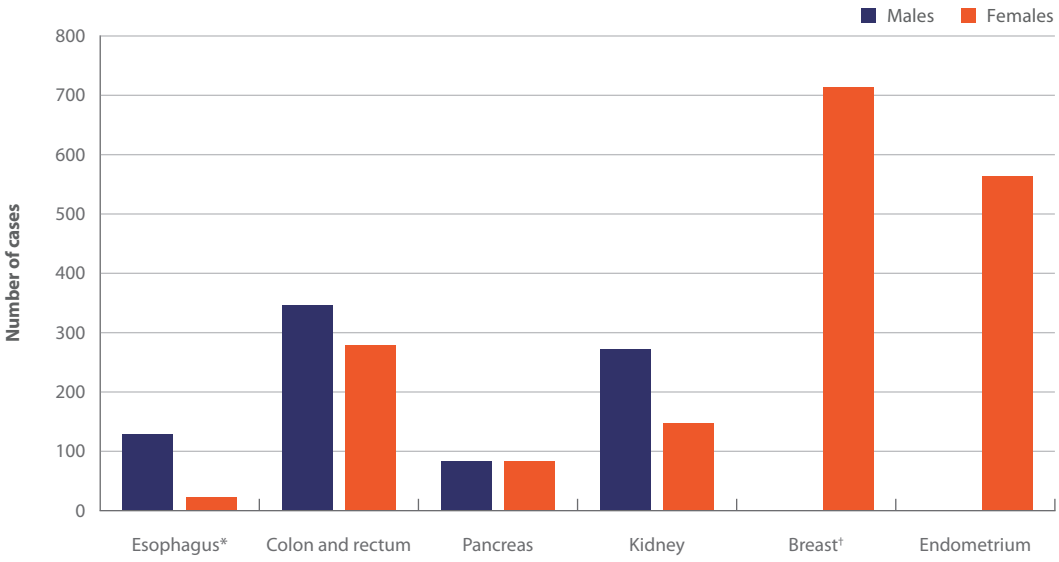
	Both sexes		Males		Females	
Cancer type	Total cases	Attributable cases (%)	Total cases	Attributable cases (%)	Total cases	Attributable cases (%)
Esophagus*	758	152 (20.1)	557	129 (23.1)	201	23 (11.2)
Colon and rectum	7,585	625 (8.2)	4,012	346 (8.6)	3,573	279 (7.8)
Pancreas	1,484	167 (11.3)	712	84 (11.8)	772	83 (10.8)
Kidney	1,841	420 (22.8)	1,152	272 (23.6)	689	148 (21.5)
Breast†	8,889	714 (8.0)			8,889	714 (8.0)
Endometrium	1,705	563 (33.0)			1,705	563 (33.0)
All cancers related to overweight/ obesity	**22,262**	**2,641 (11.9)**	**6,433**	**831 (12.9)**	**15,829**	**1,810 (11.4)**

Source: Ontario Cancer Registry, 2013 (Cancer Care Ontario); Canadian Community Health Survey, 2000/01 (Statistics Canada)
Notes: *Attributable cases only include adenocarcinomas, but percentages are based on all esophageal cancers.
†Attributable cases only include cancers in post-menopausal women (aged ≥50), but percentages are based on all breast cancers.

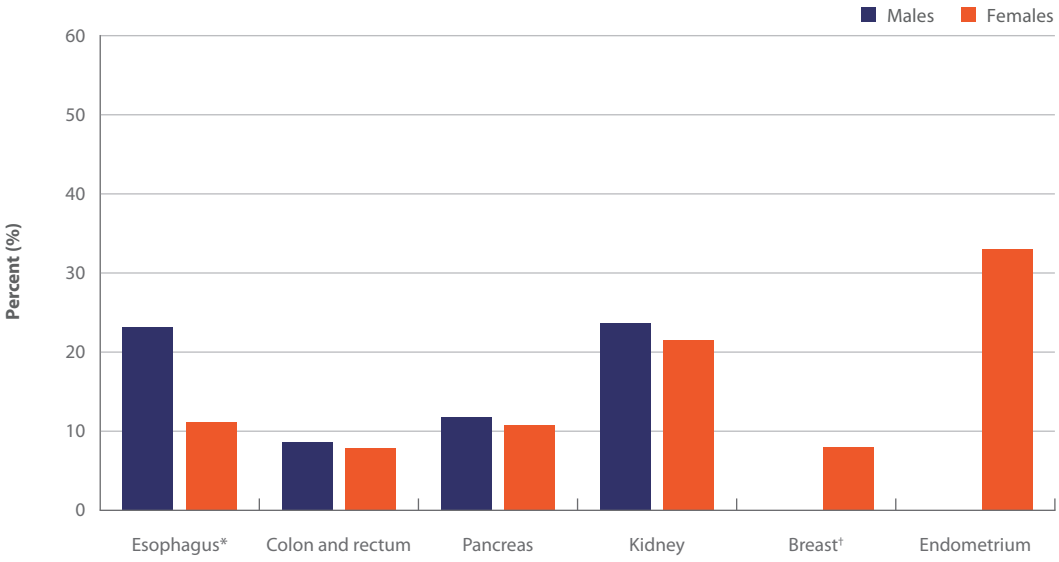
FIGURE 2.

Number and proportion of new cancer cases in Ontario adults attributable to excess body weight (overweight and obesity), by sex and cancer type, 2010

a. Number of new cancer cases



b. Proportion of new cancer cases



Source: Ontario Cancer Registry, 2013 (Cancer Care Ontario); Canadian Community Health Survey, 2000/01 (Statistics Canada)

Notes: *Attributable cases only include adenocarcinomas, but percentages are based on all esophageal cancers.
†Attributable cases only include cancers in post-menopausal women (aged ≥50), but percentages are based on all breast cancers.

BOX 2.

Self-reported vs. measured estimates of body mass index (BMI)

- BMI estimates calculated from Canadian Community Health Survey (CCHS) data are based on respondents' self-reported height and weight. Self-reported data are routinely used for population health surveillance because they are less expensive and time-consuming to collect than actual body measurements. However, several international and Canadian studies have shown that survey respondents tend to overestimate height and underestimate weight, making the resulting prevalence estimates for overweight and obese systematically underestimated.[23]
- Statistics Canada has developed sex-specific correction equations for adjusting self-reported measures of BMI to provide more accurate estimates of overweight and obesity prevalence in the population.[23] As shown in the figure below, when BMI measures based on self-reported CCHS data are adjusted using these correction equations, the prevalence of overweight and obesity combined increases in males from 61.9% to 68.3% and in females from 44.5% to 53.4% for 2013. Obesity alone increases in males from 18.4% to 25.4% and in females from 17.3% to 24.0% for 2013.
- All estimates of overweight and obesity presented in this report have been adjusted to account for this underestimation of BMI based on self-reported height and weight. The use of this correction should be taken into consideration if comparing results from this report with other sources that present BMI estimates based on CCHS self-reported data.

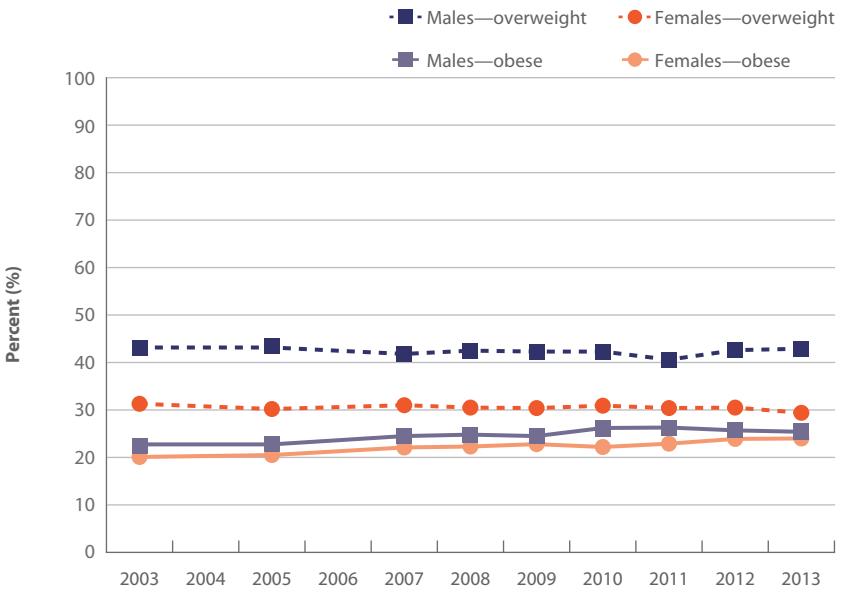
Percentage of Ontario adults (aged 18+) who were overweight or obese, self-reported data vs. adjusted data, by sex, 2013

Source: Canadian Community Health Survey, 2013 (Statistics Canada)
Notes: Estimates are age-standardized to the 2006 Canadian population.
I represent 95% confidence intervals for overweight and obese combined.

2.2 BODY MASS INDEX

In 2013, 37.2% of Ontario adults (aged 18+) were classified as having a normal weight, 36.2% were overweight and 24.7% were obese, according to body mass index (BMI) values, adjusted to account for misreporting of height and weight in the Canadian Community Health Survey (CCHS). This means that in 2013, roughly 6,150,892 Ontario adults (approximately 3,432,733 males and 2,718,159 females) were overweight or obese.

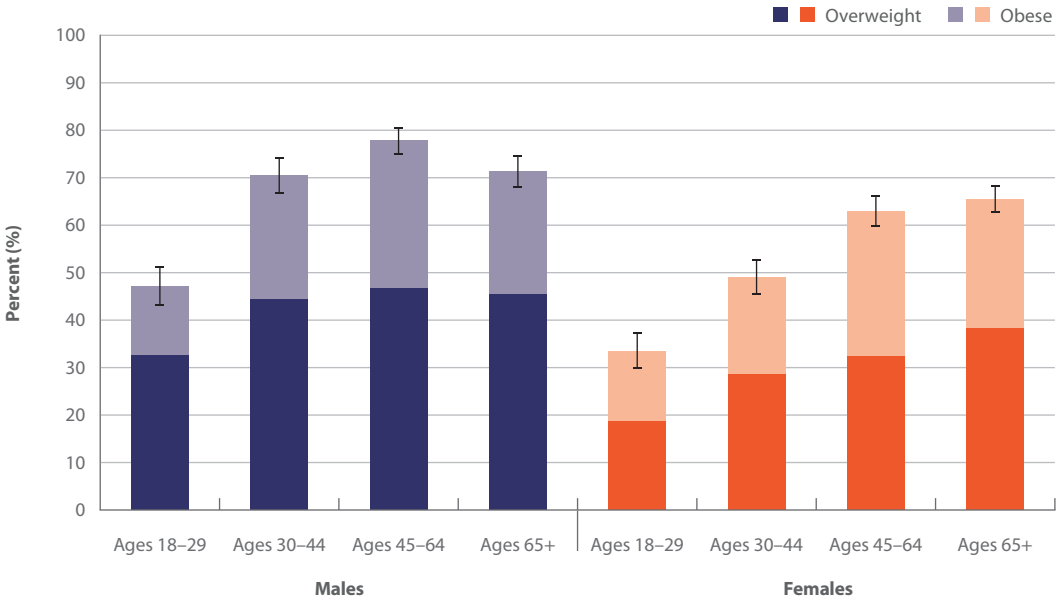
FIGURE 3.
Percentage of Ontario adults (aged 18+) who were overweight or obese, by sex, 2003–2013



Source: Canadian Community Health Survey, 2003, 2005, 2007–2013 (Statistics Canada)
Notes: Estimates are age-standardized to the 2006 Canadian population.
Overweight and obesity are defined by BMI values, corrected to account for misreporting of height and weight by CCHS survey respondents.

- Between 2003 and 2013, the proportion of Ontario adults aged 18 and older who were overweight was relatively stable, remaining around 42.0%–43.0% in males and 30.0%–31.0% in females (Figure 3). The proportion of adults who were obese, however, increased significantly in both males and females, rising from 22.5% to 25.4% in males and from 20.1% to 24.0% in females.
- The prevalence of overweight is significantly higher in males than in females (absolute difference of roughly 14 percentage points) and has been since at least 2003. A much smaller difference exists between males and females for obesity, which has appeared slightly higher in males, although not significantly so, for every year between 2003 and 2013.
- Rising obesity rates have been observed since at least the 1980s in several jurisdictions in Canada, the United States and Western Europe.[24,25,26] The increase in obesity seen in Ontario between 2003 and 2013 indicates that this trend is ongoing and continuing increases are projected for the coming years.[27] This suggests that the proportion of cancers attributable to overweight and obesity in Ontario will continue to rise for several years due to the large number of Ontario adults who are overweight or obese currently and the latency period prior to cancer development.

FIGURE 4.
Percentage of Ontario adults (aged 18+) who were overweight or obese, by sex and age group, 2013

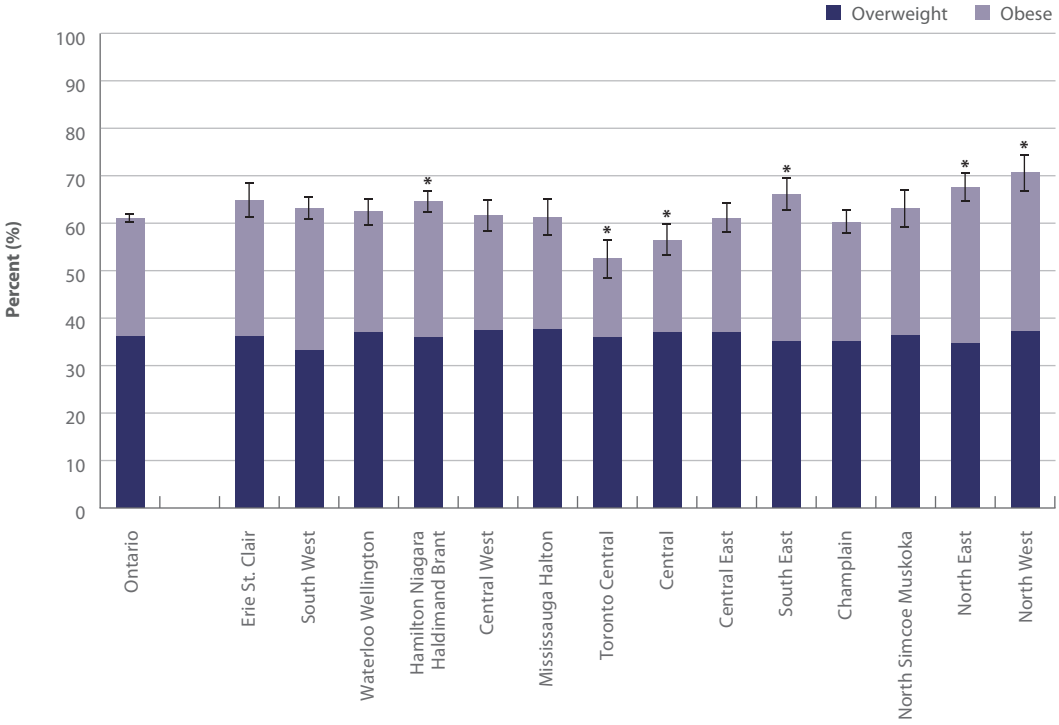


Source: Canadian Community Health Survey, 2013 (Statistics Canada)
Notes: I represent 95% confidence intervals for overweight and obese combined.
Overweight and obesity are defined by BMI values, corrected to account for misreporting of height and weight by CCHS survey respondents.

- The proportion of both male and female adults who are overweight or obese is generally higher in each successive age group (Figure 4). In 2013, the prevalence of overweight and obesity combined in males and females was lowest among those aged 18–29 (47.2% in males, 33.5% in females) and increased across age groups, peaking in males aged 45–64 (77.8%) and in females aged 65 and older (65.5%).
- When overweight and obesity were examined separately, the prevalence of overweight increased between the 18–29 (32.6% males, 18.6% females) and 30–44 (44.4% males, 28.5% females) age groups for both males and females but continued to rise across successive age groups for females only. For both males and females, obesity prevalence increased across successive age groups through to age 45–64, before appearing to stabilize or decline slightly in the 65+ age group.
- Given that it is difficult to reverse weight gain due to physiologic changes that occur as individuals age[28,29] and that weight gain during adulthood is itself associated with an increased risk of certain cancers, preventing weight gain in Ontarians of all ages, including younger adults, is important to control overweight and obesity in the population and reduce their associated health consequences.

FIGURE 5.

Percentage of Ontario adults (aged 18+) who were overweight or obese, by Local Health Integration Network, 2012–2013 combined



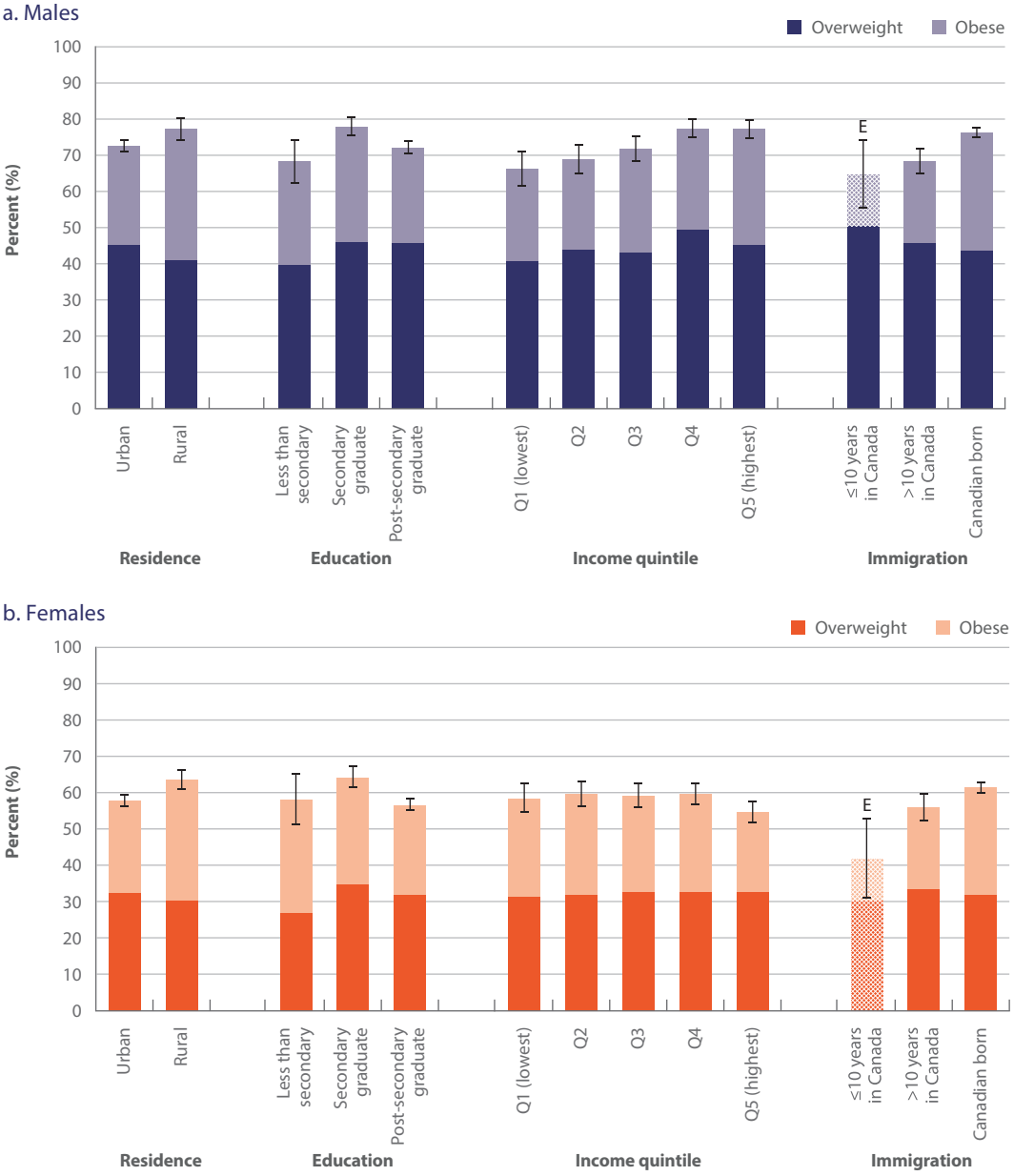
Source: Canadian Community Health Survey, 2012–2013 (Statistics Canada)

Notes: Estimates are age-standardized to the 2006 Canadian population.
I represent 95% confidence intervals for overweight and obese combined.
Data from CCHS cycles 2012 and 2013 combined to increase sample size for analyses by Local Health Integration Network.
*Estimate is significantly higher or lower than the Ontario estimate.
Overweight and obesity are defined by BMI values, corrected to account for misreporting of height and weight by CCHS survey respondents.

- The prevalence of overweight and obesity varies significantly across Ontario's 14 Local Health Integration Networks (LHINs). In 2012–2013, the age-adjusted prevalence of overweight and obesity combined ranged from a low of 52.5% in the Toronto Central LHIN to a high of 70.7% in the North West LHIN. Compared to the estimate for Ontario overall (61.1%), the prevalence of overweight and obesity was significantly lower in the Toronto Central and Central LHINs, and significantly higher in the Hamilton Niagara Haldimand Brant, South East, North East and North West LHINs (Figure 5).
- When overweight and obesity were examined separately, a similar pattern and degree of variation in the prevalence of obesity was observed across LHINs, while the prevalence of overweight varied very little.

FIGURE 6.

Percentage of Ontario adults (aged 30+) who were overweight or obese, by sex and selected socio-demographic factors, 2012–2013 combined



Source: Canadian Community Health Survey, 2012–2013 (Statistics Canada)

Notes: Estimates are age-standardized to the 2006 Canadian population.

I represent 95% confidence intervals for overweight and obese combined.

Data from CCHS cycles 2012 and 2013 combined to increase sample size for analyses by socio-demographic factors.

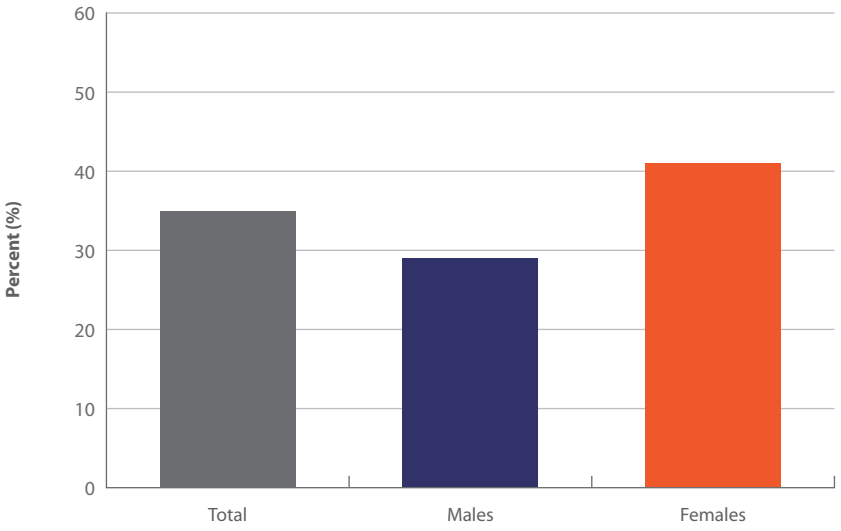
E - Interpret cross-hatched estimates with caution due to high sampling variability.

Overweight and obesity are defined by BMI values, corrected to account for misreporting of height and weight by CCHS survey respondents.

- In 2012–2013, the prevalence of overweight and obesity varied significantly across levels of several socio-demographic factors (Figure 6). Socio-demographic characteristics were analyzed for adults aged 30 and older to restrict the sample to those who have likely completed their education and reached their adult socio-demographic status.
- **Urban/rural:** The proportion of males and females who were overweight or obese was significantly higher among those living in rural areas compared to urban areas. This difference was due to a higher prevalence of obesity, as the prevalence of overweight was similar in rural and urban areas. After adjusting for all other socio-demographic characteristics, however, the higher prevalence of overweight and obesity combined in rural compared with urban areas, remained significant for females only, while higher rates of obesity in rural areas remained significant for males and females (supplementary Table 7).
- **Education:** No clear pattern was observed in the relationship between education, and overweight and obesity. For males, the proportion of adults who were overweight or obese and who were obese was significantly higher among secondary school graduates than post-secondary graduates; this remained significant after adjusting for all other socio-demographic factors. For females, overweight and obesity prevalence was significantly higher among secondary school graduates compared to post-secondary school graduates, while obesity prevalence appeared to decrease with increasing levels of education. These associations remained significant after adjusting for all other socio-demographic factors.
- **Income quintile:** For both males and females, the prevalence of obesity, and of overweight and obesity combined, varied significantly across income quintiles. The direction of the gradient, however, differed by sex. For males, the prevalence of overweight and obesity generally increased with increasing income. This difference was apparent for both overweight and obesity, and remained significant after adjusting for other socio-demographic factors. In contrast, for females, the prevalence of obesity, and of overweight and obesity combined was similar for the first four income quintiles, but was significantly lower in the highest income quintile, even after adjusting for other socio-demographic factors.
- **Immigration:** For males and females, even after adjusting for other socio-demographic factors, the prevalence of obesity was significantly lower among immigrants to Canada compared with Canadian-born adults. The prevalence of overweight, however, was similar between immigrants and Canadian-born adults.

2.3 WAIST CIRCUMFERENCE

FIGURE 7.
Percentage of Canadian adults (aged 18–79) with a waist circumference associated with increased risk of health problems, by sex, 2009–2011 combined



Source: Canadian Health Measures Survey, 2009–2011 (Statistics Canada), adapted from Statistics Canada, 2012[30]
Notes: Waist circumference ≥102 cm for males and ≥88 cm for females based on the World Health Organization cut-offs and the Canadian Guidelines for Body Weight Classification in Adults.

- According to the World Health Organization and Health Canada, a waist circumference of 102 cm or higher for men and 88 cm or higher for women—roughly equivalent to a BMI of 30—is associated with an increased risk of developing health problems such as type 2 diabetes, coronary heart disease and hypertension.[17,18]
- Based on data from Cycle 2 of the Canadian Health Measures Survey, in the 2009–2011 period, Canadian men aged 18–79 had an average waist circumference of 95.1 cm while the average for women in this age range was 87.3 cm.[30] In contrast to the prevalence of obesity based on BMI (24.0% for women, 25.4% for men), a substantially higher proportion of Canadian women (41%) than men (29%) had a waist circumference associated with an increased risk of developing health problems (Figure 7).[30]
- The higher prevalence of Canadians, particularly females, with a waist circumference associated with increased risk of health problems, compared to the prevalence of obesity, suggests that obesity is not the only factor that should be considered when assessing the cancer risk in the population related to excess body weight; individuals may have both a BMI in the normal range *and* a waist circumference associated with increased risk of developing health problems, including cancer.

3. HEALTHY EATING

Several foods and dietary components, including non-starchy vegetables and fruit, red and processed meat, dietary fibre and salt, are risk modifiers for certain cancers. Population-level data on consumption of red and processed meat, dietary fibre and salt are not routinely available, which is why older data for these risk modifiers at the provincial and national levels are presented in this report. This section presents data, by sex, on time trends and on prevalence by age group, socio-demographic factors and Local Health Integration Network (LHIN) for self-reported vegetable and fruit, red meat, fibre and sodium consumption in Ontario.

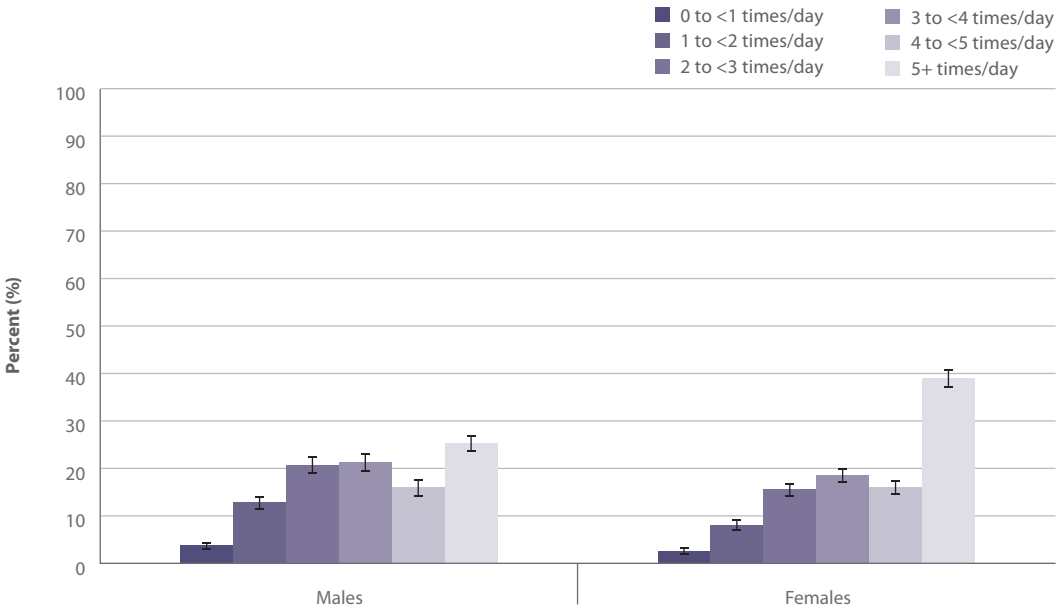
3.1 VEGETABLE AND FRUIT CONSUMPTION

BOX 3.
Measuring vegetable and fruit consumption

- Consuming non-starchy vegetables and fruit may protect against cancers of the oral cavity and pharynx, larynx, esophagus and stomach, and consuming fruit may protect against lung cancer.[2,31] The World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) recommendation for cancer prevention is to eat at least five portions or servings of a variety of non-starchy vegetables and fruit every day.[2]
- Consumption of vegetables and fruit is a good marker of overall diet quality[32] and is the one aspect of diet routinely captured by the Canadian Community Health Survey (CCHS).
- Vegetable and fruit consumption data shown throughout this report are expressed in terms of times per day because the CCHS uses this frequency measure. Validation of a similar food frequency questionnaire in three Ontario regions found vegetable and fruit frequency per day did not differ significantly from 24-hour recall of servings per day.[33]
- While fruit juice consumption was included in this calculation, respondents who reported consuming fruit juice more than once daily were considered as having consumed it only once. This decision is based on the 2007 WCRF/AICR report, which states that because the nutritional properties of fruit juice are different from those of whole fruit (e.g., fruit juices contain added sugars and minimal amounts of dietary fibre), fruit juice should only count as one portion per day, regardless of the amount consumed.[2]

FIGURE 8.

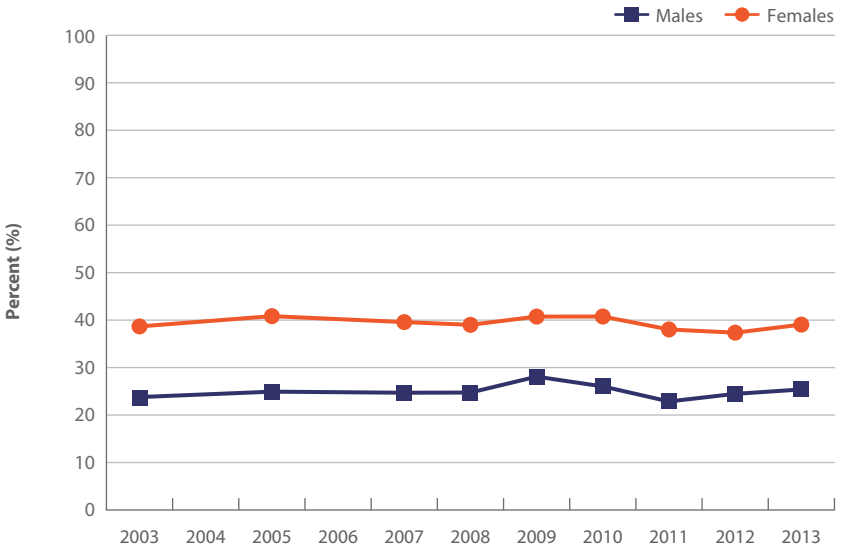
Daily vegetable and fruit consumption among Ontario adults (aged 18+), by sex, 2013



Source: Canadian Community Health Survey, 2013 (Statistics Canada)
Notes: Estimates are age-standardized to the 2006 Canadian population.
I represent 95% confidence intervals.
Vegetables exclude potatoes and fruit juice is only counted up to a maximum of one time per day.

- While most Ontario adults consume some vegetables and fruit on a daily basis, the majority eat less than the recommended amount. Males, in particular, do not consume enough vegetables and fruit; they are less likely than females to eat vegetables and fruit five or more times per day and more likely to eat vegetables and fruit less than four times per day.
- In 2013, 32.4% of Ontario adults aged 18 years and older reported consuming vegetables and fruit five or more times per day. The proportion was significantly higher among females (39.1%) than males (25.4%) (Figure 8). For males and females, the proportion was not significantly different among different age groups (see supplementary Table 10).
- A similar proportion of adult males (16.0%) and females (16.1%) reported consuming vegetables and fruit between four and five times per day.
- A significantly higher proportion of adult males (58.6%) than females (44.8%) reported consuming vegetables and fruit less than four times per day.

FIGURE 9.
Percentage of Ontario adults (aged 18+) eating vegetables and fruit five or more times per day, by sex, 2003–2013

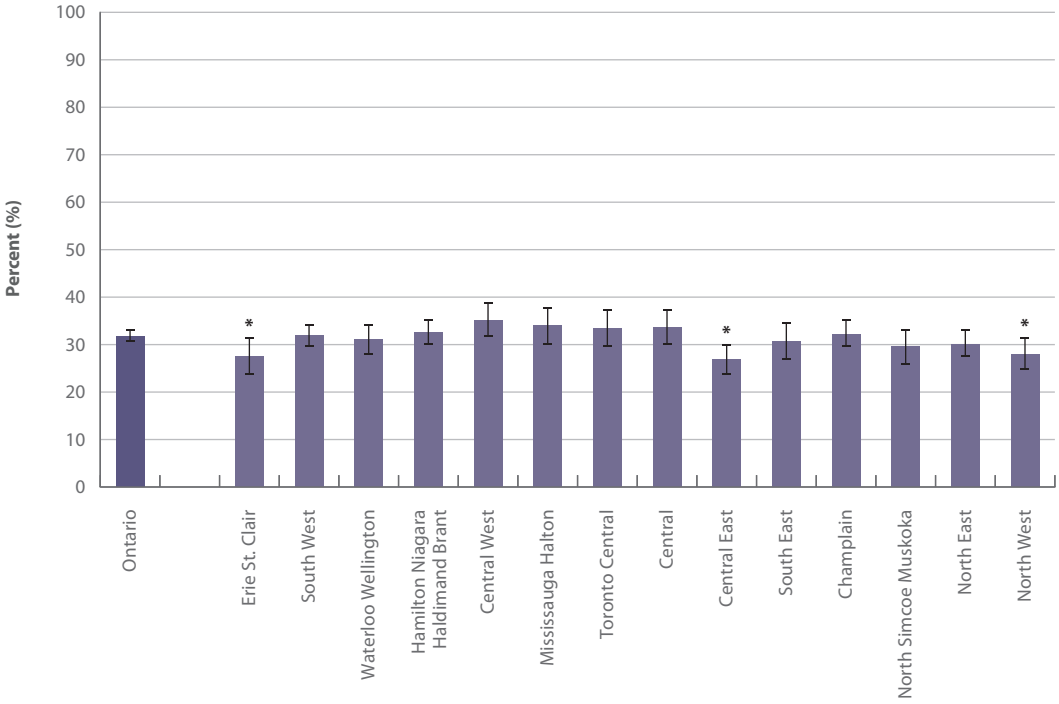


Source: Canadian Community Health Survey, 2003, 2005, 2007–2013 (Statistics Canada)
Notes: Estimates are age-standardized to the 2006 Canadian population.
Vegetables exclude potatoes and fruit juice is only counted up to a maximum of one time per day.

- Between 2003 and 2013, the prevalence of consuming vegetables and fruit five or more times per day was consistently higher among adult females than males in Ontario (Figure 9). In 2013, 25.4% of males and 39.1% of females aged 18 and older reported consuming vegetables (excluding potatoes) and fruit five or more times per day.
- The proportion of adult Ontarians consuming vegetables and fruit five or more times per day was low, especially for males, and did not change significantly between 2003 and 2013.

FIGURE 10.

Percentage of Ontario adults (aged 18+) eating vegetables and fruit five or more times per day, by Local Health Integration Network, 2012–2013 combined



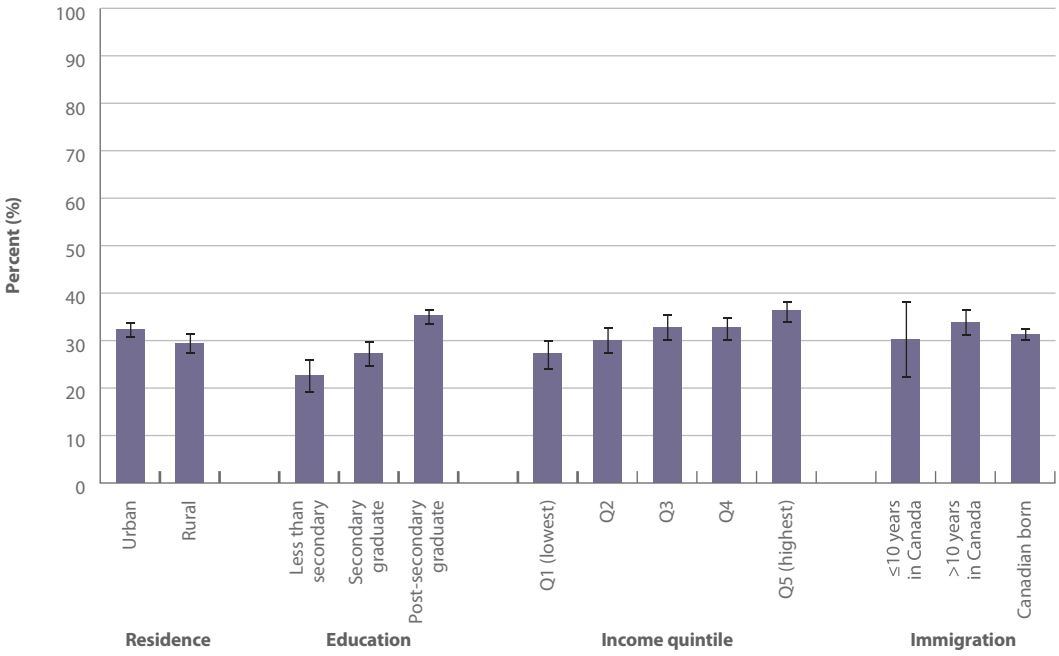
Source: Canadian Community Health Survey, 2012–2013 (Statistics Canada)

Notes: Estimates are age-standardized to the 2006 Canadian population.
I represent 95% confidence intervals.
Data from CCHS cycles 2012 and 2013 combined to increase sample size for analyses by Local Health Integration Network.
*Estimate is significantly higher or lower than the Ontario estimate.
Vegetables exclude potatoes and fruit juice is only counted up to a maximum of one time per day.

- For 2012–2013 combined, the proportion of Ontario adults consuming vegetables and fruit five or more times per day was low across Ontario's 14 Local Health Integration Networks (LHINs) (Figure 10). While prevalence ranged from 26.8% in the Central East LHIN to 35.1% in the Central West LHIN, there was little variation among most LHINs, where prevalence generally fell between 28% and 34%.
- Compared to the 2012–2013 combined provincial estimate of 31.6%, the age-adjusted prevalence of consuming vegetables and fruit five or more times per day was significantly lower in the Erie St. Clair, Central East, and North West LHINs.

FIGURE 11.

Percentage of Ontario adults (aged 30+) eating vegetables and fruit five or more times per day, by selected socio-demographic factors, 2012–2013 combined



Source: Canadian Community Health Survey, 2012–2013 (Statistics Canada)

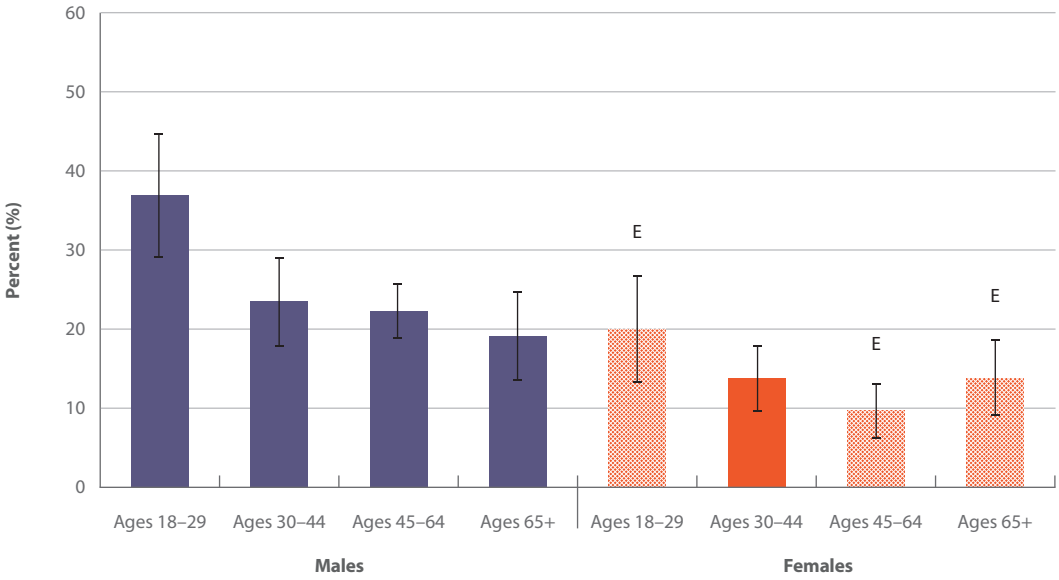
Notes: Estimates are age-standardized to the 2006 Canadian population.
I represent 95% confidence intervals.
Data from CCHS cycles 2012 and 2013 combined to increase sample size for analyses by socio-demographic factors.
Vegetables exclude potatoes and fruit juice is only counted up to a maximum of one time per day.

- The proportion of Ontario adults consuming vegetables and fruit five or more times per day differs across levels of four socio-demographic factors (Figure 11). Socio-demographic factors were analyzed for adults aged 30 and older to restrict the sample to those who have likely completed their education and reached their adult socio-demographic status.
- For 2012–2013 combined, the prevalence of consuming vegetables and fruit five or more times per day was significantly higher among adults (aged 30+) living in urban (32.4%) than in rural areas (29.4%), among adults who have graduated from post-secondary education (35.3%) than adults who have attained lower levels of education (e.g., less than secondary school education at 22.6%) and among those in the highest income quintile (36.3%) than in every other income quintile (e.g., the lowest income quintile at 27.2%). The proportion of adults consuming vegetables and fruit five or more times per day did not differ significantly by immigrant status.

- These significant differences across differing residence and levels of education and income remained statistically significant when controlling for age, sex and the other socio-demographic characteristics in a multivariate analysis (see supplementary Table 15). After controlling for other socio-demographic characteristics, the prevalence of consuming vegetables and fruit five or more times per day was significantly higher among immigrants who have been in Canada for more than 10 years compared with Canadian-born adults.
- The increase in prevalence of consuming vegetables and fruit five or more times per day with increasing education and income is consistent with studies in Europe and the United States.[34] Individuals with less education and in the lower income quintiles may experience affordability and availability barriers to accessing fresh vegetables and fruit.
- The higher prevalence of consuming vegetables and fruit five or more times per day in urban than in rural areas is consistent with findings for Canada as a whole.[35]

3.2 RED MEAT CONSUMPTION

FIGURE 12.
Percentage of Canadian adults (aged 18+) eating more than 500 g of red and processed meat per week, by sex and age group, 2007–2009 combined

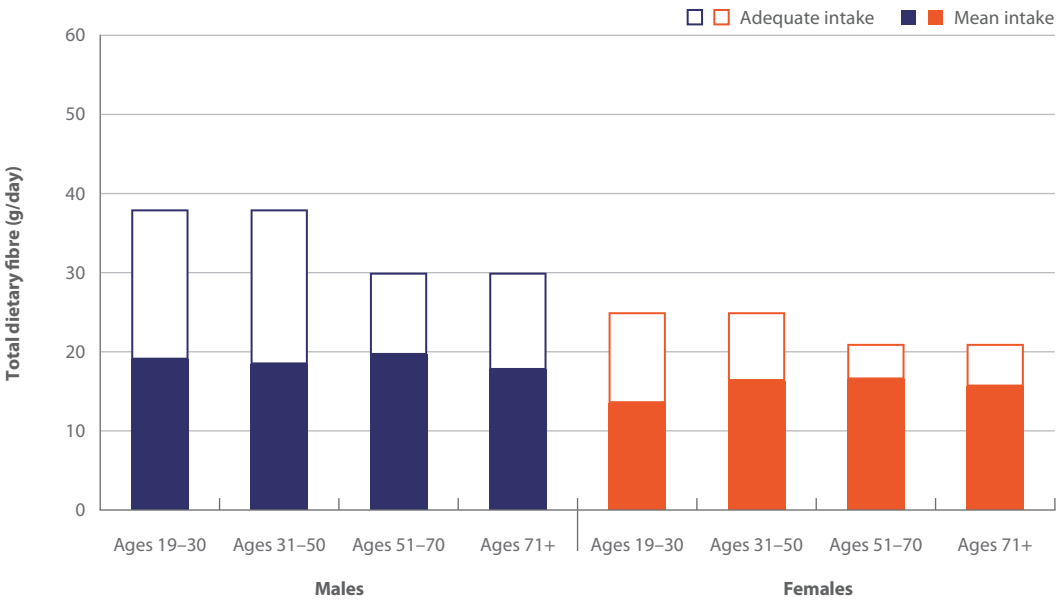


Source: Canadian Health Measures Survey, 2007–2009 (Statistics Canada)
Notes: I represent 95% confidence intervals.
E – Interpret cross-hatched estimates with caution due to high sampling variability.

- Intake of red and processed meat are risk factors for colorectal cancer.[2,5] Red meat includes beef, pork, lamb and goat while processed meat generally refers to meat preserved by smoking, curing, salting or through the addition of chemical preservatives (e.g., ham, bacon, sausages and hot dogs).[3] The WCRF/AICR recommendation is that if red meat is consumed, it should be limited to less than 500 g a week and that very little, if any, of this red meat should be processed.[2]
- In 2007–2009, 25.1% of adult male and 13.7% of adult female Canadians consumed more than 500 g of red and processed meat per week (see supplementary Table 16).
- Adult male Canadians, particularly those aged 18–29, were most likely (25.4%) to consume more than 500 g of red and processed meat per week (Figure 12).
- The proportion was higher among males than females across all age groups.

3.3 FIBRE CONSUMPTION

FIGURE 13.
Total dietary fibre intake (g/day) and adequate intakes among Ontario adults (aged 19+), by sex and age group, 2004



Source: Canadian Community Health Survey, 2004 (Statistics Canada), adapted from Statistics Canada, 2004[36]

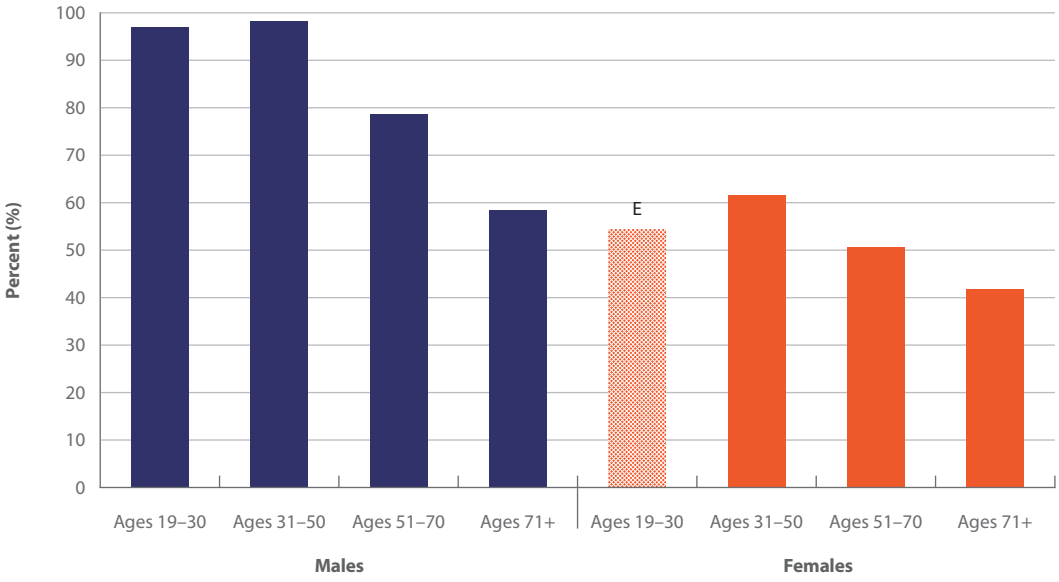
Notes: Total dietary fibre intake includes both soluble and insoluble fibre that is naturally occurring in foods; it does not include functional fibre, such as isolated or synthetic fibre added to food products.

Adequate intakes are the daily intake levels recommended by the Institute of Medicine and are based on estimates of the amount of fibre consumed by people who are maintaining general health and an adequate nutritional state; adequate intakes include both dietary and functional fibre.[37]

- Dietary fibre consumption is a protective factor for colorectal cancer.[2,5] Naturally occurring dietary fibre is derived from plant foods, including pulses (legumes) and cereals (grains) that have undergone minimal processing, vegetables and fruit.[3]
- The recommended daily intake levels for fibre, developed jointly for Canada and the United States by the Institute of Medicine, are termed adequate intakes. These are determined by the amount of fibre consumed by people who are maintaining general health and an adequate nutritional state.[37,38] Adequate intakes are higher for males than for females, and within each sex adequate intakes are higher for younger adults than for older adults.
- In 2004, the mean total dietary fibre intake for Ontario males ranged from 17.7 g/day in the 71+ age group to 19.6 g/day in the 51–70 age group (Figure 13). For females, mean intake ranged from 13.5 g/day in the 19–30 age group to 16.5 g/day in the 51–70 age group.
- While mean intakes were below adequate intake levels in all age and sex groups, the differences were greatest among males in the two youngest age groups (where intakes were approximately half the adequate intake levels). Mean intakes among females aged 51 and older most closely approached the adequate intake levels.
- The mean intakes of dietary fibre presented here include both soluble and insoluble fibre that is naturally occurring in foods, and do not include functional fibre, such as isolated or synthetic fibre added to food products. Because the CCHS measured only naturally occurring fibre, the mean intakes are likely underestimated, resulting in overestimates of the differences when compared to adequate intake levels (which include both dietary and functional fibre).[38]
- Although these data are from 2004, current levels of fibre intake are likely to be similar; a recent study of dietary fibre intake in the United States showed that intakes did not change significantly between 1999 and 2008,[39] and the prevalence of consuming five or more vegetables or fruit daily, an important source of fibre, remained much the same between 2003 and 2013 in Ontario (Figure 9).

3.4 SODIUM CONSUMPTION

FIGURE 14.
Percentage of Ontario adults (aged 19+) consuming more than 2,300 mg of sodium per day, by sex and age group, 2004



Source: Canadian Community Health Survey, 2004 (Statistics Canada), adapted from Statistics Canada, 2004[36]
Notes: E – Interpret cross-hatched estimates with caution due to high sampling variability.
2,300 mg is the tolerable upper intake level for sodium as defined by the Institute of Medicine in the United States and adopted in Canada.

- Dietary salt intake, which contains sodium, may increase the risk of stomach cancer.[2] The WCRF/AICR recommendation for salt is to limit daily intake to less than 6,000 mg, or 2,400 mg of sodium.[2] This is based on a population nutrient goal published by the World Health Organization in 1990, updated in 2003 to reflect a lowered upper limit of 5,000 mg of salt, or 2,000 mg of sodium.[1,40] The tolerable upper intake level for sodium, developed jointly for Canada and the United States by the Institute of Medicine, is 2,300 mg a day and is meant to indicate the highest level of daily nutrient intake that is unlikely to cause any adverse health effects in the general population.[41] In addition to being a potential risk factor for cancer, excess consumption of sodium results in higher blood pressure, which increases the risk of heart disease and stroke.
- In 2004, the majority of Ontario adults aged 19 years and older consumed more than the recommended upper limit of 2,300 mg of sodium per day. Processed foods are the main source of dietary salt intake in most industrialized countries, with only a small amount added during cooking or at the table.[3]

- In 2004, the proportion of Ontario adults aged 19 years and older consuming more than 2,300 mg of sodium a day was higher among males than females across all age groups (Figure 14).
- The proportion of adults consuming more than 2,300 mg of sodium a day was highest in the two youngest age groups for males (97.1% for ages 19–30 and 98.3% for ages 31–50) and females (54.5% for ages 19–30 and 61.7% for ages 31–50).
- For both sexes, the proportion of adults consuming more than 2,300 mg of sodium a day was lowest in the oldest age group (58.5% for males and 41.9% for females).
- Although these data are from 2004, a study of the prevalence of excess dietary sodium intake in the United States has shown that prevalence among adults has not changed significantly between 2003 and 2010.[42]

4. ACTIVE LIVING

Moderate physical activity is a protective factor for colon cancer and may be protective for post-menopausal breast cancer and endometrial cancer.[2] Recent reviews present evidence for a convincing effect of physical activity as lowering the risk of breast and endometrial cancer.[43] This section presents self-reported data on time trends for leisure time physical activity, by sex, and on prevalence by age group, socio-demographic factors, and Local Health Integration Network (LHIN) for self-reported leisure time and transportation physical activity. It also presents data on leisure time sedentary behaviour in Ontario adults.

BOX 4.
Defining and measuring physical activity

Population-level physical activity measurement presents some challenges. Questionnaires may address only a part of total physical activity and miss important domains, such as occupation and household chores.[44] Leisure time and transportation physical activity may account for a relatively small part of total physical activity levels—substantial variation in activity can exist in the activities of daily living, domestic chores, commuting and occupational physical activity. Activity levels in these other aspects of life may play a large role in explaining individual differences in reporting leisure time and transportation physical activity; self-reports are also vulnerable to over-reporting because of the perceived desirability of reporting healthy behaviours.[44,45] Accelerometer data have yielded lower levels than self-report for the Canadian population, but are impractical for large population surveys and may result in underestimates because they are unable to capture all types of activities.[46] Despite the limitations of self-reported physical activity data, the Canadian Community Health Survey (CCHS) provides nation-wide information on the levels and variation of two aspects of daily life, are annually updated and yield information down to the regional level.

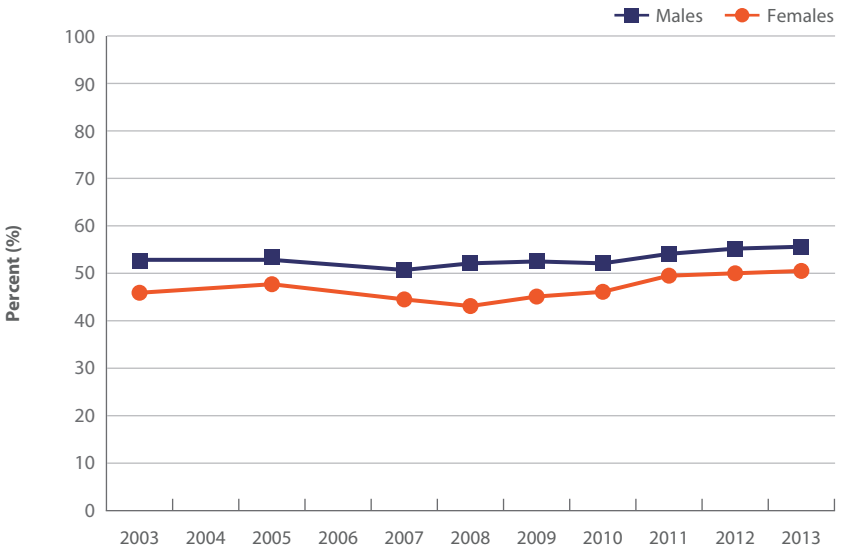
The CCHS collects self-reported information on leisure time activities and active transportation during the previous three months. Statistics Canada then converts this information into daily energy expenditure (EE) levels and based on daily totals, categorizes respondents as being “active”, “moderately active” or “inactive” during leisure time and/or active transportation.

- Inactive—EE <1.5 kcal/kg/day
- Moderately active—1.5 kcal/kg/day ≤ EE <3.0 kcal/kg/day
- Active—EE ≥3.0 kcal/kg/day

This report presents data on Ontario adults whose activities met the “moderately active” and “active” levels of daily energy expenditure during leisure time and/or active transportation.

4.1 LEISURE TIME PHYSICAL ACTIVITY

FIGURE 15.
Percentage of Ontario adults (aged 18+) who were moderately active or active during leisure time physical activity, by sex, 2003–2013

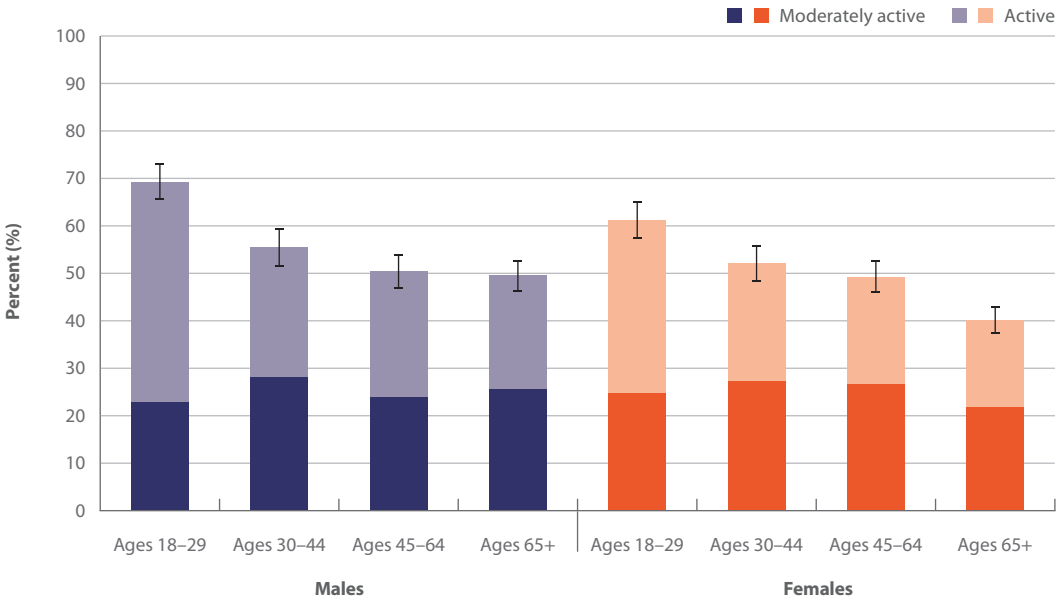


Source: Canadian Community Health Survey, 2003, 2005, 2007–2013 (Statistics Canada)
Notes: Estimates are age-standardized to the 2006 Canadian population.

- The proportion of Ontario adults who are moderately active or active in their leisure time is low (52.9% in 2013) and has not increased for at least the past 10 years. Trends over time are shown in Figure 15 for leisure time physical activity only, due to changes in the Canadian Community Health Survey (CCHS) questions on active transportation beginning in 2007.
- Between 2003 and 2013, the proportion of adults aged 18 and older who were at least moderately active remained stable in both males and females, with 55.6% of males and 50.5% of females reporting activity levels classified as moderately active or active in 2013 (Figure 15). A greater proportion of males than females were at least moderately active throughout this period.
- The stable trends for leisure time physical activity reflect an unchanging proportion of males and females classified as moderately active, at around 25.0% from 2003 to 2013. The proportion classified as active increased in both sexes, rising from 27.4% to 30.1% in males and from 20.7% to 24.6% in females. Males were more often classified as active than moderately active between 2003 and 2013, whereas females were more often only moderately active (data not shown).

4.2 LEISURE TIME AND TRANSPORTATION PHYSICAL ACTIVITY

FIGURE 16.
Percentage of Ontario adults (aged 18+) who were moderately active or active during leisure time and transportation, by sex and age group, 2013

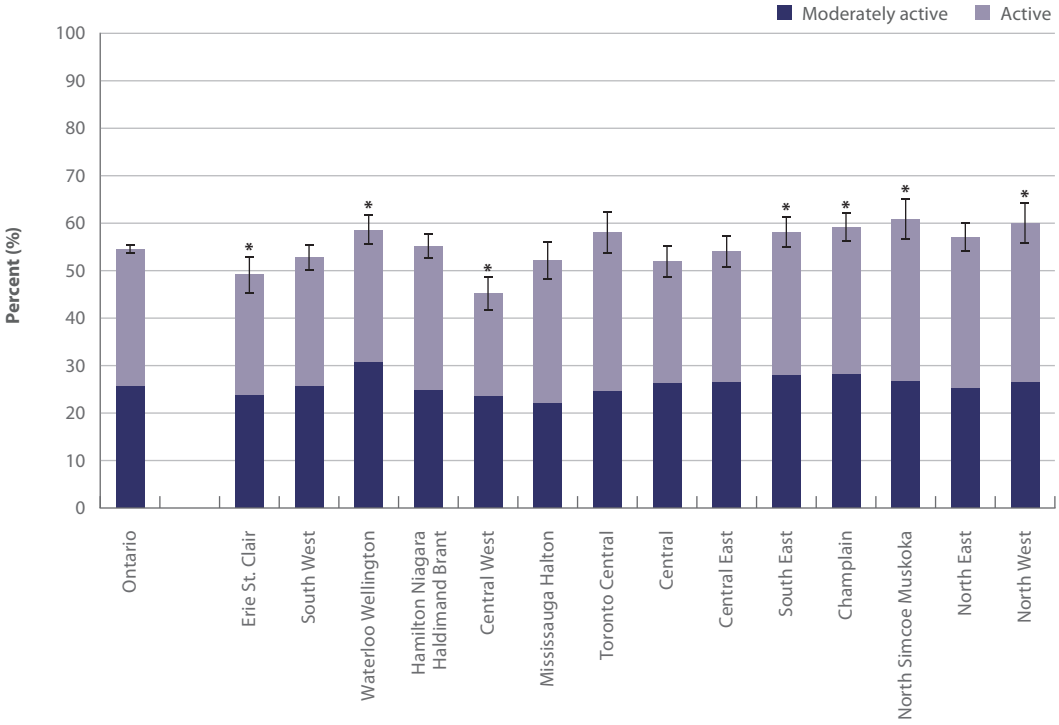


Source: Canadian Community Health Survey, 2013 (Statistics Canada)
Notes: I represent 95% confidence intervals for moderately active and active combined.

- The proportion of adults who are moderately active or active during their leisure time and transportation activities decreases across successive age groups in males and females.
- In 2013, the proportion of both males and females who were moderately active or active during leisure time or transportation was highest among those aged 18–29 (69.4% in males, 61.3% in females) and decreased across successive age groups, with the lowest rates among those aged 65 and older (49.5% in males, 40.1% in females) (Figure 16). Ontario adults aged 18–29 were more often classified as having active, rather than moderately active, levels of leisure time and transportation physical activity.
- The proportion of adults who were moderately active or active was higher in males than females in the youngest (18–29) and oldest (65+) age groups.

FIGURE 17.

Percentage of Ontario adults (aged 18+) who were moderately active or active during leisure time and transportation, by Local Health Integration Network, 2012–2013 combined



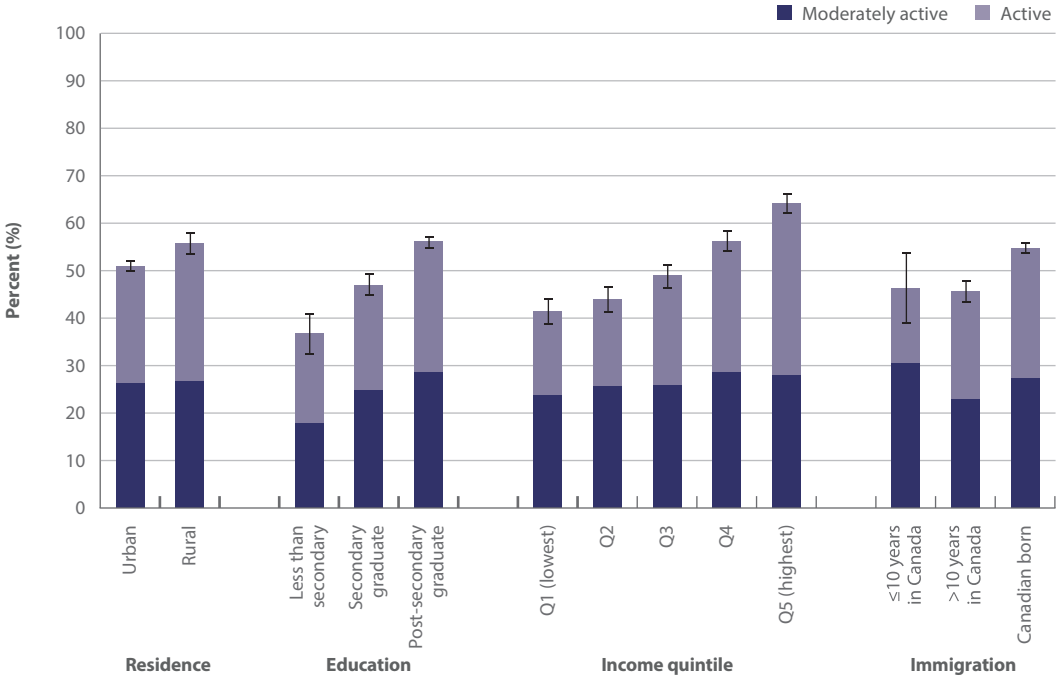
Source: Canadian Community Health Survey, 2012–2013 (Statistics Canada)

Notes: Estimates are age-standardized to the 2006 Canadian population.
I represent 95% confidence intervals for moderately active and active combined.
Data from CCHS cycles 2012 and 2013 combined to increase sample size for analyses by Local Health Integration Network.
*Estimate is significantly higher or lower than the Ontario estimate.

- Within Ontario, there is significant variation in the prevalence of leisure time and transportation physical activity across the 14 Local Health Integration Networks (LHINs).
- In 2012–2013, the prevalence of leisure time and transportation physical activity ranged from a low of 45.2% in the Central West LHIN to a high of 60.9% in the North Simcoe Muskoka LHIN (Figure 17). Compared to the provincial estimate of 54.5%, the age-adjusted prevalence of leisure time and transportation physical activity was significantly higher in the Waterloo Wellington, South East, Champlain, North Simcoe Muskoka and North West LHINs, and significantly lower in the Erie St. Clair and Central West LHINs.
- Leisure time physical activity, rather than active transportation, contributes the vast majority of the physical activity shown here.
- Similar regional variation was apparent when moderate and active physical activity levels were examined separately, with greater variation in levels classified as active than moderately active physical activity.

FIGURE 18.

Percentage of Ontario adults (aged 30+) who were moderately active or active during leisure time and transportation, by selected socio-demographic factors, 2012–2013 combined



Source: Canadian Community Health Survey, 2012–2013 (Statistics Canada)

Notes: Estimates are age-standardized to the 2006 Canadian population.
I represent 95% confidence intervals for moderately active and active combined.
Data from CCHS cycles 2012 and 2013 combined to increase sample size for analyses by socio-demographic factors.

- The proportion of Ontario adults who are moderately active or active during leisure time and transportation physical activity differs significantly across levels of four socio-demographic factors (Figure 18). Socio-demographic factors were analyzed for adults aged 30 and older to restrict the sample to those who have likely completed their education and reached their adult socio-demographic status.
- In 2012–2013, the prevalence of being moderately active or active was significantly higher among adults (aged 30+) living in rural (55.7%) than in urban areas (51.0%), among post-secondary graduates (56.0%) than adults with lower levels of education (e.g., less than secondary school education at 36.7%), in the highest income quintile (64.1%) than in all lower income quintiles (e.g., the lowest at 41.4%), and among Canadian-born adults (54.7%) compared with immigrants who have been in Canada for 10 years or less (46.4%) and who have been in Canada more than 10 years (45.6%).

- Most of the differences within each socio-demographic characteristic remained statistically significant after adjusting for the other socio-demographic characteristics, age and sex (see supplementary Table 24). The exception was the difference between urban versus rural residence, a difference which was no longer significant after adjusting for other socio-demographic characteristics.
- The difference in prevalence across levels of each socio-demographic factor was greater in active levels of physical activity compared to the moderately active group. The prevalence of moderate physical activity was only significantly different across education levels, and between immigrants who have been in Canada for more than 10 years compared to Canadian-born individuals.

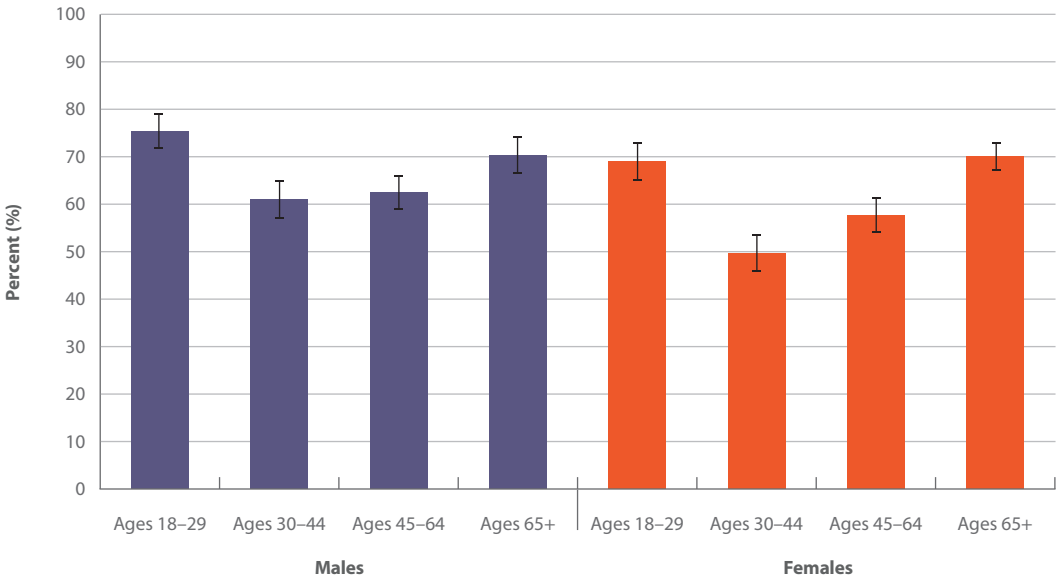
4.3 SEDENTARY BEHAVIOUR

Emerging evidence suggests that a positive association exists between sedentary behaviour (prolonged sitting or reclining characterized by low energy expenditure) and risk of colorectal, endometrial, ovarian and prostate cancers, and possibly lung cancer.[10-12] Sedentary behaviour is becoming recognized as a phenomenon distinct from physical inactivity that has independent and qualitatively different effects on metabolism, physical function and health outcomes.[47] That is, the increased risk of cancer seen in individuals with prolonged time spent being sedentary is not entirely explained by an absence of physical activity, although an examination of Canadian Community Health Survey (CCHS) data for Canadian adolescents suggests a complicated relationship.[10,48] Among sedentary behaviours, screen time (television and computer) has been shown to carry more health risks than non-screen sedentary leisure time behaviours like reading.[49] Information on sedentary behaviour in other domains of life, such as occupation and transportation, is not available at the population level for Ontario, but likely contributes a large proportion of total sedentary time.

Although no hours-specific health guideline for leisure screen time has been developed for adults, the Canadian Paediatric Society recommends a maximum of two hours of television per day for children.[50] This report uses the Public Health Agency of Canada's chronic disease risk indicator defined as more than 14 hours per week spent watching television or using computers during leisure time.[51]

FIGURE 19.

Percentage of Ontario adults (aged 18+) who reported more than 14 hours of leisure screen time per week, by sex and age group, 2012



Source: Canadian Community Health Survey, 2012 (Statistics Canada)
Notes: I represent 95% confidence intervals.
Screen time includes television, computer and video games.

- In 2012, the prevalence of more than 14 hours of leisure screen time per week among males and females was highest in the 18–29 (males 75.4%, females 69.0%) and 65 and older (males 70.3%, females 70.0%) age groups (Figure 19), and significantly lower in the 30–44 (males 60.9%, females 49.7%) and 45–64 (males 62.5%, females 57.7%) age groups. It is probable, however, that high proportions of Ontarians between the ages of 30 and 64 have a substantial amount of sedentary occupational time not captured in CCHS data.
- In all age groups, except for those 65 and older, males appeared more likely to exceed 14 hours per week of leisure screen time than females. The difference between males and females, however, was only statistically significant in the 18–29 and 30–44 age groups.
- Among the age groups presented here, males and females aged 18–29 have the highest prevalence of at least moderate physical activity (Figure 16) but also have the highest prevalence of more than 14 hours of weekly leisure screen time. Males and females in the oldest age group (65 and older), however, have a high proportion (70%) exceeding 14 hours of weekly screen time and have the lowest prevalence of physical activity. Limiting sedentary time may have potential for cancer prevention both among inactive individuals and for individuals meeting physical activity recommendations.[10]

5. IMPLICATIONS FOR CANCER CONTROL

This report can serve as a resource for public health professionals, policy-makers and planners to support initiatives that aim to increase the prevalence of healthy weights, healthy eating and physical activity in Ontario, thereby lowering the risk of cancer, other chronic diseases and premature mortality.

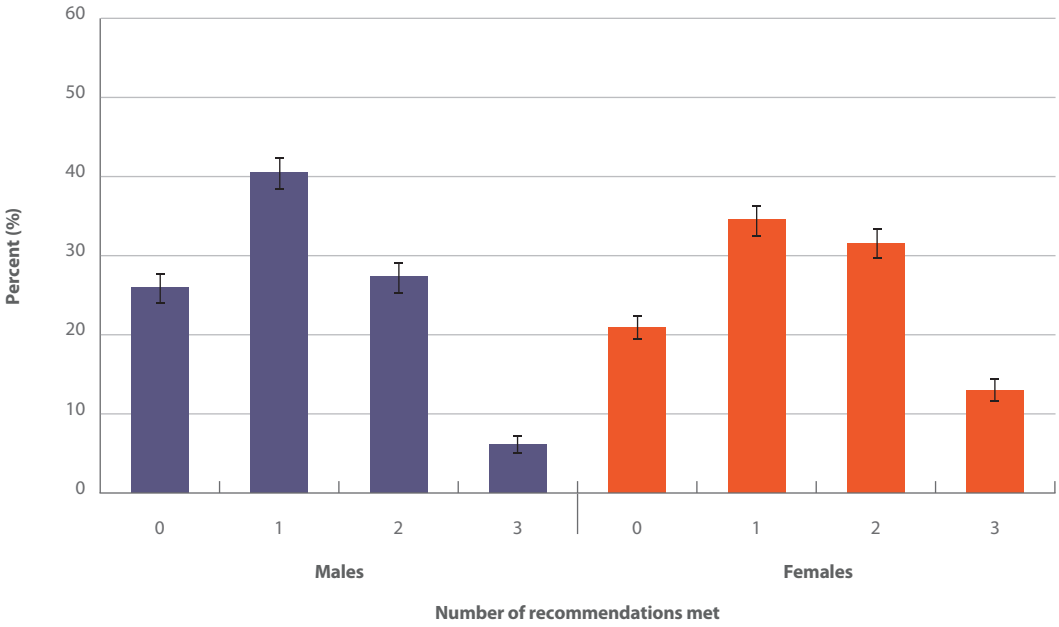
This section notes the potential for lowering the burden of cancer in Ontario specifically related to healthy weights, healthy eating and active living, possibly through targeted efforts in priority areas, and collecting adequate data to monitor the impact of prevention initiatives.

5.1 BURDEN OF CANCER AND MODIFIABLE RISK FACTORS

- Approximately 2,640 new cancer cases diagnosed annually in Ontario could be prevented by reducing the proportion of adults who are overweight or obese. Unhealthy eating and physical inactivity likely contribute to a portion of the cancers attributable to unhealthy weights due to their close relationship with overweight and obesity. Additional cases could be prevented by increasing healthy eating and physical activity because of their contribution to lowering cancer risk beyond their contribution to maintaining healthy body weights.
- The proportion of overweight or obese Ontario adults has continued to rise since as far back as the late 1980s and, if the trend for all of Canada applies, since the 1950s.[24,25] If this trend continues, a corresponding increase in the burden of cancer and other chronic diseases attributable to overweight and obesity can be expected. Population-level reductions in overweight and obesity are unlikely without increasing physical activity and decreasing sedentary time. A large proportion of the Ontario population is physically inactive and does not meet dietary recommendations for cancer prevention and general health, which include increasing consumption of fruit, non-starchy vegetables and other fibre-containing foods, while decreasing consumption of red and processed meats and salty foods.
- The World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) recommendations addressed with current Ontario data in this report are:
    - **Body fatness:** be as lean as possible within the normal range of body weight (for Canada, within the World Health Organization Body Mass Index [BMI] range of 18.50 to 24.99 kg/m^2).
    - **Physical activity:** be physically active as part of everyday life (that is, be moderately physically active, equivalent to brisk walking, for at least 30 minutes every day); and limit sedentary behaviours, such as watching television.
    - **Vegetables and fruit:** eat at least five servings of non-starchy vegetables and fruit every day.

FIGURE 20.

Percentage of Ontario adults (aged 18+) following cancer prevention recommendations for body fatness, vegetable and fruit consumption and physical activity, by sex, 2013



Source: Canadian Community Health Survey, 2013 (Statistics Canada)
Notes: Estimates are age-standardized to the 2006 Canadian population.
I represent 95% confidence intervals.

- Although obesity, diet and physical activity are strongly related, available data show that individuals vary in the combinations of cancer prevention recommendations they meet. In 2013, only 6.1% of male adults aged 18 years and older and 13.0% of female adults in Ontario met the cancer prevention recommendations for all three of body fatness (BMI between 18.50 and 24.99 kg/m^2), vegetable and fruit intake (five or more servings daily), and physical activity (moderately active or active) (Figure 20). More Ontarians met either one or two of the recommendations. One-quarter (26.0%) of males and one-fifth (20.9%) of females met none of the three recommendations and are at an increased risk of cancer as a result. Compared to males, a lower proportion of females met the physical activity recommendations, and a higher proportion met the recommendations for vegetable and fruit consumption and healthy weights. Overall, the highest proportion of Ontario adults followed the recommendations for physical activity, followed by vegetable and fruit consumption and having a healthy weight (data not shown).

5.2 CURRENT INITIATIVES AND PRIORITY AREAS FOR PREVENTION

Although not specific to cancer prevention, priority actions have been proposed and several initiatives have been implemented or are currently under consideration to address chronic disease prevention by reducing overweight and obesity, promoting healthy eating and increasing physical activity in the Ontario population.

- **Support for healthy behaviours.** Cancer Care Ontario and Public Health Ontario's joint 2012 report, *Taking Action to Prevent Chronic Disease: Recommendations for a Healthier Ontario*, outlines several chronic disease prevention recommendations addressing tobacco, alcohol, physical activity and healthy eating.[52] These include requiring physical education credits in every high school grade, evaluation and continued implementation of the Ontario elementary school daily physical activity policy, support for active transportation, a workplace physical activity policy, an Ontario food and nutrition strategy, food skills in school curricula, support for healthy eating in provincial workplaces and institutions, and menu labelling in large-scale food service operations. The recommendations recognize the need for action at federal, provincial and municipal levels; the utility of a whole-of-government approach at the provincial level; and the need for systematic data gathering, capacity-building and coordinated health communications. Some related actions are under way. For example, in June 2014 Cancer Care Ontario implemented a comprehensive workplace health promotion program, Health Works. The first Health Works project was aimed at increasing physical activity and reducing sedentary behaviour among employees.
- **Focus on children and youth.** Children and youth are an important target population for public health interventions related to overweight and obesity, healthy eating and physical activity. Children who are obese are more likely to remain obese as adults.[29] Being breastfed is likely to protect against excess weight in childhood.[2] *Ontario's Action Plan for Health Care* and the Ministry of Health and Long-Term Care's Healthy Kids Panel have both identified reducing childhood obesity as a priority.[53,54] Ontario is taking action to implement recommendations from the Healthy Kids Panel by focusing on three pillars: healthy start, healthy food and healthy active communities.[54]
    - In the Healthy Kids Community Challenge, a cross-government initiative of Ontario's Healthy Kids Strategy, 45 Ontario communities are delivering local programs and activities to support children and youth in healthy living, including healthy eating and physical activity to promote children's health.[55]

- The Ministry of Health and Long-Term Care is establishing new breastfeeding support initiatives, with access to expert support for mothers who are breastfeeding through a 24-hour telephone advisory service; resources to help Ontario hospitals and other healthcare locations to adopt best practices in infant feeding and to address mothers' and babies' individual needs; and new resources and tools for families and healthcare providers to support mothers in breastfeeding, including a guide developed in consultation with Aboriginal communities.[56]

- **Sustainable built environments.** Overweight and obesity, availability of healthy food, and physical activity vary substantially across geographic regions in Ontario. While this may be explained, in part, by the population composition of the different regions, it may also highlight the potential role of differences in the built environments. Physical activity, for example, may be influenced by urban planning and land use policies, the availability of bike paths and sidewalks, and mixed land-use that provides walkable destinations, such as public parks, recreational facilities and retail outlets. Medical Officers of Health in the Greater Toronto–Hamilton Area have worked with transportation and land-use planners, and with municipal and provincial government politicians and staff to specify actions to develop public transit infrastructure, strengthen provincial policies and normalize municipal planning to support active transportation and public transit use. Their 2014 report cites development standards and guidelines already adopted by several Ontario municipalities.[57]

- **Consideration of socio-demographic disparities.** This report presents significant disparities across several socio-demographic factors to be considered when developing programs and policies to address chronic disease risk modifiers. For example, while vegetable and fruit consumption and physical activity are lowest in the lowest income quintile, the relationship between income and obesity is more complicated. To avoid exacerbating differences between income groups and the underlying system-level barriers that may be driving them, the complexity of these relationships must be considered, and possibly further investigated with qualitative data, during the design of prevention programs and policies. The Health Equity Impact Assessment Tool, developed by the Ministry of Health and Long-Term Care, can assist planners in assessing socio-demographic inequities that might result from a new program or policy so as to mitigate those impacts.[58]

Ontarians who self-identify as Aboriginal are significantly more likely to be obese, and some have lower intake of vegetables and fruit, than non-Aboriginals.[59] While the main active prevention priority of Cancer Care Ontario's Aboriginal Cancer Strategy II (ACS II) has been reduction of non-traditional tobacco use, Cancer Care Ontario's Aboriginal Cancer Control Unit is working with First Nations, Inuit and Métis organizations and communities across the province to develop a "chronic disease prevention blueprint," which will identify priority prevention policies and activities in the areas of alcohol use, physical activity and healthy diet.[59] This work will assist in defining specific prevention priorities for the ACS III, which will be released in 2015.

5.3 DATA GAPS AND OPPORTUNITIES

- Preparation of a report like this one draws attention to gaps in the data available for monitoring and measuring overweight and obesity, healthy eating and physical activity in the Ontario population. Addressing these gaps will be important for effectively monitoring trends over time and evaluating outcomes following implementation of provincial and local interventions.
    - There is a lack of routinely collected data at a provincial level for dietary factors other than vegetables and fruit. Although the Canadian Health Measures Survey (CHMS) does collect information on some cancer-related dietary factors, such as red and processed meat consumption, that survey was not designed to provide provincial-level estimates. Information on other important dietary components, such as consumption of high-sodium foods, energy-dense foods and beverages, and fast foods, that can influence weight gain and overweight and obesity are not routinely collected at a national or provincial level.
    - Although physical activity during leisure time and active transportation is routinely assessed through the Canadian Community Health Survey (CCHS), there is a lack of national and provincial data related to other domains of physical activity, including activity within occupational settings.
    - There is a lack of comprehensive, systematically collected data on child and youth health widely available and analyzable at regional levels.
- Despite these notable gaps, some efforts are currently underway to address data available at the provincial and sub-provincial levels for diet and physical activity. As part of the CCHS program, a Nutrition Survey will begin data collection in 2015, and will provide more comprehensive data on food consumption and allow for more in-depth analysis of dietary risk factors. The CCHS physical activity module is being revised for data collection beginning in 2015, and will incorporate questions about activity in occupational and school settings and active transportation (Andrew MacKenzie, Statistics Canada, personal communication, Ontario consultation on the 2015 CCHS Redesign Project, November 2013). Statistics Canada is developing the Canadian Health Survey on Children and Youth for implementation in 2017, to represent Canadians aged 1 through 17.

6. CONCLUSION

Several efforts to influence healthy weights, healthy eating and active living are already underway in Ontario. Data presented here by age group, sex, geography and socio-demographic characteristics have the potential to inform policy-makers, public health and other health professionals in focusing prevention efforts on those in the Ontario population who are more likely to be overweight or obese, have an unhealthy diet and be physically inactive.

The data in this report highlight a considerable opportunity for cancer and chronic disease prevention efforts in the related domains of overweight and obesity, aspects of diet, physical inactivity and sedentary time. They provide a reasonable estimate of the potential impact of successful initiatives to promote healthy weights on the burden of cancer in Ontario. However, some data gaps exist which, if and when addressed, will increase system capacity for monitoring the impact of policy changes and program interventions aimed at chronic disease prevention. Ultimately, efforts to increase healthy eating and physical activity, and decrease sedentary time, have the potential to decrease the cancer burden due to overweight and obesity and to further reduce the burden related directly to physical inactivity and components of diet. These are among the most directly modifiable population chronic disease risk factors. Sustained change requires a collaborative commitment from individuals, communities and all levels of government.

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APPENDIX A: DATA SOURCES

CANADIAN COMMUNITY HEALTH SURVEY (CCHS), ONTARIO SHARE FILES

The Canadian Community Health Survey (CCHS) is a population-based cross-sectional survey conducted by Statistics Canada that collects information on health status, healthcare utilization and determinants of health for the Canadian population aged 12 years and older living in private dwellings. Individuals living on First Nation reserves and other Aboriginal settlements, institutional residents, full-time members of the Canadian Forces and residents of certain remote regions are excluded from the CCHS. It is representative of 98% of the Canadian population aged 12+ and produces reliable estimates at the health region level.

The CCHS began in 2000/01 and was initially designed to be administered every two years, sampling approximately 130,000 respondents (39,000 in Ontario) in each cycle. In 2007, this format changed to its current iteration where approximately 65,000 respondents (20,000 in Ontario) are sampled annually.

For this report, CCHS full survey waves 2000/01, 2003 and 2005 and half-survey annual waves 2007–2013 were used in most analyses. CCHS 2.2, which focused on nutrition and was conducted in 2004, was used to obtain additional information on nutrient intakes that are not regularly captured by the CCHS questionnaire.

CANADIAN HEALTH MEASURES SURVEY (CHMS)

Red meat consumption estimates were derived from the Canadian Health Measures Survey (CHMS), Cycle 1, 2007–2009. The CHMS, a national survey conducted by Statistics Canada, collects data from a nationally representative sample of the population aged six–79 years living in private households at the time of the survey. Residents of First Nations reserves, Crown lands, institutions and certain remote regions, and full-time members of the Canadian Forces are excluded. Approximately 96% of Canadians are represented.

ONTARIO CANCER REGISTRY (OCR)

The Ontario Cancer Registry (OCR) is operated by Cancer Care Ontario and registers all newly diagnosed cases of reportable cancers, except for basal and squamous cell skin cancers. Electronic records are linked at the person level and then "resolved" into incident cases of cancer using computerized medical logic. Major data sources are the following:

- cancer-related hospital inpatient and outpatient discharge records from the Canadian Institute for Health Information
- cancer-related pathology reports, received mostly electronically from hospital and community laboratories
- consultation and treatment records of patients referred to one of 14 Regional Cancer Centres
- death certificates with cancer identified as the underlying cause of death, received from the Ontario Registrar General

The OCR was used to obtain the number of new cancer cases diagnosed in 2010 for the analysis of population attributable fractions (PAF) calculated for overweight and obesity.

APPENDIX B: INDICATOR DEFINITIONS

ADULT BODY MASS INDEX (CORRECTED)

Definition: Percentage of Ontario adults aged 18 years and older that are normal weight (BMI 18.5–24.99), overweight (BMI 25.0–29.99) or obese (BMI ≥30.0) corrected for biases in using self-reported height and weight.

Method of Calculation:

Normal weight:

$$\frac{\text{Weighted number of adults aged 18+ years with } 18.5 \leq \text{BMI (corrected)} \leq 24.99}{\text{Weighted total population aged 18+ years}} \times 100$$

Overweight:

$$\frac{\text{Weighted number of adults aged 18+ years with } 25.0 \leq \text{BMI (corrected)} \leq 29.99}{\text{Weighted total population aged 18+ years}} \times 100$$

Obese:

$$\frac{\text{Weighted number of adults aged 18+ years with BMI (corrected)} \geq 30.0}{\text{Weighted total population aged 18+years}} \times 100$$

Where BMI (corrected)[1] is calculated as follows:

- **Males:** *BMI (corrected) = -1.07575 + [1.07592×BMI (self-reported)]*
- **Females:** *BMI (corrected) = -0.12374 + [1.05129×BMI (self-reported)]*

- Respondents identified as a refusal, don't know or not stated to the required survey question were excluded.
- Respondents who were pregnant at the time of the survey were excluded.
- The calculation of BMI excluded respondents less than three feet (0.914 m) tall or those greater than six feet 11 inches (2.108 m).

Canadian Community Health Survey (CCHS) Survey Questions:

- How tall are you without shoes on?
- How much do you weigh?
- Are you pregnant?

PERCENTAGE OF ONTARIO ADULTS EATING VEGETABLES AND FRUIT FIVE OR MORE TIMES PER DAY

Definition: Percentage of Ontario adults aged 18 years and older who reported eating non-starchy vegetables and fruit five or more times per day.

Method of Calculation:

$$\frac{\text{Weighted number of adults aged 18+ years eating vegetables (excluding potatoes) and fruit five or more times per day}}{\text{Weighted total population aged 18+ years}} \times 100$$

- Respondents who reported consuming fruit juice more than once daily were considered as having consumed it only once. This decision is based on the 2007 World Cancer Research Fund/American Institute for Cancer Research report, which states that because the nutritional properties of fruit juice are different from those of whole fruits (e.g., fruit juices contain added sugars and minimal amounts of dietary fibre), fruit juice should only count as one portion per day, regardless of the amount consumed.[2]
- Respondents identified as a refusal, don't know or not stated to the required survey questions were excluded.

CCHS Survey Questions:

- How often do you usually drink fruit juices such as orange, grapefruit or tomato?
- Not counting juice, how often do you usually eat fruit?
- How often do you (usually) eat green salad?
- How often do you (usually) eat carrots?
- Not counting carrots, potatoes or salad, how many servings of other vegetables do you usually eat?

PERCENTAGE OF CANADIAN ADULTS EATING MORE THAN 500 g OF RED AND PROCESSED MEAT PER WEEK

Definition: Percentage of Canadian adults aged 18 years and older who reported eating more than 500 g of red meat (including beef, hamburger, pork or lamb) and processed meat (including beef or pork hot dogs, sausage or bacon) per week.

Method of Calculation:

$$\frac{\text{Weighted number of adults aged 18+ years eating more than 500 g of red and processed meat per week}}{\text{Weighted total population aged 18+ years}} \times 100$$

- Red and processed meat consumption was reported in times per year. Times per year was then converted to g/week. 500 g represents 6.67 times per week (or 347 times per year), assuming the Canada's Food Guide estimate of 75 g per serving.

Canadian Health Measures Survey (CHMS) Survey Questions:

- How often do you usually eat red meat, such as beef, hamburger, pork or lamb?
- How often do you usually eat beef or pork hot dogs?
- How often do you usually eat sausage or bacon (including all types of sausages, such as breakfast, pepperoni and Kielbassa, but excluding low-fat, light or turkey varieties)?

PERCENTAGE OF ONTARIO ADULTS WHO WERE MODERATELY ACTIVE OR ACTIVE DURING LEISURE TIME AND/OR TRANSPORTATION

Definition: Percentage of Ontario adults aged 18 years and older who reported levels of activity classified in CCHS as moderately active or active during leisure time and transportation physical activity.

Method of Calculation:

Leisure time physical activity:

$$\frac{\text{Weighted number of adults aged 18+ years who are moderately active or active during leisure time}}{\text{Weighted total population aged 18+ years}} \times 100$$

- Moderately active and active physical activity were based on the derived variable (PACDPAI) in the CCHS.
- Respondents identified as a refusal, don't know or not stated to the required survey questions were excluded.

Leisure time and transportation physical activity:

$$\frac{\text{Weighted number of adults aged 18+ years who are moderately active or active during leisure time and transportation}}{\text{Weighted total population aged 18+ years}} \times 100$$

- Moderately active and active physical activity were based on the derived variable (PACDLTI) in the CCHS.
- Respondents identified as a refusal, don't know or not stated to the required survey questions were excluded.

CCHS Survey Questions:

Now I'd like to ask you about some of your physical activities. To begin with, I'll be dealing with physical activities not related to work, that is, leisure time activities.

- Have you done any of the following in the past three months, that is, from (date three months ago) to yesterday? (choose from list of 21 activities: mark all that apply).
- In the past 3 months, did you do any other physical activity for leisure?
- What was this activity?
- In the past 3 months, how many times did you participate in the activity?
- About how much time did you spend on each occasion?
- Other than the (X) times you already reported walking/bicycling for exercise was there any other time in the past three months when you walked/bicycled to and from work or school?
  - How many times?
  - About how much time did you spend on each occasion?

PERCENTAGE OF ONTARIO ADULTS WHO REPORTED MORE THAN 14 HOURS OF LEISURE SCREEN TIME PER WEEK

Definition: Percentage of Ontario adults aged 18 years and older exceeding 14 hours of screen time (television, computer and video games) during leisure time per week.[3]

Method of Calculation:

$$\frac{\text{Weighted number of adults 18+ years reporting > 14 hours of screen time per week during leisure time}}{\text{Weighted total population aged 18+ years}} \times 100$$

- Respondents identified as a refusal, don't know or not stated to the required survey questions were excluded.

CCHS Survey Questions:

Now, a few additional questions about activities you do in your leisure time, that is, activities not at work or school.

- In a typical week in the past three months how many hours did you usually spend:
  - On a computer, including playing computer games and using the Internet?
  - Playing video games on a game console or on a hand-held electronic device?
  - Watching television or videos?

PERCENTAGE FOLLOWING CANCER PREVENTION RECOMMENDATIONS FOR VEGETABLE AND FRUIT CONSUMPTION, BODY FATNESS AND PHYSICAL ACTIVITY

Definition: Percentage of Ontario adults who are a normal body weight (corrected BMI 18.5 to 24.99), consume non-starchy vegetables and fruit five or more times daily and are moderately active or active during leisure time and transportation.

Method of Calculation:

The number of adults who met the criteria for normal body weight (corrected BMI 18.5 to 24.99), vegetable and fruit consumption (eating vegetables, excluding potatoes, and fruit five or more times per day) and being moderately active or active during leisure time and transportation (calculated according to the methods described for each individual indicator) were categorized into those meeting zero, one, two or all three recommendations. The weighted total for each category was divided by the weighted total population. Respondents meeting the exclusion criteria for any of the individual indicators were excluded from this analysis.

DEFINITION OF CANCER TYPES ASSOCIATED WITH OVERWEIGHT AND OBESITY

CANCER TYPE	ICD-O-3 SITE CODE*† (ICD-O-3 HISTOLOGY CODES)
Esophagus (adenocarcinoma)	C15 (8140–8141,8143–8145,8190–8231,8260–8263,8310,8401,8480–8490,8550–8551,8570–8574,8576)
Colon and rectum	C18–C20, C26.0
Pancreas	C25
Breast	C50
Endometrium	C54.1
Kidney (including renal pelvis)	C64.9, C65.9

* ICD-O-3 refers to the Third Edition of the International Classification of Diseases for Oncology (2000). ICD-O-3 site/histology codes were based on the Surveillance, Epidemiology, and End Results (SEER) site recode definition. See http://seer.cancer.gov/siterecode/icdo3_dwhoheme/index.html.
† For all cancers, except esophagus (adenocarcinoma), definitions include all histology codes, excluding 9590–9992, 9050–9055 and 9140.

APPENDIX C: ANALYTIC METHODS

PREVALENCE ESTIMATES

- Most estimates were age-standardized to the age distribution of the 2006 Canadian population using the age groups from the Canadian Community Health Survey (CCHS) person-level sampling strategy: 18–29, 30–44, 45–64 and 65+. The exceptions were age-specific estimates for which unadjusted estimates were provided.
- Bootstrapping techniques were used to obtain variance estimates and 95% confidence intervals of all estimates.[4]
- Time periods used for indicator calculations varied according to the availability of CCHS content for a given indicator or population:
- **2000/01:** Used in the population attributable fraction analyses to provide the greatest lag time between calculated body mass index (BMI) and cancer outcome.
- **2013:** Used for most analyses because it is the most current CCHS data available when writing this report.
- **2003–2013:** Used to examine time trends; estimates from the 2000/01 CCHS cycle were excluded because a change in the administration of the survey beginning in 2003 affected the comparability of some estimates.[5]
- **2012–2013 combined:** Pooled data used to increase the survey sample to a size that is acceptable for the release of indicators stratified by geographic regions and socio-demographic characteristics without introducing a high degree of sampling variability.
- Socio-demographic characteristics were analyzed for adults aged 30+ years to restrict the sample to those who have likely completed their education and reached their adult socio-demographic status. The selected socio-demographic factors were chosen for this analysis based on the availability and quality of the data from CCHS and the evidence suggesting an association between the risk factor and the socio-demographic variable.

  These factors were defined as follows:

  Urban/rural residence: Respondents living within any census metropolitan area (CMA) or census agglomeration (CA) were considered "urban residents" and those living outside of any CMA or CA were classified as "rural residents."

  Income quintile: Sorts respondents' derived household income into quintiles based on the ratio of household income to the low-income cut-off (LICO) for the household size and community. Starting in 2011, Statistics Canada imputed all missing household incomes to account for the one-third of missing responses to the income question.

  Education: Highest level of education attained by the respondent, according to three categories: less than secondary school graduation, secondary school graduation or some post-secondary education, and post-secondary graduation.

  Immigration status: Distinguishes immigrants, according to time since immigration, from the Canadian-born population based on three categories: Canadian-born, immigrant >10 years in Canada and immigrant ≤10 years in Canada. The years since immigration refers to the first time the respondent arrived in Canada (excluding holidays) to live as a landed immigrant, by claiming refugee status, with a work permit or with a study permit.
- Estimates for Local Health Integration Networks (LHINs) were analyzed using survey weights that were calibrated to the LHIN geographic boundaries, which do not correspond to the standard population weights at the public health unit (PHU) level.
- Statistically significant differences in risk factor prevalence between a given LHIN and Ontario, and between categories of a given socio-demographic factor were tested by comparing the absolute difference between the two estimates with the square root of the sum of the margin of error (i.e., the upper 95% confidence limit minus the estimate) squared for each estimate being compared. If the difference between the estimates was greater than the square root of the sum of the squares of the two margins of error, the estimates were considered significantly different (approximately $p < 0.05$).
  - Socio-demographic factors were compared against the following reference variables: urban areas for analyses by urban/rural residence, income quintile 5 (Q5) for analyses by income quintile, post-secondary graduate for analyses by education status and Canadian-born for analyses by immigration status.
- Socio-demographic differences were explored in this report, each on their own and then using logistic regression to control for their effects on one another. The logistic regression analyses were conducted using the "LOGREG " SAS macro included in the Bootvar program provided by Statistics Canada, which uses the SAS "logistic" procedure to calculate logistic regression parameter estimates, as well as corresponding odds ratios, Wald statistics and p-values.[4] For each regression model, the association between the selected indicators and several socio-demographic factors was examined, with age, urban/rural residence, income quintile, highest level of education and immigration status each included as independent variables. Other potential contributing factors have not been included in the regression models. Statistically significant differences were reported where $p < 0.05$ (see supplementary tables).

CANCERS ATTRIBUTABLE TO EXCESS BODY WEIGHT (OVERWEIGHT AND OBESITY)

- To estimate the number and proportion of cancers in Ontario adults attributable to excess body weight (overweight and obesity), the population attributable fraction (PAF) for overweight and obesity was calculated using Levin's frequently used formula:

$$PAF = \frac{[(P1(RR1 - 1) + P2(RR2 - 1))]}{[1 + (P1(RR1 - 1) + P2(RR2 - 1))]}$$

Where P1 is the prevalence of overweight ($25.0 \leq BMI \leq 29.99$), P2 is the prevalence of obesity ($BMI \geq 30.0$), RR1 is the relative risk of cancer for overweight vs. normal weight, RR2 is the relative risk of cancer for obesity vs. normal weight.

- The PAF was calculated for each cancer for which there is "convincing" evidence of an association with excess body weight (overweight and obesity).[2] Cancer types with "probable" evidence of an association with excess body weight were not included in the analysis, with the intention of providing a more conservative estimate.
- Relative risk estimates for overweight and obesity were primarily obtained from the meta-analyses conducted for the World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) second expert panel report, *Food, nutrition, physical activity and the prevention of cancer,*[2] or from the WCRF/AICR Continuous Update Project reports for breast cancer[6] or colorectal cancer,[7] as noted in Table C1 below. Similar to the methods used in a recent study that estimated the cancer burden attributable to overweight and obesity in the United Kingdom,[8] the relative risk estimates for a 5 kg/m^2 increase in body mass index (BMI) reported in the WCRF/AICR reports was used for the overweight category. For the obese category, the square of this value was used on the assumption that risk increases at a constant rate with increasing BMI.

TABLE C1. RELATIVE RISK ESTIMATES FOR OVERWEIGHT AND OBESITY WITH ASSOCIATED CANCER TYPES

CANCER TYPE	RELATIVE RISK	
	OVERWEIGHT	OBESE
Esophagus*	1.55	2.40
Colon and rectum[a]	1.10	1.21
Pancreas	1.14	1.30
Breast (post-menopausal)[b]	1.13	1.28
Endometrium	1.52	2.31
Kidney	1.31	1.72

Source: WCRF/AICR 2007 (except a. WCRF/AICR 2011, b. WCRF/AICR 2010)
Note: *Adenocarcinoma only

- The prevalence of overweight and obesity was calculated using the 2000/2001 Canadian Community Health Survey (CCHS), the earliest year for which data on BMI could be easily extracted. The proportion of Ontario adults in the overweight and obese categories was based on corrected BMI estimates, calculated using the sex-specific correction equations developed by Statistics Canada to adjust for biases in BMI estimates based on self-reported height and weight[1,9] (see Section 2.2, Box 2 and Appendix B, Adult Body Mass Index [corrected] for more information). Prevalence estimates were calculated by sex and age group. The age groups used were 18–29, 30–44, 45–64 and 65+, consistent with the age group sampling strategy of the CCHS.
- For each associated cancer type, PAFs were calculated by sex and age group, using the cancer-specific relative risk estimates noted above and the sex- and age-specific prevalence estimates of overweight and obesity.
- The number of cancers attributable to overweight and obesity was calculated for 2010, assuming a 10-year latency period between time of exposure to overweight and obesity and the time of cancer diagnosis. This assumption is consistent with the methods used by Parkin and Boyd[8] to estimate the burden of cancer attributable to overweight and obesity in the United Kingdom and by Brenner[10] in a similar analysis for Canada, and is in line with a meta-analysis of cohort studies that had a mean duration between overweight and obesity exposure and incident cancer ranging from 8.4 (for breast cancer) to 11.0 years (for colorectal cancer).[11] Based on this 10-year latency, the age groups used for extracting cancer incidence data were 28–39, 40–54, 54–74 and 75+. Since overweight and obesity are only risk factors for post-menopausal breast cancers, only breast cancers occurring in women aged 50 years or older were considered as potentially being attributable to overweight and obesity.
- For each sex and age group combination, the number of cases of a given cancer attributable to overweight and obesity was calculated by multiplying the sex- and age-specific PAF for that cancer type with the number of cancers diagnosed in that sex and age group combination. To obtain an estimate of the total number of cases of a given cancer attributable to overweight and obesity, the number of attributable cancers in each age group was summed for each cancer type by sex.
- This method for calculating the number of cancers attributable to overweight and obesity adopts several assumptions that may underestimate or overestimate the true number of cancers attributable to these factors in Ontario. Most notably:
  - The relationship between BMI and cancer risk is linear, with risk increasing at a constant rate with increasing BMI.
  - Individuals within the overweight and obese categories have the same risk of cancer as all others within their BMI category.
  - A latency period of 10 years between exposure to overweight and obesity and the development of cancer is appropriate.
  - The risk of cancer associated with overweight and obesity does not differ between males and females, although small differences between males and females have been observed for some cancers, particularly colorectal cancer, in some studies.[11]
  - The cancer types for which the evidence of an association with overweight and obesity is less than "convincing," as classified by the WCRF/AICR, are not associated with overweight or obesity and therefore zero cases of these cancers are attributable to these factors.

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For more information:

The *Cancer Risk Factors in Ontario* publication series is designed to support Cancer Care Ontario's priority to reduce chronic disease through prevention.

- ***Cancer Risk Factors in Ontario: Evidence Summary***, published 2013, is the first report in the series and summarizes the epidemiologic evidence for a wide range of cancer risk factors.
  Please see www.cancercare.on.ca/riskfactor
- ***Cancer Risk Factors in Ontario: Tobacco***, published early 2014, provides information on tobacco use in Ontario as it relates to cancer and estimates the smoking-related cancer risk in the population.
  Please see www.cancercare.on.ca/tobaccoreport
- ***Cancer Risk Factors in Ontario: Alcohol***, published April 2014, provides information on alcohol use in Ontario as it relates to cancer and estimates the alcohol-related cancer risk in the population.
  Please see www.cancercare.on.ca/alcoholreport

Ontario Cancer Facts are short, monthly fact sheets intended to increase knowledge about cancer and its risk modifiers in Ontario. Data typically originate from several sources including the Ontario Cancer Registry, Cancer Care Ontario publications, and Canadian, provincial or regional health surveys. Readers may subscribe to receive *Ontario Cancer Facts* by e-mail.
Please see www.cancercare.on.ca/cancerfacts

In 2012 Cancer Care Ontario partnered with Public Health Ontario to release ***Taking Action to Prevent Chronic Disease: Recommendations for a healthier Ontario***. The report outlines population-level recommendations to address the modifiable risk factors of tobacco use, alcohol consumption, unhealthy eating and physical inactivity. These evidence-informed recommendations identify policy-based interventions and system-wide changes to inform provincial action on the four risk factors associated with chronic disease, build capacity for chronic disease prevention and work towards health equity.
Please visit https://cancercare.on.ca/takingaction

Cancer Care Ontario has launched ***My CancerIQ***™, a suite of online personalized cancer risk assessments to help Ontarians assess their cancer risk and take action to reduce it. Questions vary according to the type of cancer, but *My CancerIQ* assessments probe on a variety of risk and protective factors: family and personal medical history, lifestyle, and occupational and environmental exposures. *My CancerIQ* launched with assessments for colorectal, lung, cervical and female breast cancer and additional assessments will be added each year.
Please visit www.mycanceriq.ca to find out more.

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