Health Reports

Vol. 17 No. 3

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- Childhood obesity
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···   not applicable

p   preliminary figures

r   revised figures

x   suppressed to meet the confidentiality requirements of the *Statistics Act*

E   use with caution

F   too unreliable to be published

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Adult obesity

Michael Tjepkema

Abstract

Objectives
Based on direct measures of height and weight, this article compares the prevalence of obesity among adults aged 18 or older in 1978/79 and 2004. Prevalence by demographic, socio-economic and lifestyle characteristics is presented, along with associations between obesity and selected chronic conditions. Canadian and US data are also compared.

Data sources
Data are from the 2004 Canadian Community Health Survey: Nutrition, the 1978/79 Canada Health Survey and the 1986 to 1992 Canadian Heart Health Surveys. US data are from the 1999-2002 National Health and Nutrition Examination Survey.

Analytical techniques
Descriptive statistics were used to estimate the proportion of adults who were obese in 2004 in relation to selected characteristics. Logistic regression models were used to examine relationships between obesity and high blood pressure, diabetes and heart disease, controlling for socio-economic status and other risk factors such as smoking and physical activity.

Main results
In 2004, 23% of adults, 5.5 million people aged 18 or older, were obese—up substantially from 14% in 1978/79. An additional 36% (8.6 million) were overweight. Obese individuals tended to have sedentary leisure-time pursuits and to consume fruit and vegetables infrequently. As body mass index (BMI) increased, so did an individual's likelihood of reporting high blood pressure, diabetes and heart disease.

Keywords
body weight, body mass index, health behaviour, lifestyle

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The percentage of Canadians who are overweight or obese has risen dramatically in recent years, mirroring a worldwide phenomenon.[1-4] The health consequences of excess weight are well known. It is a risk factor for type 2 diabetes, cardiovascular disease, high blood pressure, osteoarthritis, some cancers, and gallbladder disease.[5-7] As well, psychosocial problems, functional limitations and disabilities are associated with being overweight or obese.[5,8]

For more than a decade, information about Canadians' weight has been based on self-reports; that is, survey respondents have reported their own height and weight. However, such data are known to underestimate the prevalence of overweight and obesity.[9-12] The 2004 Canadian Community Health Survey (CCHS): Nutrition, which measured respondents' height and weight, makes it possible to draw a more accurate picture.

To trace trends in obesity over the last quarter century, results from the CCHS are compared with findings from earlier Canadian surveys that also took direct measures of height and weight (see *Methods*). As well, the 2004 results for Canada are compared with American data from the 1999-2002 National Health and Nutrition Examination Survey (NHANES).

Methods

Data sources

Data from the 2004 Canadian Community Health Survey (CCHS): Nutrition were used to estimate the prevalence of overweight and obesity among adults aged 18 or older by selected demographic, lifestyle and socio-economic factors (see http://www.statcan.ca/english/concepts/hs/index.htm). The 2004 CCHS was designed to gather information on the nutritional status of the Canadian population at the provincial level. It excludes residents of institutions, the three territories, Indian reserves, some remote areas, members of the regular Armed Forces, and civilian residents of military bases. The response rate was 76.5%. The height and weight of 57.5% of adults (18 or older) who responded to the survey were measured (see *Limitations*).

Historical estimates of obesity in Canada, based on measured height and weight, are from the 1978/79 Canada Health Survey (CHS) and the Canadian Heart Health Surveys that were conducted in different provinces during the 1986-to-1992 period. Estimates based on self-reported data are from the 1985 and 1990 Health Promotion Survey, the 1994/95, 1996/97 and 1998/99 National Population Health Survey (NPHS), and the 2000/01 and 2003 CCHS.

Overweight and obesity among American adults were estimated using data from the 1999-2002 National Health and Nutrition Examination Survey (NHANES). The NHANES obtained direct measures of height and weight for 9,488 respondents aged 18 or older.

Analytical techniques

Descriptive statistics were used to estimate the proportion of adults who were obese in relation to selected characteristics (Appendix Tables A, B and C). Actual measures of height and weight were obtained for 12,428 CCHS respondents aged 18 or older. Because they represented just 57.5% of adults who responded to the 2004 CCHS, an adjustment was made to minimize non-response bias. A special sampling weight was created by redistributing the sampling weights of non-respondents to respondents using response propensity classes. Variables such as province, age, sex, household income, education, ethnicity, physical activity, fruit and vegetable consumption and chronic conditions were used to create the classes. The classes were created with the CHAID (Chi-Square Automatic Interaction Detector) algorithm available in Knowledge Seeker[13] to identify the characteristics that best split the sample into groups that were dissimilar with respect to response/non-response. This adjusted sampling weight was used to produce all the estimates in this analysis. Standard errors and coefficients of variation were estimated with the bootstrap technique, which accounts for the survey design effects.[14-16]

The body mass index (BMI) distribution (Chart 2) was smoothed by calculating three-point averages. For example, the percentage of the population with a BMI of 23 was calculated by summing the percentage with a BMI of 22, the percentage with a BMI of 23 and the percentage with a BMI of 24, and dividing the result by 3.

Standard errors and coefficients of variation for estimates from the 1978/79 CHS and the 1999-2002 NHANES were estimated with SUDAAN, which uses a Taylor series linearization method to account for the complex survey sample design.[17] The American estimates and Canadian historical estimates are based on weighted data.

To compare the prevalence of obesity between surveys, the data were age-standardized to the 2004 CCHS using the direct method. The following age groups were used: 18 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, 65 to 74, and 75 or older.

Logistic regression models were used to determine if associations between obesity and fruit and vegetable consumption and leisure-time physical activity remained when age, marital status, education and household income were taken into account.

Separate logistic regressions for each sex were used to model having high blood pressure, diabetes or heart disease in relation to BMI. The model included the following control variables: age, marital status, education, household income, smoking and leisure-time physical activity. Respondents who were underweight or had missing information for education, smoking or leisure-time physical activity were excluded from the models.

Table 1
Percentage distribution of household population aged 18 or older, by sex and body mass index (BMI) category, Canada excluding territories, 2004

BMI category (range)	Both sexes		Men		Women	
	'000	%	'000	%	'000	%
Overweight and obese (≥ 25)	14,185	59.1	7,706	65.0*	6,480	53.4
Obese (≥ 30)	5,539	23.1	2,722	22.9	2,817	23.2
Underweight (< 18.5)	471	2.0	170E	1.4*E	302	2.5
Normal weight (18.5 to 24.9)	9,328	38.9	3,986	33.6*	5,343	44.1
Overweight (not obese) (25.0 to 29.9)	8,647	36.1	4,984	42.0*	3,663	30.2
Obese Class I (30.0 to 34.9)	3,656	15.2	1,959	16.5	1,697	14.0
Obese Class II (35.0 to 39.9)	1,231	5.1	568	4.8	663	5.5
Obese Class III (≥ 40.0)	651	2.7	194	1.6*	457	3.8

Data source: *2004 Canadian Community Health Survey: Nutrition*
* Significantly different from corresponding estimate for women (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Majority overweight or obese

According to the 2004 CCHS, 23.1% of Canadians aged 18 or older, an estimated 5.5 million adults, had a body mass index (BMI) of 30 or more, indicating that they were obese (Table 1) (see *What is BMI?*). This is significantly higher than the 2003 estimate of 15.2%, which was derived from self-reported data (see *Methodology makes a difference*). Another 8.6 million Canadian adults (36.1%) were overweight in 2004.

Because BMIs vary greatly among people who are obese, obesity has been divided into three levels, with successive values representing escalating health risks.[3,5] People in Class I (BMI 30.0 to 34.9) have a high risk of developing health problems. For those in Class II (BMI 35.0 to 39.9), the risk is

very high, and in Class III (BMI 40 or more), extremely high. In 2004, 15.2% of Canadian adults had a BMI that put them in Class I; 5.1% were in Class II, and 2.7% were in Class III.

Sharp increase

In 1978/79, the Canada Health Survey collected measurements of height and weight for a nationally representative sample of adults. That year, the age-adjusted obesity estimate was 13.8%, far below the 2004 figure of 23.1%. The increase was evident for each level of obesity, especially the two higher classes (Table 2). The proportion of adults in Class II rose from 2.3% to 5.1%; in Class III, from 0.9% to 2.7%.

Table 2
Percentage distribution of household population aged 18 or older, by sex and body mass index (BMI) category, Canada excluding territories, 1978/79 and 2004

BMI category (range)	Both sexes		Men		Women	
	1978/79	2004	1978/79	2004	1978/79	2004
Overweight and obese (≥ 25)	49.2	59.1*	54.0	65.0*	44.6	53.4*
Obese (≥ 30)	13.8	23.1*	11.5	22.9*	15.9	23.2*
Underweight (< 18.5)	2.4	2.0	1.3E	1.4E	3.4	2.5
Normal weight (18.5 to 24.9)	48.4	38.9*	44.6	33.6*	52.0	44.1*
Overweight (not obese) (25.0 to 29.9)	35.4	36.1	42.5	42.0	28.7	30.2
Obese Class I (30.0 to 34.9)	10.5	15.2*	9.5	16.5*	11.5	14.0*
Obese Class II (35.0 to 39.9)	2.3E	5.1*	F	4.8*	2.9	5.5*
Obese Class III (≥ 40.0)	0.9E	2.7*	F	1.6*	1.5E	3.8*
Average BMI	25.4	27.0*	25.6	27.2*	25.2	26.7*

Data sources: *1978/79 Canada Health Survey; 2004 Canadian Community Health Survey: Nutrition*
Note: *The 1978/79 Canada Health Survey estimates were age-standardized to the 2004 CCHS population.*
* Significantly different from corresponding estimate for 1978/79 (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)
F Coefficient of variation greater than 33.3% (suppressed because of extreme sampling variability)

What is BMI?

Overweight and obesity are based on body mass index (BMI), which is a measure of an individual's weight in relation to his or her height. BMI is highly correlated with body fat and is widely used to indicate health risks.[5] According to Canadian guidelines, which are in line with those of the World Health Organization, BMI for adults is classified into six categories, each representing a different level of health risk:

BMI		Level of health risk
Category	**Range**	
Underweight	< 18.5	Increased
Normal weight	18.5 to 24.9	Least
Overweight	25.0 to 29.9	Increased
Obese Class I	30.0 to 34.9	High
Obese Class II	35.0 to 39.9	Very high
Obese Class III	≥ 40.0	Extremely high

BMI is calculated as follows:
Metric: BMI=weight (kg)/height (metres)^2
Non-metric: BMI=weight (pounds)/height (inches)^2 x 703

For example, the weight ranges that would place an individual with a height of 1.78m (5′10″) in the various BMI classes are:

	Weight	
	Kilograms	**Pounds**
Underweight	≤ 58.4	≤ 128
Normal weight	58.5 - 79.0	129 - 173
Overweight	79.1 - 94.8	174 - 208
Obese Class I	94.9 - 110.7	209 - 243
Obese Class II	110.8 - 126.5	244 - 278
Obese Class III	≥ 126.6	≥ 279

From 1978/79 to 2004, the prevalence of obesity rose in every age group except 65 to 74 (Chart 1). The most striking increases were among people younger than 35 and those 75 or older. For instance, the percentage of 25- to 34-year-olds who were obese more than doubled from 8.5% to 20.5%. The magnitude of the increase among people aged 75 or older was about the same: from 10.6% to 23.6%.

The median BMI of adults rose from 24.4 in 1978/79 to 26.1 in 2004, and the BMI distribution of the adult population shifted toward the overweight and obese ranges (Chart 2).

Chart 1
Percentage obese, by age group, household population aged 18 or older, Canada excluding territories, 1978/79 and 2004
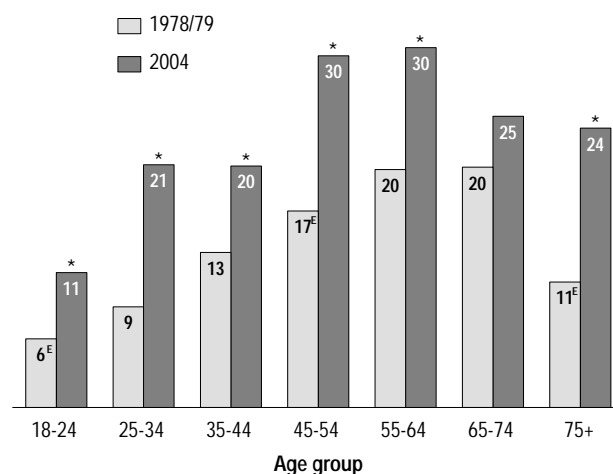
Data sources: *1978/79 Canada Health Survey; 2004 Canadian Community Health Survey: Nutrition*
* Significantly higher than estimate for 1978/79 (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Chart 2
Percentage distribution of household population aged 18 or older, by body mass index (BMI), Canada excluding territories, 1978/79 and 2004
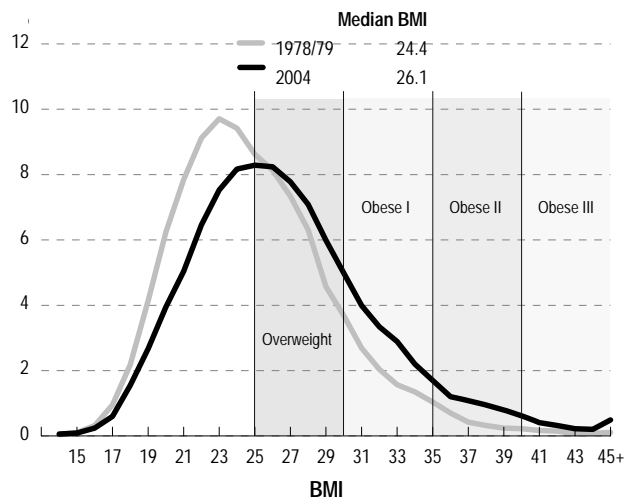
Data sources: *1978/79 Canada Health Survey; 2004 Canadian Community Health Survey: Nutrition*

Peaks in middle-age

In 2004, men and women were equally likely to be obese: 22.9% and 23.2%, respectively (Table 1). However, when the three classes of obesity were examined separately, a difference between the sexes

emerged: a higher percentage of women were in Class III (Chart 3).

For both sexes, obesity was lowest at ages 18 to 24 (10.7% of men and 12.1% of women), and peaked at around 30% among 45- to 64-year-olds (Chart 4).

Chart 3

Percentage distribution of household population aged 18 or older, by sex and body mass index (BMI) category, Canada excluding territories, 2004
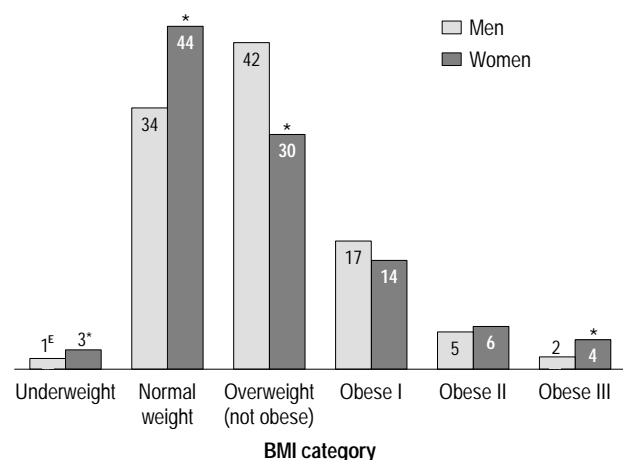
Data source: 2004 Canadian Community Health Survey: Nutrition
* Significantly different from estimate for men (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Chart 4

Percentage obese, by sex and age group, household population aged 18 or older, Canada excluding territories, 2004

Data source: 2004 Canadian Community Health Survey: Nutrition
* Significantly different from overall estimate for same sex (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Canada/United States

While information about obesity in Canada has usually been based on self-reported data, the United States has collected actual measurements of height and weight since the early 1960s. With the direct measurements obtained by the 2004 CCHS, it is possible to compare the prevalence of obesity in the two countries.

Age-standardized results show that 29.7% of Americans aged 18 or older were obese in 1999-2002, significantly above the 2004 figure for Canada (23.1%) (Table 3). Most of this difference was attributable to the situation among women. Whereas 23.2% of Canadian women were obese, the figure for American women was 32.7%. As well, each class of obesity contained a higher percentage of American than Canadian women. This difference prevailed for women in all age groups except 45-to-54 and 75-or-older (Chart 5).

The percentage of Canadian men who were obese was also significantly below the figure for American men: 22.9% versus 26.6%. However, this was mainly a reflection of Class III obesity: American men were much more likely to have a BMI of 40 or more. The percentages of Canadian

Chart 5

Percentage obese, by age group, female household population aged 18 or older, Canada excluding territories (2004) and United States (1999-2002)
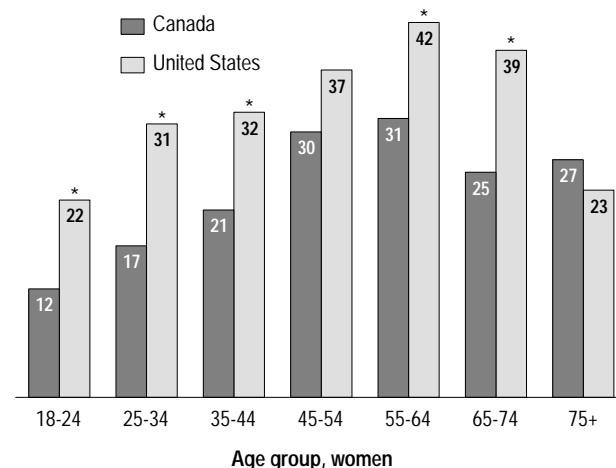
Data sources: 2004 Canadian Community Health Survey: Nutrition;
1999-2002 National Health and Nutrition Examination Survey
* Significantly different from estimate for Canada (p < 0.05)

Table 3
Percentage distribution of household population aged 18 or older, by sex, race and body mass index (BMI) category, Canada excluding territories (2004) and United States (1999-2002)

BMI category (range)	Both sexes				Men				Women			
	All races		White		All races		White		All races		White	
	Canada	US	Canada	US	Canada	US	Canada	US	Canada	US	Canada	US
	%		%		%		%		%		%	
Overweight and obese (≥ 25)	59.1	64.0*	61.7	62.9	65.0	67.2	69.0	68.5	53.4	60.9*	54.7	57.4
Obese (≥ 30)	23.1	29.7*	25.2	29.2*	22.9	26.6*	25.5	27.6	23.2	32.7*	24.8	30.8*
Underweight (< 18.5)	2.0	2.1	1.7	2.2	1.4^E	1.2^E	1.1^E	1.1^E	2.5	2.9	2.2	3.3*
Normal weight (18.5 to 24.9)	38.9	34.0*	36.6	34.8*	33.6	31.6	29.9	30.4	44.1	36.2*	43.1	39.2
Overweight (not obese) (25.0 to 29.9)	36.1	34.3	36.5	33.7*	42.0	40.6	43.4	40.9	30.2	28.2	29.9	26.6
Obese Class I (30.0 to 34.9)	15.2	17.4*	16.5	17.4	16.5	17.5	18.3	18.7	14.0	17.3*	14.7	16.2
Obese Class II (35.0 to 39.9)	5.1	7.6*	5.6	7.5*	4.8	5.8	5.3	5.6	5.5	9.3*	5.8	9.3*
Obese Class III (≥ 40.0)	2.7	4.7*	3.1	4.3*	1.6	3.3*	1.9^E	3.3*	3.8	6.1*	4.2	5.3
Average BMI	27.0	27.9*	27.3	27.8*	27.2	27.7*	27.6	27.9	26.7	28.1*	27.1	27.6*

Data sources: *2004 Canadian Community Health Survey: Nutrition; 1999-2002 National Health and Nutrition Examination Survey*
Note: *The 1999-2002 NHANES estimates were age-standardized to the 2004 CCHS population.*
* Significantly different from estimate for Canada (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

and American men whose BMIs placed them in Class I or II were statistically similar. American men aged 18 to 24, 35 to 44 and 65 to 74 were more likely than their Canadian counterparts to be obese (Chart 6).

The racial make-up of the two countries may

Chart 6
Percentage obese, by age group, male household population aged 18 or older, Canada excluding territories (2004) and United States (1999-2002)
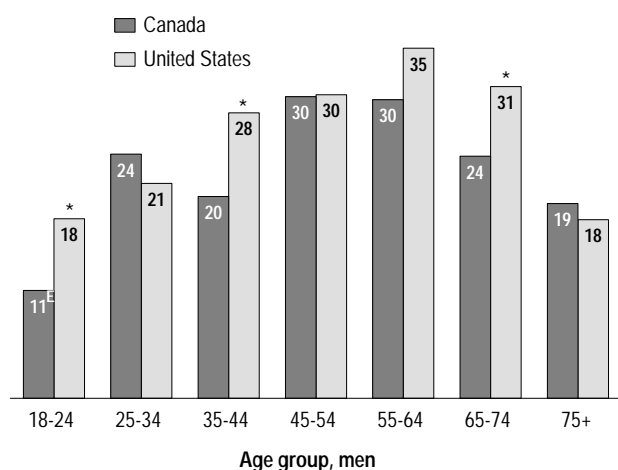
Data sources: *2004 Canadian Community Health Survey: Nutrition; 1999-2002 National Health and Nutrition Examination Survey*
* Significantly different from estimate for Canada (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

explain some of the differences, as research has shown that the prevalence of obesity varies by ethnic origin (see *Definitions*).[18] In fact, the percentages of White American and Canadian men who were obese did not differ significantly. However, White women in the United States were strikingly more likely than those in Canada to be obese: 30.3% versus 24.8% (Table 3)

In Canada, a high percentage of people of Aboriginal origin (off-reserve) were obese—37.8%—about 1.6 times the national figure (Appendix Tables A, B and C). These results are consistent with other research based on self-reported data.[18]

Related to lifestyle

Diet and exercise, not surprisingly, were related to obesity. Men and women who ate fruit and vegetables less than three times a day were more likely to be obese than were those who consumed such foods five or more times (Chart 7). Although other factors may be driving this relationship, the association persisted when age and socio-economic status were taken into account (data not shown). Another study has also shown obesity to be independently associated with infrequent consumption of fruit and vegetables.[21] However,

Definitions

The *frequency of fruit and vegetable consumption* was assessed with questions from the Behavioral Risk Factor Surveillance System in the United States.[19] Respondents were asked:

- "How often do you usually drink fruit juices such as orange, grapefruit or tomato?" (for example, once a day, three times a week, twice a month)
- "Not counting juice, how often do you usually eat fruit?"
- "How often do you usually eat green salad?"
- "How often do you usually eat potatoes, not including French fries, fried potatoes, or potato chips?"
- "How often do you usually eat carrots?"
- "Not counting carrots, potatoes or salad, how many servings of other vegetables do you usually eat?"

Leisure-time physical activity level was based on total energy expenditure (EE) during leisure time. EE was calculated from the reported frequency and duration of all of a respondent's leisure-time physical activities in the three months before his or her 2004 CCHS interview and the metabolic energy demand (MET value) of each activity, which was independently established.[20]

$EE = \sum (N_i * D_i * MET_i / 365 \text{ days})$, where

N_i = number of occasions of activity i in a year,

D_i = average duration in hours of activity i, and

MET_i = a constant value for metabolic energy cost of activity i.

An EE of 3 or more kilocalories per kilogram per day (KKD) was defined as *active*; 1.5 to 2.9 KKD, *moderately active*; and less than 1.5 KKD, *sedentary*.

Ethnicity was based on the question: "People living in Canada come from many different cultural and racial backgrounds. Are you:

1. White?"
2. Chinese?"
3. South Asian (e.g., East Indian, Pakistani, Sri Lankan, etc.?)"
4. Black?"
5. Filipino?"
6. Latin American?"
7. Southeast Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese, etc.)?"
8. Arab?"
9. West Asian (e.g., Afghan, Iranian, etc.)?"
10. Japanese?"
11. Korean?"
12. Aboriginal Peoples of North America (North American Indian, Métis, Inuit)?"
13. Other – specify.

For the comparison with the White population in the United States, category 1 was selected. To compare ethnic groups within Canada, the following categories were used: White (1); Black (4); Southeast/East Asian (2, 5, 7, 10, 11); off-reserve Aboriginal (12); and Other (3, 6, 8, 9, 13). Multiple responses across the categories defined here were coded to "Other."

Four categories were established for current *marital status*: married or living common-law; divorced or separated; widowed; and never married.

Household income was based on the number of people in the household and total household income from all sources in the 12 months before the interview.

Household income group	People in household	Total household income
Lowest	1 to 4	Less than $10,000
	5 or more	Less than $15,000
Lower-middle	1 or 2	$10,000 to $14,999
	3 or 4	$10,000 to $19,999
	5 or more	$15,000 to $29,999
Middle	1 or 2	$15,000 to $29,999
	3 or 4	$20,000 to $39,999
	5 or more	$30,000 to $59,999
Upper-middle	1 or 2	$30,000 to $59,999
	3 or 4	$40,000 to $79,999
	5 or more	$60,000 to $79,999
Highest	1 or 2	$60,000 or more
	3 or more	$80,000 or more

Respondents were grouped into four *education* categories based on the highest level attained: less than secondary graduation, secondary graduation, some postsecondary, and postsecondary graduation.

To measure chronic conditions, respondents were asked about long-term physical conditions that had lasted or were expected to last six months or longer and that had been diagnosed by a health professional. Three conditions were considered for this analysis: *high blood pressure*, *diabetes* and *heart disease*.

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because the CCHS data are cross-sectional, the direction of this relationship cannot be determined (see *Limitations*).

Physical activity, too, was related to obesity. People who were sedentary in their leisure time were more likely than those who were physically active to be obese. For example, 27.0% of sedentary men were obese, compared with 19.6% of active men (Chart 8). Among women, the prevalence of obesity was high not only for those who were sedentary, but also for those who were moderately active. These relationships remained statistically significant when adjustments were made to account for age and socio-economic status (data not shown).

Socio-economic differences

The likelihood of being obese varied by marital status for women, but not for men (Chart 9). Just under a quarter (23.4%) of married women aged

Chart 7
Percentage obese, by sex and daily fruit and vegetable consumption, household population aged 18 or older, Canada excluding territories, 2004

Daily fruit and vegetable consumption

Men		Women
* 26	Less than 3 times	27 *
23	3 to less than 5 times	23
19	5 or more times	20
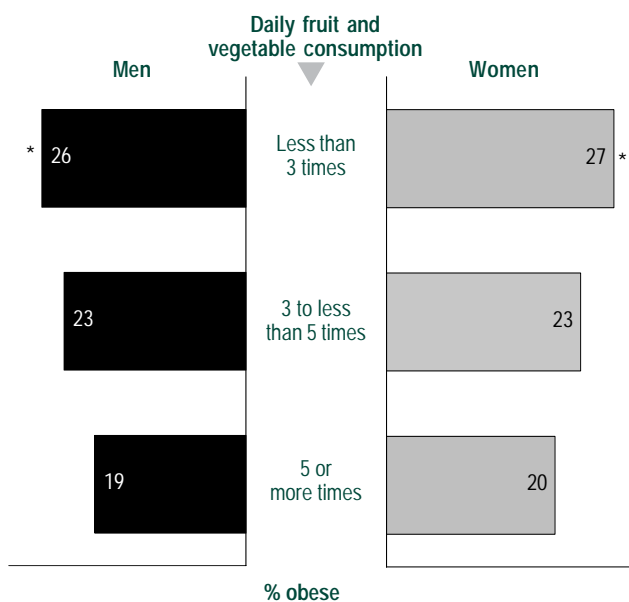
% obese

Data source: 2004 Canadian Community Health Survey: Nutrition
* Significantly different from estimate for 5 or more times (p < 0.05)

Chart 9
Percentage obese, by sex and marital status, household population aged 25 or older, Canada excluding territories, 2004
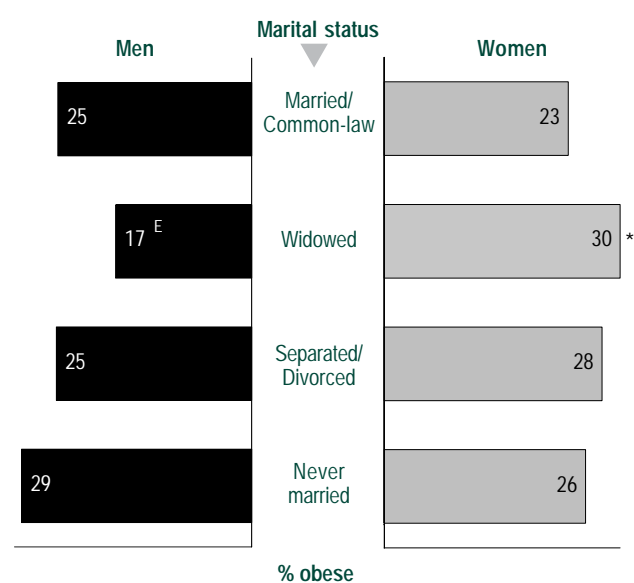
Marital status

Men		Women
25	Married/Common-law	23
17 E	Widowed	30 *
25	Separated/Divorced	28
29	Never married	26

% obese

Data source: 2004 Canadian Community Health Survey: Nutrition
* Significantly different from estimate for married/common-law category (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Chart 8
Percentage obese, by sex and leisure-time physical activity level, household population aged 18 or older, Canada excluding territories, 2004

Leisure-time physical activity level

Men		Women
20	Active	14
17	Moderately active	21 *
* 27	Sedentary	27 *
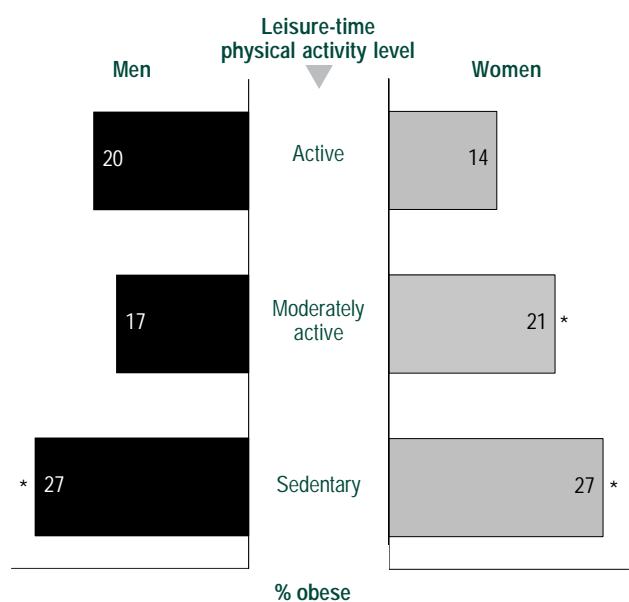
% obese

Data source: 2004 Canadian Community Health Survey: Nutrition
* Significantly different from estimate for active category (p < 0.05)

Chart 10
Percentage obese, by sex and educational attainment, household population aged 25 to 64, Canada excluding territories, 2004

Educational attainment

Men		Women
* 35	Less than secondary graduation	37 *
* 32	Secondary graduation	25
23 E	Some postsecondary	32 *
22	Postsecondary graduation	21

% obese

Data source: 2004 Canadian Community Health Survey: Nutrition
* Significantly different from estimate for postsecondary graduation category (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Methodology makes a difference

In the United States, data from the National Health and Nutritional Examination Survey (NHANES) show sharp increases in the prevalence of obesity among adults from 1976-1980 to 1988-1994 and, again, from 1988-1994 to 1999-2002.[22]

Because of variations in the methods used to collect information on height and weight, it is difficult to pinpoint when the prevalence of obesity increased in Canada. Comparable obesity estimates[23] for adults aged 18 or older, based on directly measured height and weight, can be calculated for 1978/79, the 1986-to-1992 period, and 2004 (see *Methods*). The data reveal little change in the proportion of adults who were obese between 1978/79 and 1986-1992, but a substantial increase by 2004. Although the percentages are consistently lower, self-reported data show that the prevalence of obesity increased substantially between 1985 and 1994/95, but stabilized from 1994/95 to 2003.

Between 2003 and 2004, when the data collection method changed to direct measures, the prevalence of obesity rose sharply. This is not surprising, as self-reports generally yield lower estimates of overweight and obesity.[9-12] Women are inclined to underestimate their weight, while men tend to overestimate their height. Moreover, underreporting of weight increases with higher levels of BMI.[24]

Another problem with overweight/obesity information based on self-reports is variation in the mode of collection. Self-reported data from face-to-face interviews result in a higher prevalence of obesity than do data collected from telephone interviews.[25] In Canada, in 1985 and 1990, all interviews were conducted by telephone. In 1994/95, almost all interviews took place in person; in 1996/97 and 1998/99, most were by telephone. In 2000/01, interviews were approximately half and half, and in 2003, about one-quarter were in person.

Trends in obesity, based on direct measures and self-reported data, household population aged 18 or older, Canada excluding territories, selected years, 1978/79 to 2004
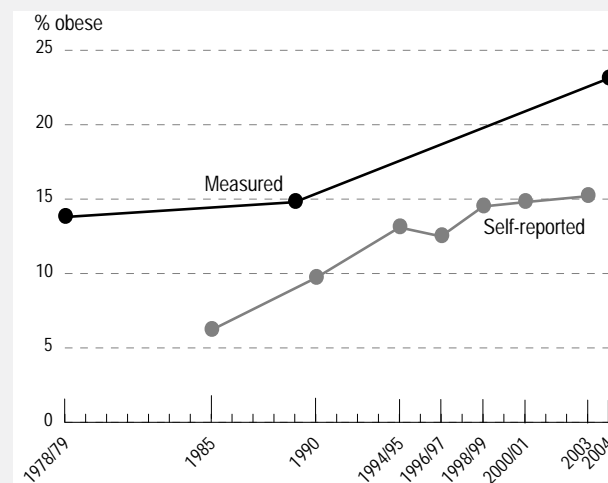
Data sources: Measured: 1978/79 Canada Health Survey; 1986-1992 Canadian Heart Health Surveys (ages 18 to 74); 2004 Canadian Community Health Survey: Nutrition. Self-reported: 1985 and 1990 Health Promotion Survey; 1994/95, 1996/97 and 1998/99 National Population Health Survey; 2000/01 and 2003 Canadian Community Health Survey.
Notes: All survey data have been age-standardized to the 2004 CCHS population. Age-adjusted obesity rates based on measured height and weight for the population aged 18 to 74 are as follows: 13.7% (1978/79), 14.6% (1986-1992) and 23.1% (2004).

25 or older were obese. The percentage was significantly higher among women who were widowed (30.0%). By contrast, the percentages of married, widowed, separated/divorced and never-married men who were obese did not differ significantly.

The association between level of education and obesity was not straightforward. Men aged 25 to 64 with secondary graduation or less were significantly more likely to be obese than were men with postsecondary graduation (Chart 10). Among women, those with less than secondary graduation were more likely than postsecondary graduates to be obese. As well, obesity among women who had some, but not a complete, postsecondary education, was high.

Men in lower-middle income households were less likely to be obese than those in the highest income households (Chart 11). For women, those in middle and upper-middle income households had a significantly elevated likelihood of being obese, compared with women in the highest income households. When age was taken into account, the associations between level of income and obesity persisted for men, but for women, only those in middle income households were more likely to be obese (data not shown).

Limitations

For various reasons, 42.5% of respondents who participated in the 2004 Canadian Community Health Survey (CCHS) did not have their weight and height directly measured. This level of non-response might bias estimates if these people differed systematically from those for whom measurements were obtained. A special technique was employed to reduce the possibility of such bias (see *Methods*). Overall, men had a lower response rate than women: 54.4% versus 60.6%.

Percentage distribution of respondents, by response and reason for non-response

	Total	Men	Women
	%	%	%
Total	100.0	100.0	100.0
Measured	57.5	54.4	60.6
Not measured, total	42.5	45.6	39.4
Refusal	13.6	13.0	14.2
Measuring equipment	9.0	8.6	9.3
Too tall for interviewer to measure	7.1	11.5	2.8
Telephone interview	4.5	4.5	4.4
Interview setting	3.5	4.2	2.8
Physical condition	1.8	1.4	2.1
Other	3.0	2.3	3.8

Data source: *2004 Canadian Community Health Survey: Nutrition*

Men's response rates differed significantly by age and household income; women's, by fruit and vegetable consumption, marital status, and household income (Appendix Table D).

Although body mass index (BMI) classifications using data from the 1978/79 Canada Health Survey (CHS), the 1986 to 1992 Canadian Heart Health Surveys (CHHS), the 1999-2002 National Health and Nutrition Examination Survey (NHANES) and the 2004 Canadian Community Health Survey (CCHS) were based on direct measurements of height and weight, the surveys did not use the same collection methods. For example, for the 2004 CCHS, field interviewers used portable electronic scales to weigh respondents in their homes; for the 1999-2002 NHANES, health professionals measured respondents in mobile laboratories.

BMI has a number of limitations. It does not measure the distribution of body fat, which is important because excess fat in the abdominal area is associated with increased health risks.[5] BMI may misclassify young adults who have not reached full growth, people who are naturally very lean or very muscular, people who are very tall or very short, and certain ethnic or racial groups.[18] For this reason, BMI is a good measure at the population level, but not necessarily at the individual level.

BMI should not be calculated for pregnant women.[5] However, because pregnancy status was not asked in the 1978/79 CHS, the 1985 and 1990 Health Promotion Surveys, and the 1986 to 1992 Canada Heart Health Surveys, pregnant women could not be excluded.

In the 2004 CCHS, variables other than height and weight were self-reported. The degree to which these variables accurately reflect a person's health status/characteristics is not known.

Respondents were asked about their leisure-time physical activities over the past three months. The results may have been affected by recall problems. Moreover, because physical activity at school and work were excluded, leisure time may not accurately reflect overall physical activity.

The questions on fruit and vegetable consumption pertain to the number of times a day such foods were consumed, not the amounts consumed. Because portion size was not specified, compliance with daily intake recommendations, such as the Canada Food Guide, cannot be assessed.

Rather than weight itself, factors associated with weight such as physical activity, body composition, visceral adiposity, physical fitness or dietary intake might be responsible for some or all of the associations of weight with high blood pressure, diabetes and heart disease.[26] As well, some diseases cause weight loss, while others are associated with weight gain. This analysis does not take into account recent weight gain/loss, which may be independently associated with poor health.

It was not possible to differentiate between type 1, type 2 and gestational diabetes in this analysis. Since the risk factors for the various forms of diabetes differ, the strength of the relationship between BMI and the prevalence of "adult onset" diabetes (type 2) may have been diluted.

Because the CCHS is cross-sectional, no causality between obesity and a health behaviour or other characteristic can be inferred.

Chart 11
Percentage obese, by sex and household income, household population aged 18 or older, Canada excluding territories, 2004

Table 4
Prevalence of high blood pressure, diabetes and heart disease, by BMI category, household population aged 18 or older, Canada excluding territories, 2004

BMI category (range)	Both sexes	Men	Women
	%	%	%
High blood pressure			
Normal weight (18.5 to 24.9)	8.7	7.9E	9.2
Overweight (not obese) (25.0 to 29.9)	15.1*	15.1*	15.2*
Obese Class I (30.0 to 34.9)	23.7*	22.1*	25.5*
Obese Class II (35.0 to 39.9)	30.1*	32.5*E	28.0*
Obese Class III (≥ 40.0)	29.5*	28.1*E	30.1*
Diabetes			
Normal weight (18.5 to 24.9)	2.2	2.1E	2.2E
Overweight (not obese) (25.0 to 29.9)	4.3*	3.7*	5.2*E
Obese Class I (30.0 to 34.9)	9.9*	11.0*E	8.6*
Obese Class II, III (≥ 35.0)	12.0*	14.1*E	10.5*E
Heart disease			
Normal weight (18.5 to 24.9)	3.0	2.8	3.1
Overweight (not obese) (25.0 to 29.9)	5.2*	6.0*	4.2
Obese Class I (30.0 to 34.9)	7.2*	7.7*E	6.6*E
Obese Class II, III (≥ 35.0)	6.7*E	7.9*E	5.8E

Chronic conditions

Being overweight or obese is a risk factor for a number of chronic conditions. Analysis of CCHS data reveals associations between excess weight and concurrent high blood pressure, diabetes and heart disease.

In 2004, less than 10% of men and women whose BMI was in the normal range reported having high blood pressure (Table 4). The figure was just over 15% among those who were overweight and more than 20% among those who were obese. Even when age, marital status, education, household income, smoking status and leisure-time physical activity were taken into account, excess weight was strongly associated with high blood pressure (Table 5) (see *Limitations*).

A high BMI is a risk factor for type 2 diabetes.[27] Just 2.1% of men whose BMI was in the normal range reported diabetes, compared with 3.7% among overweight men. Men who were obese were five times as likely to have diabetes as were men with BMIs in the normal range. The pattern was similar for women. And even when the effects of the other factors were taken into consideration, obese men and women had significantly high odds of reporting diabetes.

The prevalence of heart disease increased with BMI among men. While 2.8% of men with a normal BMI reported heart disease, the prevalence was 6.0% among men who were overweight and nearly 8% among those who were obese (Table 4). Even when age, marital status, education, household income, smoking, and leisure-time physical activity were taken into account, the association between BMI and heart disease among men remained (Table 5).

For women, the prevalence of heart disease generally did not differ significantly by BMI. The exception was women in obese Class I who were more likely to have been diagnosed with heart disease than were women whose BMI was in the normal range (Table 4). But when the other demographic, socio-economic and lifestyle factors were considered, this relationship disappeared (Table 5).

Table 5
Adjusted odds ratios relating body mass index (BMI) category to high blood pressure, diabetes and heart disease, by sex, household population aged 18 or older, Canada excluding territories, 2004

BMI category (range)	High blood pressure		Diabetes		Heart disease	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Both sexes						
Normal weight (18.5 to 24.9)	1.0	…	1.0	…	1.0	…
Overweight (not obese) (25.0 to 29.9)	1.5*	1.2, 2.0	1.6*	1.1, 2.3	1.3	0.9, 1.9
Obese Class I (30.0 to 34.9)	2.9*	2.1, 3.8	3.8*	2.5, 5.8	1.8*	1.2, 2.9
Obese Class II, III (≥ 35.0)	…	…	5.4*	3.4, 8.4	2.1*	1.3, 3.5
Obese Class II (35.0 to 39.9)	4.7*	3.0, 7.5	…	…	…	…
Obese Class III (≥ 40.0)	5.4*	3.3, 8.6	…	…	…	…
Men						
Normal weight (18.5 to 24.9)	1.0	…	1.0	…	1.0	…
Overweight (not obese) (25.0 to 29.9)	1.8*	1.1, 2.9	1.5	0.9, 2.5	1.7*	1.1, 2.7
Obese Class I (30.0 to 34.9)	3.3*	2.0, 5.5	5.1*	2.6, 10.1	2.4*	1.2, 4.5
Obese Class II, III (≥ 35.0)	…	…	7.0*	3.4, 14.4	2.7*	1.2, 5.8
Obese Class II (35.0 to 39.9)	6.6*	3.0, 14.4	…	…	…	…
Obese Class III (≥ 40.0)	4.9*	1.9, 12.7	…	…	…	…
Women						
Normal weight (18.5 to 24.9)	1.0	…	1.0	…	1.0	…
Overweight (not obese) (25.0 to 29.9)	1.3	0.9, 1.7	1.8*	1.0, 3.3	1.0	0.6, 1.6
Obese Class I (30.0 to 34.9)	2.5*	1.7, 3.7	2.9*	1.7, 4.9	1.4	0.7, 2.7
Obese Class II, III (≥ 35.0)	…	…	4.4*	2.4, 8.1	1.6	0.8, 3.1
Obese Class II (35.0 to 39.9)	3.5*	1.9, 6.2	…	…	…	…
Obese Class III (≥ 40.0)	5.2*	2.8, 9.5	…	…	…	…

Data source: *2004 Canadian Community Health Survey: Nutrition*
Note: *Models control for age (continuous), marital status, education, household income, smoking, and leisure-time physical activity.*
* Significanlty different from estimate for normal weight (p < 0.05)
… Not applicable

Concluding remarks

Results from the 2004 Canadian Community Health Survey: Nutrition (CCHS), based on actual measurements of height and weight, indicate that 23% of adults were obese. This was up from 14% in 1978/79, but still below the obesity rate in the United States (30%). However, in 2004, another 36% of Canadians were overweight. Consequently, a majority of Canadian adults—almost 60%—were in a weight range that increased their risk of developing health problems. In fact, CCHS data show that BMI is strongly related to the likelihood of having high blood pressure, diabetes or heart disease. ●

An electronic version of this article, "Adult obesity in Canada: Measured height and weight," was released on July 6, 2005, as part of the Nutrition: Findings from the Canadian Community Health Survey *series (82-620-MWE, free). This publication is available at: http://www.statcan.ca/english/research/82-620-MIE/82-620-MIE2005001.htm*

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Appendix

Table A

Percentage overweight and obese, by selected characteristics, male household population aged 18 or older, Canada excluding territories, 2004

	Estimated population '000	Overweight		Obese		Overweight/Obese	
		%	95% confidence interval	%	95% confidence interval	%	95% confidence interval
Total	11,861	42.0	39.3, 44.8	22.9	20.7, 25.2	65.0	62.4, 67.5
Age group							
18 to 24	1,681	27.0*	21.5, 32.4	10.7*E	6.7, 14.8	37.7*	31.8, 43.7
25 to 34	1,900	39.9	33.3, 46.6	24.2	18.0, 30.4	64.1	58.1, 70.1
35 to 44	2,577	44.5	37.3, 51.7	20.0	15.2, 24.7	64.5	57.5, 71.4
45 to 54	2,370	42.4	36.0, 48.8	29.9*	24.6, 35.2	72.3*	66.2, 78.3
55 to 64	1,623	45.9	40.0, 51.7	29.6*	23.8, 35.4	75.5*	69.4, 81.5
65 to 74	1,025	52.7*	46.5, 58.8	24.0	19.4, 28.6	76.7*	71.9, 81.5
75 or older	685	49.0*	42.1, 55.8	19.3	13.5, 25.1	68.3	62.0, 74.6
Ethnicity							
White	9,720	43.4	40.5, 46.3	25.5*	23.0, 28.0	69.0*	66.4, 71.5
Black	172	31.0E	10.9, 51.1	F	…	50.7E	27.1, 74.3
Southeast/East Asian	811	35.4E	22.1, 48.6	F	…	39.1*E	26.0, 52.3
Aboriginal (off-reserve)	86	31.8E	16.5, 47.0	33.6E	19.2, 48.0	65.3	50.7, 80.0
Other	1,027	38.6	27.4, 49.8	14.2*E	7.0, 21.4	52.8*	41.6, 64.0
Daily fruit and vegetable consumption							
Less than 3 times	4,124	37.4*	33.3, 41.5	25.8*	22.1, 29.5	63.2	58.9, 67.5
3 to less than 5 times	4,605	42.2	37.7, 46.6	23.0	19.4, 26.7	65.2	60.8, 69.7
5 or more times†	3,100	47.8	42.7, 52.9	19.1	15.0, 23.2	66.9	62.2, 71.6
Leisure-time physical activity level							
High†	2,361	45.8	40.7, 50.8	19.6	15.3, 23.9	65.3	60.1, 70.6
Moderate	2,979	44.8	39.8, 49.8	16.7	13.5, 20.0	61.5	56.4, 66.6
Sedentary	6,520	39.4	35.4, 43.4	27.0*	23.7, 30.3	66.4	62.9, 70.0
Marital status (aged 25 or older)							
Married/Common-law†	7,590	46.2	42.7, 49.8	24.5	21.6, 27.3	70.7	67.2, 74.2
Widowed	237	55.6	43.5, 67.7	17.2E	9.7, 24.8	72.9	63.8, 81.9
Separated/Divorced	822	42.6	33.4, 51.9	24.7	17.6, 31.8	67.3	58.2, 76.5
Never married	1,516	34.8*	28.5, 41.0	29.1	22.0, 36.2	63.8*	58.3, 69.4
Education (aged 25 to 64)							
Less than secondary graduation	1,149	39.6	31.7, 47.5	34.5*	26.8, 42.3	74.1	66.7, 81.6
Secondary graduation	1,487	36.7	28.2, 45.1	32.1*	23.6, 40.6	68.8	60.4, 77.1
Some postsecondary	550	44.6	31.5, 57.6	22.6E	13.7, 31.5	67.2	55.5, 78.9
Postsecondary graduation†	5,197	45.4	41.0, 49.8	22.0	18.6, 25.3	67.4	63.1, 71.7
Household income							
Lowest	245	36.2E	20.1, 52.2	18.5E	7.6, 29.5	54.7*	40.0, 69.5
Lower-middle	540	44.4	30.7, 58.1	15.6*E	8.2, 23.0	60.0	45.2, 74.8
Middle	2,139	40.4	34.0, 46.8	22.7	16.9, 28.5	63.1*	57.1, 69.1
Upper-middle	4,160	39.6*	35.3, 43.8	24.4	20.7, 28.1	64.0*	59.5, 68.5
Highest†	3,886	45.9	41.3, 50.5	26.1	22.3, 29.9	72.0	67.7, 76.3
Not stated	891	40.5	29.8, 51.2	8.6*E	4.9, 12.3	49.1*	38.2, 60.0

Data source: *2004 Canadian Community Health Survey: Nutrition*
Notes: *Age groups and ethnicity are compared with the estimate for Canada. Three respondents had a missing value for marital status, 40 for education, and 14 for fruit and vegetable consumption.*
† Reference category
* Significantly different from estimate for reference category (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)
F Coefficient of variation greater than 33.3% (suppressed because of extreme sampling variability)
… Not applicable

Table B
Percentage overweight and obese, by selected characteristics, female household population aged 18 or older, Canada excluding territories, 2004

	Estimated population '000	Overweight		Obese		Overweight/Obese	
		%	95% confidence interval	%	95% confidence interval	%	95% confidence interval
Total	12,124	30.2	28.1, 32.3	23.2	21.3, 25.1	53.4	51.2, 55.7
Age group							
18 to 24	1,463	22.3*	17.6, 27.1	12.1*	8.6, 15.6	34.4*	29.2, 39.6
25 to 34	1,926	26.1	20.0, 32.2	16.9*	12.9, 21.0	43.0*	36.5, 49.5
35 to 44	2,529	27.6	22.3, 32.9	20.9	16.6, 25.2	48.5	42.5, 54.6
45 to 54	2,428	33.8	28.4, 39.2	29.6*	24.4, 34.8	63.4*	57.5, 69.3
55 to 64	1,718	32.1	27.5, 36.8	31.1*	26.2, 36.1	63.3*	58.0, 68.5
65 to 74	1,028	37.9*	32.2, 43.6	25.1	20.4, 29.8	63.0*	56.6, 69.4
75 or older	1,032	36.1*	31.3, 40.9	26.5	21.8, 31.1	62.5*	57.5, 67.6
Ethnicity							
White	10,134	29.9	27.7, 32.1	24.8*	22.7, 26.9	54.7	52.3, 57.1
Black	223	42.7E	19.9, 65.5	F	…	65.8E	41.5, 90.0
Southeast/East Asian	664	24.0E	13.1, 34.9	F	…	31.4*E	19.4, 43.5
Aboriginal (off-reserve)	174	29.3E	19.3, 39.3	40.0*	27.9, 52.0	69.3*	56.9, 81.6
Other	930	35.3E	23.1, 47.4	14.5*E	7.9, 21.2	49.8	38.1, 61.5
Daily fruit and vegetable consumption							
Less than 3 times	2,919	29.1	25.1, 33.0	27.4*	23.2, 31.6	56.5	52.1, 60.8
3 to less than 5 times	4,681	29.5	26.5, 32.6	23.4	20.5, 26.3	53.0	49.4, 56.6
5 + times†	4,474	31.8	27.9, 35.8	20.3	17.1, 23.4	52.1	48.0, 56.2
Leisure-time physical activity level							
High†	1,945	27.0	22.0, 31.9	13.5	10.5, 16.6	40.5	35.1, 46.0
Moderate	2,905	31.4	27.1, 35.7	20.8*	17.5, 24.1	52.2*	47.5, 56.9
Sedentary	7,273	30.6	27.8, 33.5	26.8*	24.0, 29.5	57.4*	54.2, 60.6
Marital status (aged 25 or older)							
Married/Common-law†	7,268	32.0	29.0, 34.9	23.4	20.8, 26.1	55.4	52.2, 58.6
Widowed	1,088	37.3	32.8, 41.8	30.0*	25.2, 34.8	67.3*	63.1, 71.5
Separated/Divorced	1,124	31.5	25.1, 37.9	27.7	21.7, 33.8	59.3	51.6, 67.0
Never married	1,171	21.4*	16.4, 26.5	25.6	19.2, 31.9	47.0*	40.0, 54.1
Education (aged 25 to 64)							
Less than secondary graduation	1,168	36.5	27.9, 45.1	36.9*	28.6, 45.2	73.4*	66.9, 79.9
Secondary graduation	1,697	28.4	22.6, 34.3	24.9	19.0, 30.8	53.3	46.6, 60.0
Some postsecondary	586	31.3	22.7, 40.0	32.3*	23.9, 40.8	63.7*	54.0, 73.4
Postsecondary graduation†	5,027	29.0	25.6, 32.4	20.5	17.8, 23.2	49.5	45.7, 53.3
Household income							
Lowest	428	25.6	17.4, 33.9	21.4E	12.9, 30.0	47.1	35.0, 59.2
Lower-middle	833	30.8	23.9, 37.6	24.8	18.5, 31.1	55.6	48.0, 63.1
Middle	2,500	31.0	26.5, 35.6	27.9*	23.3, 32.5	58.9*	54.1, 63.8
Upper-middle	3,854	28.4	24.7, 32.1	24.7*	21.6, 27.9	53.1	49.2, 57.1
Highest†	3,412	31.2	26.5, 35.8	19.6	15.8, 23.5	50.8	46.0, 55.6
Missing	1,097	33.1	26.2, 39.9	18.1	13.1, 23.0	51.1	43.4, 58.9

Data source: *2004 Canadian Community Health Survey: Nutrition*
Notes: *Age groups and ethnicity are compared with the estimate for Canada. Five respondents had a missing value for marital status, 45 for education, 30 for fruit and vegetable consumption, and 2 for leisure-time physical activity level.*
† Reference category
* Significantly different from refence category (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)
F Coefficient of variation greater than 33.3% (suppressed because of extreme sampling variability).
⋯ Not applicable

Table C

Percentage overweight and obese, by selected characteristics, household population aged 18 or older, Canada excluding territories, 2004

	Estimated population '000	Overweight		Obese		Overweight/Obese	
		%	95% confidence interval	%	95% confidence interval	%	95% confidence interval
Total	**23,985**	**36.1**	**34.3, 37.8**	**23.1**	**21.7, 24.5**	**59.1**	**57.4, 60.8**
Age group							
18 to 24	3,144	24.8*	21.0, 28.7	11.4*	8.7, 14.1	36.2*	32.0, 40.3
25 to 34	3,826	33.0	28.5, 37.4	20.5	16.9, 24.2	53.5*	49.1, 57.9
35 to 44	5,106	36.2	31.9, 40.4	20.4*	17.3, 23.5	56.6	52.1, 61.0
45 to 54	4,798	38.0	34.0, 42.1	29.7*	26.2, 33.3	67.8*	63.5, 72.1
55 to 64	3,341	38.8	35.2, 42.4	30.4*	26.3, 34.5	69.2*	65.0, 73.4
65 to 74	2,053	45.3*	40.7, 49.8	24.6	21.2, 27.9	69.9*	65.6, 74.1
75 or older	1,717	41.2*	37.3, 45.2	23.6	19.9, 27.3	64.8*	60.9, 68.8
Ethnicity							
White	19,854	36.5	34.7, 38.3	25.2*	23.5, 26.8	61.7*	59.9, 63.4
Black	395	37.6^E	22.6, 52.6	21.6^E	10.1, 33.1	59.2	42.1, 76.2
Southeast/East Asian	1,475	30.2	21.5, 39.0	F	…	35.7*	26.8, 44.6
Aboriginal (off-reserve)	260	30.1	21.6, 38.6	37.8*	28.2, 47.5	68.0	58.5, 77.4
Other	1,957	37.0	28.8, 45.3	14.4*^E	9.5, 19.2	51.4*	43.6, 59.2
Daily fruit and vegetable consumption							
Less than 3 times	7,044	33.9*	31.0, 36.9	26.5*	23.8, 29.1	60.4	57.3, 63.5
3 to less than 5 times	9,287	35.8	33.1, 38.6	23.2	20.9, 25.6	59.0	56.2, 61.9
5 + times†	7,574	38.4	35.4, 41.4	19.8	17.3, 22.3	58.2	55.3, 61.1
Leisure-time physical activity level							
High†	4,306	37.3	33.6, 40.9	16.9	14.1, 19.6	54.1	50.1, 58.2
Moderate	5,885	38.2	35.0, 41.3	18.7	16.5, 21.0	56.9	53.7, 60.2
Sedentary	13,794	34.8	32.4, 37.1	26.9*	24.7, 29.0	61.7*	59.2, 64.1
Marital status (aged 25 or older)							
Married/Common-law†	14,858	39.3	37.0, 41.5	24.0	22.1, 25.8	63.2	60.9, 65.5
Widowed	1,325	40.6	36.1, 45.0	27.7	23.5, 31.9	68.3*	64.6, 72.0
Separated/Divorced	1,946	36.2	31.0, 41.4	26.5	22.0, 30.9	62.7	57.0, 68.4
Never married	2,688	29.0*	24.7, 33.2	27.5	22.7, 32.4	56.5*	51.8, 61.2
Education (aged 25 to 64)							
Less than secondary graduation	2,316	38.0	32.2, 43.9	35.7*	29.9, 41.5	73.8*	68.7, 78.8
Secondary graduation	3,184	32.3	27.8, 36.8	28.3*	23.1, 33.4	60.5	55.6, 65.4
Some postsecondary	1,136	37.7	29.4, 46.1	27.6	21.2, 34.1	65.4	57.8, 73.0
Postsecondary graduation†	10,224	37.3	34.5, 40.1	21.2	19.0, 23.5	58.6	55.6, 61.5
Household income							
Lowest	674	29.5*	21.6, 37.4	20.4^E	13.6, 27.2	49.9*	40.3, 59.4
Lower-middle	1,373	36.1	29.6, 42.7	21.2	16.2, 26.1	57.3	50.2, 64.4
Middle	4,639	35.4	31.5, 39.2	25.5	21.9, 29.1	60.9	57.0, 64.7
Upper-middle	8,014	34.2*	31.4, 37.0	24.6	22.0, 27.1	58.8	55.7, 61.9
Highest†	7,297	39.0	35.6, 42.4	23.1	20.3, 25.9	62.1	58.7, 65.5
Missing	1,988	36.4	30.3, 42.5	13.8*	10.4, 17.3	50.2*	43.8, 56.7

Data source: *2004 Canadian Community Health Survey: Nutrition*
Notes: *Age groups and ethnicity are compared with the estimate for Canada. Eight respondents had a missing value for marital status, 85 for education, 44 for fruit and vegetable consumption, and 2 for leisure-time physical activity level.*
† Reference category
* Significantly different from refence category (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)
F Coefficient of variation greater than 33.3% (suppressed because of extreme sampling variability)
··· Not applicable

Table D
Response rates to directly measured height and weight, by selected characteristics

	Men	Women
	%	%
Total	**54**	**61**
Age group		
18 to 24	57	64
25 to 34	52	61
35 to 44	56	58
45 to 54	49*	61
55 to 64	56	62
65 to 74	59	59
75 or older	57	60
Marital status (age 25 or older)		
Married/Common-law	54	62*
Widowed	54	60
Separated/Divorced	55	57
Never married	53	56
Education (aged 25 to 64)		
Less than secondary graduation	53	57
Secondary graduation	56	65
Some postsecondary	47	56
Postsecondary graduation	53	60
Household income		
Lowest	47	70*
Lower-middle	54	65
Middle	60*	63
Upper-middle	57	65*
Highest	53	58
Missing	41*	43*
Daily fruit/vegetable consumption		
Less than 3 times	54	60
3 to less than 5 times	54	59
5 or more times	56	63*
Leisure time		
Active	57	59
Moderately active	56	61
Sedentary	53	61
High blood pressure		
Yes	56	60
No	54	61
Diabetes		
Yes	50	63
No	55	61
Heart disease		
Yes	53	58
No	55	61

Data source: *2004 Canadian Community Health Survey: Nutrition*
* Significantly different from total response rate (p < 0.05)

Overweight and obesity among children and youth

Margot Shields

Abstract

Objectives
This article describes the prevalence of overweight and obesity among Canadian children and youth aged 2 to 17, based on direct measurements of their height and weight. Data from 1978/79 and 2004 are compared, and trends by sex and age groups are presented.

Data sources
Data based on direct measurements are from the 2004 Canadian Community Health Survey (CCHS): Nutrition. Other information is from the 1978/79 Canada Health Survey and the 1999-2002 National Health and Nutrition Examination Survey, conducted in the US.

Analytical techniques
The estimated prevalence of overweight and of obesity, including an overall rate reflecting both, was based on 2004 CCHS data for 8,661 children and youth whose height and weight were measured.

Main results
In 2004, 26% of Canadian children and adolescents aged 2 to 17 were overweight or obese, and 8% were obese. Over the past 25 years, the prevalence of overweight and obesity combined has more than doubled among youth aged 12 to 17, while the prevalence of obesity alone has tripled. Children and youth who ate fruit and vegetables at least five times a day were substantially less likely to be overweight or obese than were those who ate these foods less often. The likelihood of being overweight/obese rose as "screen time" (watching TV, playing video games or using a computer) increased.

Keywords
adolescence, body mass index, body weight, exercise, family health, health behaviour

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Over the past 25 years, the prevalence of overweight and obesity in children and adolescents has risen, with the most substantial increases observed in economically developed countries.[1] According to data from the 2004 Canadian Community Health Survey (CCHS): Nutrition, a considerable share of Canadian children and youth are part of this trend.

Health surveys often rely on respondents' reports of their height and weight, a practice that tends to result in underestimating the prevalence of overweight and obesity[2-5] (see *Methodology makes a difference*). The 2004 CCHS, however, directly measured the height and weight of a nationally representative sample of Canadians (see *Methods*).

Before the 2004 CCHS, the 1978/79 Canada Health Survey (CHS) measured the height and weight of a representative sample of Canadian children aged 2 to 17. Results from the CHS can be compared with the recent CCHS data to form a better picture of the increase in

Methods

Data sources

Data from the 2004 Canadian Community Health Survey (CCHS): Nutrition were used to estimate the percentages of 2- to 17-year-olds who were overweight and obese. The 2004 CCHS was designed to gather information about the nutritional status of the Canadian population at the provincial level (see http://www.statcan.ca/english/concepts/hs/index.htm*).* It excludes residents of institutions, the three territories, Indian reserves, some remote areas, members of the regular Armed Forces, and civilian residents of military bases. The response rate was 76.5%. Measured height and weight were obtained for 65% of the 2- to 17-year-olds who responded to the 2004 CCHS, a total of 8,661 children and adolescents (see *Limitations*).

Historical estimates of the percentages of Canadian children and youth in the overweight and obese categories, based on direct measures of height and weight, are from the 1978/79 Canada Health Survey, and for 12- to 17-year-olds, from the 1981 Canada Fitness Survey and the 1988 Campbell's Survey on Health and Well-being. For 12- to 17-year-olds, percentages based on self-reported data are from the 2000/01 and 2003 CCHS and the 1994/95, 1996/97 and 1998/99 National Population Health Survey (NPHS). For 2- to 11-year-olds, estimates based on data reported by parents are from the 1994/95, 1996/97, 1998/99, 2000/01 and 2002/03 National Longitudinal Survey of Children and Youth (NLSCY). NLSCY estimates for 2002/03 could be produced only for children aged 2 to 5, since the cross-sectional file does not include records for children aged 6 or older.

The prevalence of overweight and obesity among American children and adolescents was estimated using data from the 1999-2002 National Health and Nutrition Examination Survey (NHANES). The NHANES obtained measurements of height and weight for 7,297 children and adolescents.

Analytical techniques

Descriptive statistics from the 2004 CCHS were used to estimate the proportions of 2- to 17-year-olds who were overweight and obese in relation to selected characteristics (Appendix Tables A and B). All estimates were based on the 8,661 children and adolescents for whom height and weight were directly measured. Since they accounted for only 65% of children and adolescents who responded to the 2004 CCHS, an adjustment was made to minimize non-response bias. A special sampling weight was created by redistributing the sampling weights of the non-respondents to the respondents, using response propensity classes. Variables such as province, age, sex, household income, ethnicity, education, physical activity, fruit and vegetable consumption and chronic conditions were used to create the classes. The classes were created with the CHAID (Chi-Square Automatic Interaction Detector) algorithm available in Knowledge Seeker [6] to identify the characteristics that best split the sample into groups that were dissimilar with respect to response/non-response. This adjusted sampling weight was used to produce all estimates in this analysis. Standard errors and coefficients of variation were estimated using the bootstrap technique, which accounts for the survey design effects.[7-9]

The criteria specified by the International Obesity TaskForce were used to define overweight and obesity among youth (see *Calculating overweight and obesity in children and adolescents*) for all data sources used in this report.

Standard errors and coefficients of variation for estimates from the 1978/79 Canada Health Survey and the 1999-2002 NHANES were estimated with SUDAAN, which uses a Taylor series linearization method to account for the complex sample design.[10]

The distribution of the household population by body mass index (BMI) (Chart 3) was smoothed by calculating three-point averages. For example, the percentage of the population with a BMI of 23 was calculated by summing the percentage with a BMI of 22, the percentage with a BMI of 23 and the percentage with a BMI of 24, and then dividing the result by 3.

overweight and obesity among young Canadians during the past 25 years. In 1978/79, 12% of 2- to 17-year-olds were overweight and 3% were obese—a combined overweight/obesity rate of 15%. By 2004, about 1.1 million boys and girls in this age group, or 18%, were overweight, and another half a million, or 8%, were obese. This means that more than one-quarter (26%) of these young people were overweight or obese.

Notable rise in proportion overweight/obese

Increases in overweight and obesity were similar among boys and girls (Chart 1). In 2004, the combined prevalence of overweight/obesity for each sex was about 70% higher than in 1978/79, and the prevalence of obesity alone was 2.5 times higher.

Trends differed, however, for various age groups. For example, while the percentage of children aged 2 to 5 who were either overweight or obese was virtually unchanged, the figure for 12- to 17-year-olds more than doubled, rising from 14% to 29%

Chart 1
Percentage overweight or obese, by sex, household population aged 2 to 17, Canada excluding territories, 1978/79 and 2004
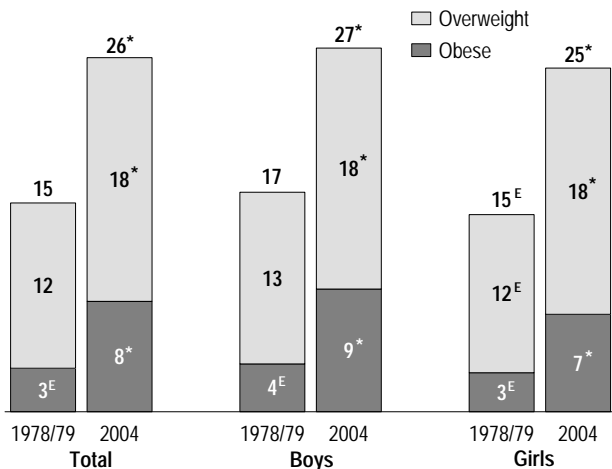
Data sources: *1978/79 Canada Health Survey; 2004 Canadian Community Health Survey: Nutrition*
Note: *Because of rounding, detail may not add to totals.*
* Significantly different from estimate for 1978/79 (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

(Chart 2). Furthermore, the percentage of youth in this age group who were obese tripled, increasing from 3% in 1978/79 to 9% in 2004.

Chart 2
Percentage overweight or obese, by age group, household population aged 2 to 17, Canada excluding territories, 1978/79 and 2004
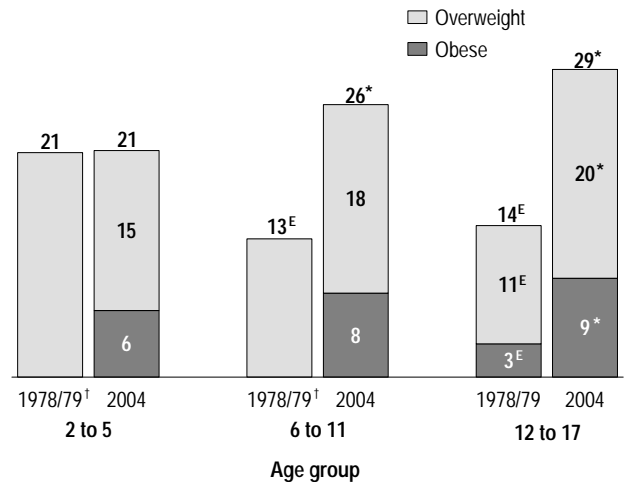
Data sources: *1978/79 Canada Health Survey; 2004 Canadian Community Health Survey: Nutrition*
† Obesity estimate has a coefficient of variation greater than 33.3%; therefore, it cannot be released and the combined overweight/obesity prevalence is shown.
* Significantly different from estimate for 1978/79 (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Surpassing BMI cut-points

Measures of overweight and obesity are based on body mass index (BMI), which takes weight and height into account (weight in kilograms divided by height in metres squared). BMI cut-points of 25 and 30 are used to classify adults aged 18 or older as overweight or obese, respectively, based on the associated health risks.[11] The cut-points for children and adolescents are lower, and also rise incrementally with every year of age (see *Calculating overweight and obesity in children and adolescents*).

Between 1978/79 and 2004, the average BMI of adolescents aged 12 to 17 rose from 20.8 to 22.1, resulting in a shift in the BMI distribution of this age group toward the higher—and heavier—BMIs. The most pronounced increases were in the

Methodology makes a difference

In the United States, data from the National Health and Nutritional Examination Survey (NHANES) show sharp rises in the percentages of children and adolescents who were overweight/obese between 1976-1980 and 1988-1994 and, again, between 1988-1994 and 1999-2002.[12]

In Canada, because of variations in the methods used to collect information on height and weight, it is difficult to pinpoint when the prevalence of overweight and obesity actually began increasing. Estimates for 12- to 17-year-olds, based on measured height and weight, can be calculated for four reference years: 1978/79, 1981, 1988, and 2004 (see *Methods*). These data reveal a small decrease in adolescents' overweight/obesity and obesity rates between 1978/79 and 1981,[13] then substantial increases between 1981 and 1988 and between 1988 and 2004 (Appendix Chart A). Calculations based on self-reported data show that figures stabilized between 1994/95 and 2003. But between 2003 and 2004, when the collection method changed from self-reported to measured data, the prevalence of overweight/obesity and obesity rose sharply. This is not surprising, as self-reports tend to yield lower estimates of overweight and obesity.[2-5]

Comparisons of the average height and weight of 12- to 17-year-olds in 2003 (self-reported) and 2004 (measured) illustrate these tendencies. In 2004, based on direct measurements, the average height of boys and girls was a third of an inch less than the 2003 averages based on self-reports. The average weight of boys in 2004 was 3 pounds more than in 2003, and for girls, 6 pounds more. As a result, one-year increases in the prevalence of overweight and obesity among adolescents were substantial.

|	2003 (self-report)	2004 (direct measure)	Difference
Boys aged 12 to 17			
Average height	66.6 in	66.3 in	-0.3 in
	169.2 cm	168.4 cm	-0.8 cm
Average weight	137.1 lb	140.4 lb	3.3 lb
	62.2 kg	63.7 kg	1.5 kg
Average BMI	21.4	22.3	0.9
% overweight/obese	24.0%	32.3%	8.3%
% obese	5.7%	11.1%	5.4%
Girls aged 12 to 17			
Average height	63.6 in	63.3 in	-0.3 in
	161.5 cm	160.8	-0.7 cm
Average weight	120.3 lb	126.0 lb	5.7 lb
	54.6 kg	57.2 kg	2.6 kg
Average BMI	20.7	22.0	1.3
% overweight/obese	14.2%	25.8%	11.6%
% obese	3.3%	7.4%	4.1%

Another problem with overweight and obesity rates based on self-reports is variation in the mode of collection. Self-reported data from face-to-face interviews result in higher obesity rates than do data collected from telephone interviews.[14] In 1994/95, almost all interviews were conducted in person; in 1996/97 and 1998/99, most were by telephone. In 2000/01, interviews were approximately half and half, and in 2003, about one-quarter were in person.

For children aged 2 to 11, reported data and actual measurements reveal a different bias. The data for 1994/95 to 2002/03 come from the National Longitudinal Survey of Children and Youth (NLSCY), in which parents reported the child's height and weight (Appendix Charts B and C). A comparison with direct measurements from the 2004 CCHS suggests that when parents report on behalf of their children, overweight and obesity rates are higher, largely because parents tend to underestimate their children's height. It is possible that they report the last measured height of the child, which could be inaccurate given how quickly children of these ages grow. If height is routinely underestimated, the result would be substantial overestimates of overweight and obesity.

	2002/03 (parent's report)	2004 (direct measure)	Difference
Ages 2 to 5			
Average height	39.7 in	40.5 in	0.8 in
	100.8 cm	102.9 cm	2.1 cm
Average weight	38.2 lb	38.5 lb	0.3 lb
	17.4 kg	17.5 kg	0.1 kg
Average BMI	17.2	16.4	-0.8
% overweight/obese	36.1%	21.5%	-14.6%
% obese	20.1%	6.3%	-13.8%

	2000/01 (parent's report)	2004 (direct measure)	Difference
Ages 6 to 11			
Average height	52.0 in	53.0 in	1.0 in
	132.1 cm	134.6 cm	2.5 cm
Average weight	70.0 lb	73.7 lb	3.7 lb
	31.8 kg	33.4 kg	1.6 kg
Average BMI	18.2	18.1	-0.1
% overweight/obese	32.1%	25.8%	-6.3%
% obese	11.7%	8.0%	-3.7%

Chart 3
Percentage distribution of household population aged 12 to 17, by body mass index (BMI), Canada excluding territories, 1978/79 and 2004
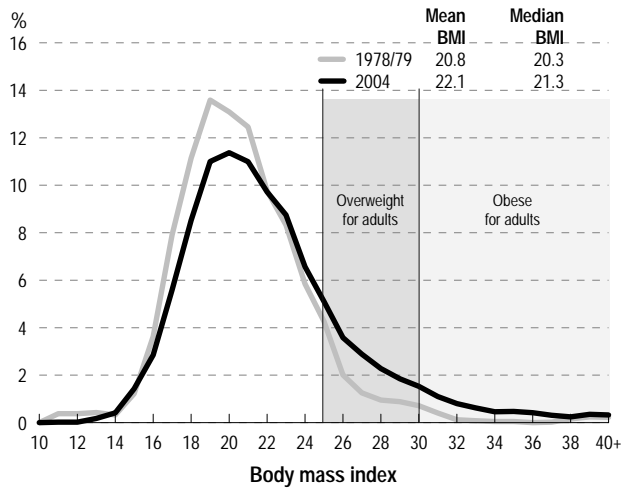
	Mean BMI	Median BMI
1978/79	20.8	20.3
2004	22.1	21.3

Data sources: *1978/79 Canada Health Survey; 2004 Canadian Community Health Survey: Nutrition*

Chart 4
Percentage overweight or obese, by sex, household population aged 2 to 17, Canada (2004) and United States (1999-2002)

Data sources: *2004 Canadian Community Health Survey: Nutrition; 1999-2002 National Health and Nutrition Examination Survey*
Note: *Because of rounding, detail may not add to totals.*
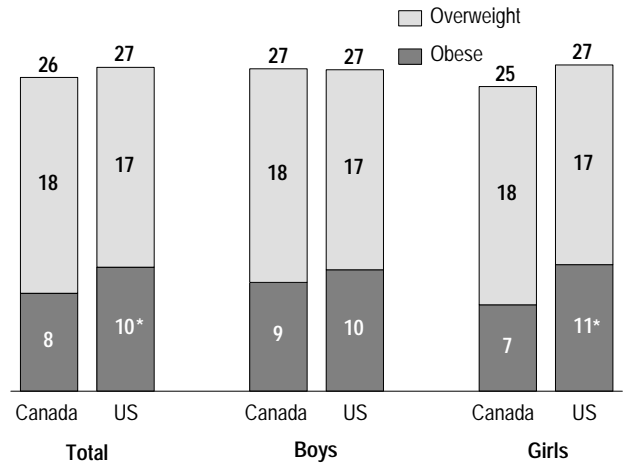** Significantly different from estimate for Canada (p < 0.05)*

proportions of 12- to 17-year-olds whose BMI exceeded 25 or 30, the overweight and obese thresholds for adults (Chart 3). This is particularly important, given that adolescence is a critical period for the development of adult obesity.[1,15-18]

Canada–US comparisons

Since the early 1960s, the height and weight of a nationally representative sample of Americans have been directly measured as part of the National Health and Nutrition Examination Survey (NHANES). Based on the most recent NHANES data (1999 to 2002), the percentage of overweight/ obese 2- to 17-year-olds was similar in the United States and Canada (Chart 4). In the US, however, the prevalence of *obesity* was slightly higher: 10% versus 8% in Canada.

The proportions of boys who were overweight/ obese, or simply obese, were similar in both countries, but differences were apparent for girls (Chart 5). Canadian girls aged 2 to 5 were more likely to be overweight/obese than were US girls

Chart 5
Percentage overweight or obese, by sex and age group, household population aged 2 to 17, Canada (2004) and United States (1999-2002)
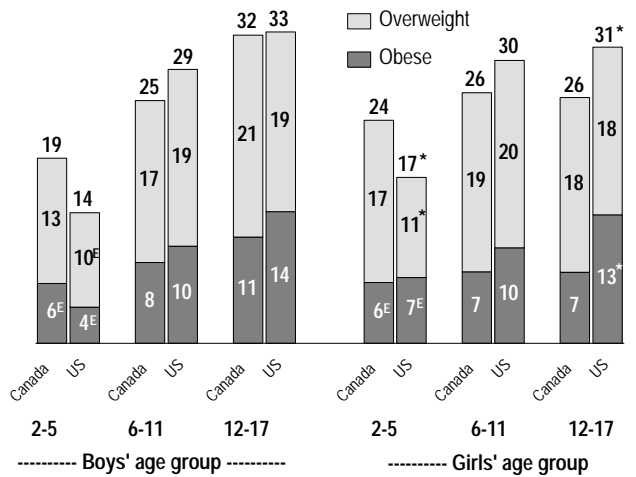
Data sources: *2004 Canadian Community Health Survey: Nutrition; 1999-2002 National Health and Nutrition Examination Survey*
Note: *Because of rounding, detail may not add to totals.*
E Coefficient of variation 16.6% to 33.3% (interpret with caution)
* Significantly different from estimate for Canada (p < 0.05)

in the same age group. By contrast, at ages 12 to 17, American girls were almost twice as likely (13%) as Canadian girls (7%) to be obese.

For young people of both sexes in the United States, the prevalence of overweight and obesity increased with age. Among American boys, the prevalence of overweight/obesity was 14% at ages 2 to 5 and 33% at ages 12 to 17; for American girls, the corresponding figures were 17% and 31%. In Canada, the proportion of overweight/obese boys was higher among those aged 12 to 17 (32%), compared with those aged 2 to 5 (19%). However, the proportion of Canadian girls who were overweight/obese was around 25%, regardless of age.

If the prevalence of overweight and obesity among youth is still increasing, differences between Canada and the United States may be greater because the American estimates are based on earlier data (collected from 1999 to 2002).

The ethnic composition of the two countries should also be considered when making comparisons. In the United States, overweight/ obesity was relatively high (more than 30%) among Black, Mexican-American and Hispanic children and adolescents (Chart 6). These ethnic groups represent about one-third of American youth, but constitute a very small share of the population in Canada. Comparisons between White Canadian and American youth indicate that the proportions of overweight/obese did not differ significantly.

In Canada, a significantly high percentage of young people of Aboriginal origin (off-reserve) were overweight/obese (41%); in fact, 20% were obese—2.5 times the national average (Chart 7). By contrast, a relatively low percentage of youth of Southeast Asian or East Asian origin were overweight/obese: 18%. These differences between ethnic groups persisted when age and socio-economic factors were taken into account (data not shown). However, because of their relatively small numbers, these groups did not strongly influence national overweight/obesity estimates.

Chart 6
Percentage overweight or obese, by ethnicity, household population aged 2 to 17, Canada (2004) and United States (1999-2002)
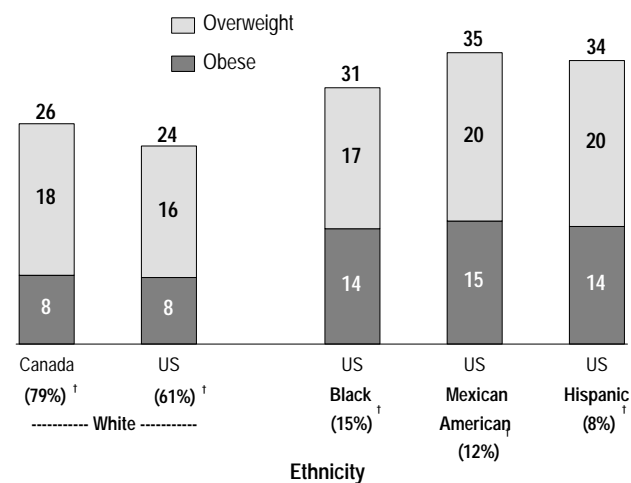
Data sources: *2004 Canadian Community Health Survey: Nutrition; 1999-2002 National Health and Nutrition Examination Survey*
† Percentage of population aged 2 to 17 in this group

Chart 7
Percentage overweight or obese, by ethnicity, household population aged 2 to 17, Canada excluding territories, 2004
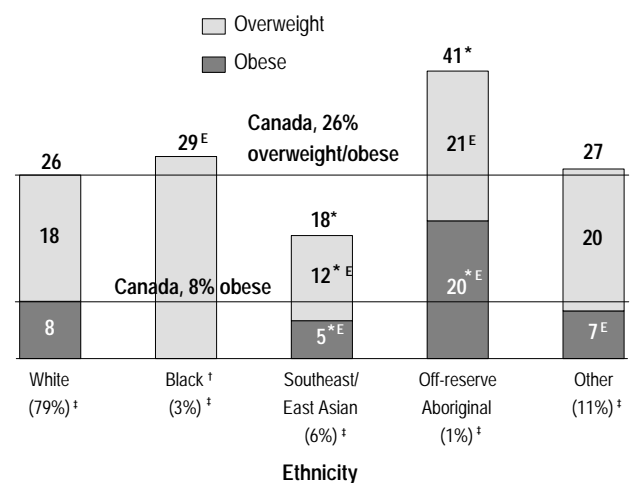
Data source: *2004 Canadian Community Health Survey: Nutrition*
† The obesity estimate has a coefficient of variation greater than 33.3%; therefore, it cannot be released and the combined overweight/obesity prevalence is shown.
‡ Percentage of population aged 2 to 17 in this group
E Coefficient of variation 16.6% to 33.3% (interpret with caution)
* Significantly different from estimate for Canada (p < 0.05)

Diet, exercise and screen time

Studies based on American data have shown that children's consumption of fast food has increased dramatically over the past two decades, and that a large majority of them do not eat enough fruit and vegetables.[1,18] Based on data from the 2004 CCHS, 59% of Canadian children and adolescents were reported to consume fruit and vegetables less than five times a day (see *Definitions*). These young people were significantly more likely to be overweight/obese than were those who ate fruit and vegetables more frequently (Chart 8).

Some studies have found that physical activity protects against childhood obesity,[19] while others have not found such a relationship[1] (see *Limitations*). Analysis of CCHS data shows that physical activity levels were not associated with overweight and obesity at ages 6 to 11 (Chart 9), but by ages 12 to 17, associations were significant, though only for boys (Chart 10). Sedentary boys were more likely than more active boys to be obese: 16% versus 9%. Unexpectedly, a higher proportion of active and moderately active boys were overweight (but

Chart 8

Percentage overweight or obese, by daily fruit and vegetable consumption, household population aged 2 to 17, Canada excluding territories, 2004

Daily fruit and vegetable consumption
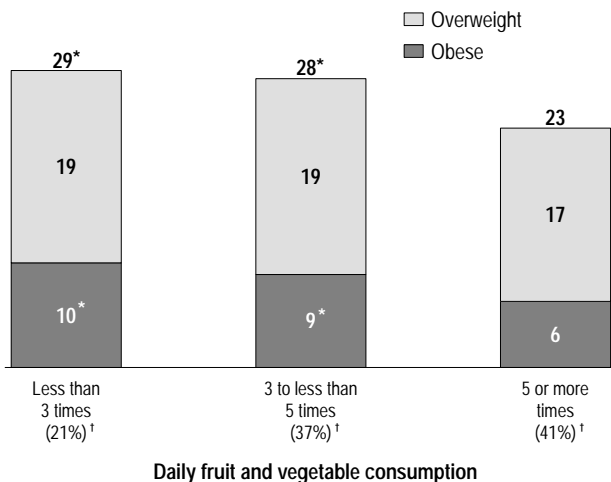
Data source: 2004 Canadian Community Health Survey: Nutrition
† Percentage of population aged 2 to 17 in this group
* Significantly different from estimate for 5 or more times (p < 0.05)

Chart 9

Percentage overweight or obese, by weekly hours of physical activity, household population aged 6 to 11, Canada excluding territories, 2004
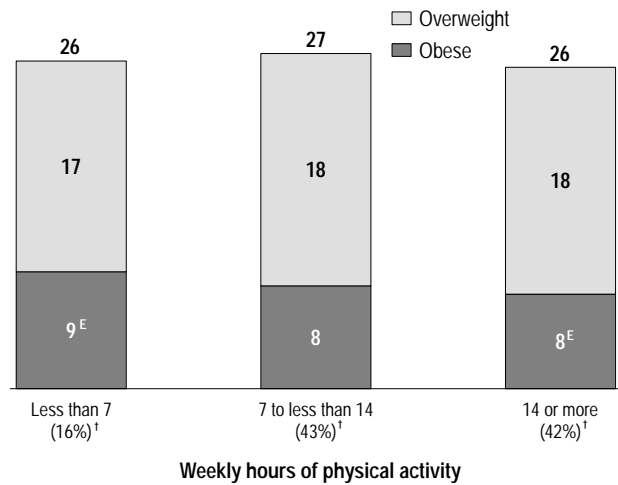
Weekly hours of physical activity

Data source: 2004 Canadian Community Health Survey: Nutrition
† Percentage of population aged 6 to 11 in this group
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Chart 10

Percentage overweight or obese, by sex and leisure-time physical activity level, household population aged 12 to 17, Canada excluding territories, 2004

Leisure-time physical activity

Data source: 2004 Canadian Community Health Survey: Nutrition
† Percentage of male/female population aged 12 to 17 in this group
E Coefficient of variation 16.6% to 33.3% (interpret with caution)
* Significantly different from estimate for active/moderately active (p < 0.05)

Definitions

The *frequency of fruit and vegetable consumption* was assessed with questions from the Behavioral Risk Factor Surveillance System in the United States.[20] Canadian Community Health Survey (CCHS) respondents were asked:
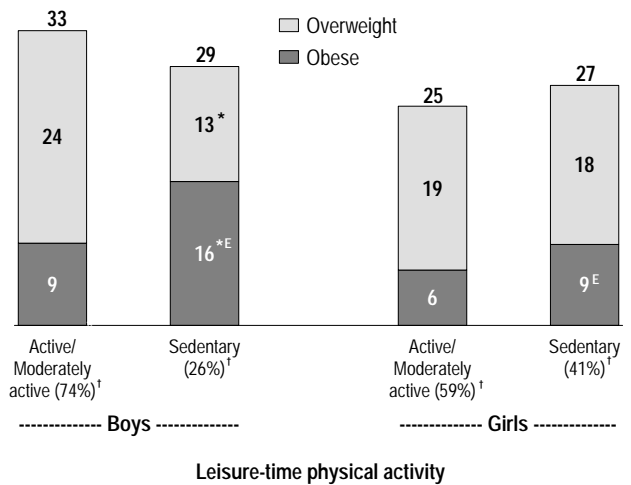
- "How often do you usually drink fruit juices such as orange, grapefruit or tomato?" (for example, once a day, three times a week, twice a month)
- "Not counting juice, how often do you usually eat fruit?"
- "How often do you usually eat green salad?"
- "How often do you usually eat potatoes, not including French fries, fried potatoes, or potato chips?"
- "How often do you usually eat carrots?"
- "Not counting carrots, potatoes or salad, how many servings of other vegetables do you usually eat?"

For 6- to 11-year-olds, *leisure-time physical activity level* was measured by asking, "About how many hours a week do you usually take part in physical activity (that makes you out of breath or warmer than usual):

- in your free time at school (for example, lunch)?"
- in your class time at school?"
- outside of school while participating in lessons or league or team sports?"
- outside of school while participating in unorganized activities, either on your own or with friends?"

For each item, the response categories were "never," "less than 1 hour per week," "2 to 3 hours per week," "4 to 6 hours a week" or "7 or more hours per week." Total physical activity was derived by taking the mid-point of the response category (0, 0.5, 2.5, 5 or 7) for each of the four items and summing the resulting values.

For 12- to 17-year-olds, *leisure-time physical activity level* was based on total energy expenditure (EE) during leisure time. EE was calculated from the reported frequency and duration of all of a respondent's leisure-time physical activities in the three months before his or her 2004 CCHS interview and the metabolic energy demand (MET value) of each activity, which was independently established.[21]

$EE = \sum (Ni*Di *METi / 365\ days)$, where

Ni = number of occasions of activity i in a year,

Di = average duration in hours of activity i, and

$METi$ = a constant value for metabolic energy cost of activity i.

An EE of 3 or more kilocalories per kilogram per day (KKD) was defined as *active*; 1.5 to 2.9 KKD, *moderately active*; and less than 1.5 KKD, *inactive*.

Screen time is the amount of time spent watching television or videos, playing video games, or using a computer. Children aged 6 to 11 were asked:

- "On average, about how many hours a day do you watch TV or videos or play video games?"
- "On average, about how many hours a day do you spend on a computer, playing games, e-mailing, chatting, surfing the Internet, etc.?"

The response categories were: "I don't watch TV or videos or play video games/I don't use a computer," "less than 1 hour a day," "1 to 2 hours a day," "3 to 4 hours a day," "5 to 6 hours a day," and "7 or more hours a day." Total daily screen time was calculated by combining the time reported in the two questions, using the mid-point of the category (0, 0.5, 1.5, 3.5, 5.5 or 7).

For 12- to 17-year-olds, the following questions were asked: "In a typical week in the past three months, how much time did you usually spend:

- on a computer, including playing computer games and using the Internet or the World Wide Web?"

- playing video games, such as SEGA, Nintendo and Playstation?"
- watching television or videos?"

The response categories were: "none," "less than an hour," "1 to 2 hours," "3 to 5 hours," "6 to 10 hours," "11 to 14 hours," "15 to 20 hours," and "more than 20 hours." Total weekly viewing time was derived by taking the mid-point of each response category (0, 0.5, 1.5, 4, 8, 12.5, 17.5, or 20) and summing the resulting values across the three questions.

Household income was based on the number of people in the household and total household income from all sources in the 12 months before the interview.

Household income group	People in household	Total household income
Lowest	1 to 4	Less than $10,000
	5 or more	Less than $15,000
Lower-middle	1 or 2	$10,000 to $14,999
	3 or 4	$10,000 to $19,999
	5 or more	$15,000 to $29,999
Middle	1 or 2	$15,000 to $29,999
	3 or 4	$20,000 to $39,999
	5 or more	$30,000 to $59,999
Upper-middle	1 or 2	$30,000 to $59,999
	3 or 4	$40,000 to $79,999
	5 or more	$60,000 to $79,999
Highest	1 or 2	$60,000 or more
	3 or more	$80,000 or more

Respondents were grouped into three *education* categories based on the highest level of attainment in the household: secondary graduation or less, some postsecondary, and postsecondary graduation.

Self-perceived health was assessed with the question, "In general would you say that your health is excellent, very good, good, fair or poor?" For this analysis, children were divided into two groups: those who reported very good or excellent health, and those who did not.

Ethnicity was based on the question: "People living in Canada come from many different cultural and racial backgrounds. Are you:

1. White?"
2. Chinese?"
3. South Asian (e.g., East Indian, Pakistani, Sri Lankan, etc.?)"
4. Black?"
5. Filipino?"
6. Latin American?"
7. Southeast Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese, etc.)?"
8. Arab?"
9. West Asian (e.g., Afghan, Iranian, etc.)?"
10. Japanese?"
11. Korean?"
12. Aboriginal Peoples of North America (North American Indian, Métis, Inuit)?"
13. Other – specify.

In this analysis, category 1 was used for the comparison with the White population in the United States. To compare ethnic groups within Canada, the following categories were used: White (1); Black (4); Southeast/East Asian (2, 5, 7, 10, 11); off-reserve Aboriginal (12); and Other (3, 6, 8, 9, 13). Multiple responses across these categories were coded to "Other."

Calculating overweight and obesity in children and adolescents

For the 2004 Canadian Community Health Survey, body mass index (BMI) was derived using the child's or adolescent's weight and height as measured by the interviewer. BMI is calculated by dividing weight in kilograms by height in metres squared.

BMI cut-points of 25 and 30 are used to classify adults as overweight and obese, based on health risks associated with being in these BMI categories.[11,22] Recently, the International Obesity TaskForce (IOTF) agreed on a new approach to measure overweight and obesity among children and adolescents.[23] Because it is not clear which BMI levels are associated with health risks at younger ages, the group recommended extrapolating the adult cut-points of 25 and 30 to create sex- and age-specific values. Using data collected between 1963 and 1993 from the United States, Great Britain, the Netherlands, Brazil, Hong Kong and Singapore, BMI centile curves that passed through the points of 25 and 30 at age 18 were derived. Because sexual maturation influences body fat, the IOTF cut-points are sensitive to the timing of puberty.[17] The overweight and obesity rates in this analysis are based on the IOTF criteria.

For example, a 7-year-old boy who is 3 feet 11 inches (119 cm) tall who weighs 56.9 pounds (25.8 kg) would have a BMI of 18.2, and would be considered overweight; a 13-year-old girl who is 5 feet 3 inches (160 cm) tall who weighs 161 pounds (73 kg) would have a BMI of 28.5 and would be considered obese.

Many previous studies have used US growth curves and classified BMIs falling over the 85th and 95th centiles for age- and sex-specific categories as overweight or obese. While the two methods generally yield similar results, the IOTF reference values tend to give lower estimates for young children and higher estimates for older children.[1,24]

	Overweight cut-points BMI greater than or equal to:		Obese cut-points BMI greater than or equal to:	
Age (years)	Boys	Girls	Boys	Girls
2	18.41	18.02	20.09	19.81
2.5	18.13	17.76	19.80	19.55
3	17.89	17.56	19.57	19.36
3.5	17.69	17.40	19.39	19.23
4	17.55	17.28	19.29	19.15
4.5	17.47	17.19	19.26	19.12
5	17.42	17.15	19.30	19.17
5.5	17.45	17.20	19.47	19.34
6	17.55	17.34	19.78	19.65
6.5	17.71	17.53	20.23	20.08
7	17.92	17.75	20.63	20.51
7.5	18.16	18.03	21.09	21.01
8	18.44	18.35	21.60	21.57
8.5	18.76	18.69	22.17	22.18
9	19.10	19.07	22.77	22.81
9.5	19.46	19.45	23.39	23.46
10	19.84	19.86	24.00	24.11
10.5	20.20	20.29	24.57	24.77
11	20.55	20.74	25.10	25.42
11.5	20.89	21.20	25.58	26.05
12	21.22	21.68	26.02	26.67
12.5	21.56	22.14	26.43	27.24
13	21.91	22.58	26.84	27.76
13.5	22.27	22.98	27.25	28.20
14	22.62	23.34	27.63	28.57
14.5	22.96	23.66	27.98	28.87
15	23.29	23.94	28.30	29.11
15.5	23.60	24.17	28.60	29.29
16	23.90	24.37	28.88	29.43
16.5	24.19	24.54	29.14	29.56
17	24.46	24.70	29.41	29.69
17.5	24.73	24.85	29.70	29.84
18+	25.00	25.00	30.00	30.00

Source: Cole et al., *Reference 23*

not obese), compared with boys who were sedentary.

Watching television, playing video games and using the computer are common activities for many Canadian children. Time spent in this way is often referred to as "screen time." In 2004, over a third (36%) of children aged 6 to 11 logged more than 2 hours of screen time each day (Chart 11). These children were twice as likely to be overweight/obese (35%) as were those whose daily viewing amounted to an hour or less (18%). Obesity was also about twice as common in this group (11%),

compared with those who had an hour or less of daily screen time (5%).

For adolescents aged 12 to 17, screen time was measured on a weekly basis. The proportions who were overweight/obese ranged from 23% of those whose viewing amounted to less than 10 hours a week to 35% of those who spent 30 or more hours a week in front of a screen (Chart 12).

The relatively recent introduction and rapid proliferation of video games and home computers make it difficult to track trends in screen time. In 1988, when the Campbell's Survey on Health and

Chart 11
Percentage overweight or obese, by daily hours of screen time, household population aged 6 to 11, Canada excluding territories, 2004

Daily hours of screen time
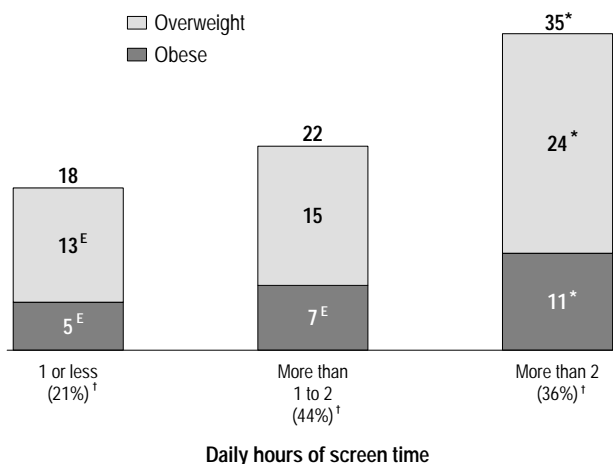
Data source: 2004 Canadian Community Health Survey: Nutrition
† Percentage of population aged 6 to 11 in this group
E Coefficient of variation 16.6% to 33.3% (interpret with caution)
* Significantly different from estimate for 1 or less category (p < 0.05)

Chart 12
Percentage overweight or obese, by weekly hours of screen time, household population aged 12 to 17, Canada excluding territories, 2004

Weekly hours of screen time

Data source: 2004 Canadian Community Health Survey: Nutrition
† Percentage of population aged 12 to 17 in this group
* Significantly different from estimate for less than 10 (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Well-being asked 12- to 17-year-olds how many hours they watched television, the weekly average was 9. In 2004, average weekly television hours were alm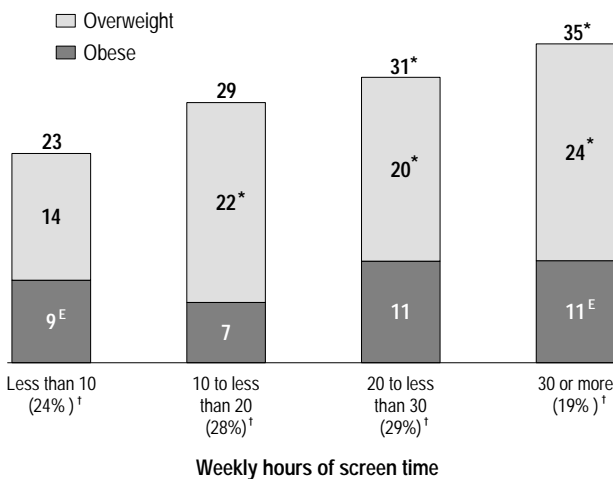ost the same, at 10. But when time spent using a computer and playing video games was included, adolescents' total average weekly screen time doubled to 20 hours (data not shown).

All associations between these lifestyle factors—fruit and vegetable consumption, leisure-time physical activity and screen time—persisted when the effects of age and socio-economic status were taken into account (data not shown).

Socio-economic status

For adults, lower socio-economic status tends to be associated with obesity. While the same relationship has been observed for children, the association is usually not as strong, and results have been inconsistent.[25-27]

According to the 2004 CCHS, children and adolescents in middle-income households were more likely to be obese than were those in high-income households (Chart 13). The proportions of obese youth in low-income and high-income households were similar.

The pattern was clearer by level of education. Young people in households where no members had more than a high school diploma were more likely to be overweight/obese than were those in households where the highest level of education was postsecondary graduation.

Negative perceptions of health

In 2004, 18% of adolescents aged 12 to 17 reported that they had at least one diagnosed chronic condition (data not shown). While this figure did not vary significantly by weight (normal, overweight or obese), young people's perceptions of their health did (Chart 14). Boys who were obese were much less likely than those whose weight was in the normal range to report their health as excellent or very good. For girls, negative ratings of their health were evident not only among those who were obese, but also among those who were

Limitations

The response rate to the 2004 Canadian Community Health Survey (CCHS): Nutrition was 76.5%. For various reasons, direct measurements of height and weight were obtained for only 65.5% of 2- to 17-year-olds.

Response rates to directly measured height and weight differed significantly by sex, age group and province. Measurements were slightly more likely to have been obtained for girls than for boys. The response rate was lowest for 2- to 5-year-olds (55%) and highest for adolescents (71%). At 56%, Ontario's response rate was particularly low. The likelihood of responding was not associated with fruit and vegetable consumption, leisure-time physical activity, screen time, household income, highest level of education in the household, presence of a chronic condition, or self-perceived health (data not shown).

Because it is difficult to measure physical activity, evidence of a relationship between energy expenditure and overweight and obesity among children and adolescents is lacking in many studies.[28] In the 2004 CCHS, parents of children aged 6 to 11 were asked about activities that increased the child's heart rate and made him/her feel out of breath some of the time (see *Definitions*). The child was encouraged to participate in answering these questions. The degree to which parents and/or children can accurately recall and report such information is unknown and may affect associations with overweight and obesity. Adolescents were asked about their leisure-time physical activities over the past three months. Again, there may have been recall problems, and leisure-time may not reflect overall physical activity because school and work were excluded.

The questions about fruit and vegetable consumption asked the *number of times* fruit and vegetables were consumed per day, but not the *amounts* consumed. Because the questions did not request portion size, compliance with daily intake recommendations, such as the Canada Food Guide, could not be assessed.

Percentage distribution of respondents aged 2 to 17, by response and reasons for non-response to measured height and weight

	Age group		
	Total	2-11	12-17
	%	%	%
Total	100.0	100.0	100.0
Measured	65.5	61.9	70.8
Not measured, total	34.5	38.1	29.2
Child not available	14.6	24.5	…
Refusal	4.4	1.7	8.3
Measuring equipment	7.2	6.2	8.7
Too tall for interviewer to measure	2.3	…	4.2
Telephone interview	1.5	…	3.4
Interview setting	0.9	…	2.0
Other	3.6	5.7	2.8

Data source: *2004 Canadian Community Health Survey: Nutrition*
… Rate too low to report

Response rates to directly measured height and weight

	%
Overall	66
Sex	
Boys	64*
Girls	67*
Age group	
2 to 5	55*
6 to 11	66
12 to 17	71*
Province	
Newfoundland and Labrador	74*
Prince Edward Island	72
Nova Scotia	77*
New Brunswick	71
Quebec	73*
Ontario	56*
Manitoba	76*
Saskatchewan	71*
Alberta	69
British Columbia	71*

Data source: *2004 Canadian Community Health Survey: Nutrition*
* Significantly different from overall rate (p < 0.05)

Chart 13
Percentage overweight or obese, by household income and highest level of education in household, household population aged 2 to 17, Canada excluding territories, 2004
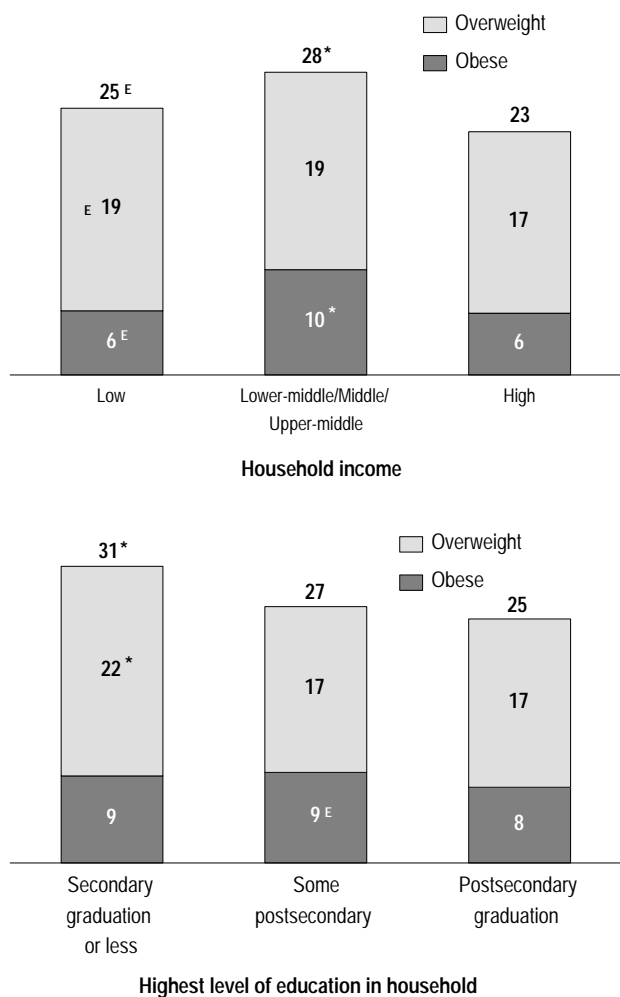
Household income

Highest level of education in household

overweight. These associations between weight and health perceptions persisted for both sexes when socio-economic status and the presence of a chronic condition were taken into account (data not shown).

Chart 14
Percentage reporting very good or excellent health, by weight status and sex, household population aged 12 to 17, Canada excluding territories, 2004
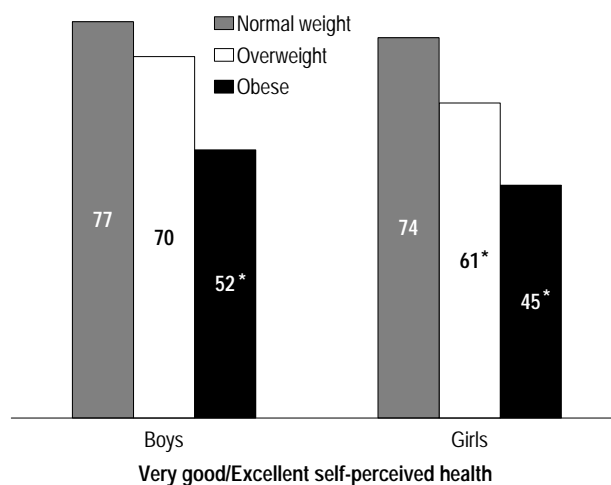
Very good/Excellent self-perceived health

Concluding remarks

Over the past 25 years, the percentage of Canadian children and adolescents who are overweight or obese has risen considerably. The increase is particularly notable among 12- to 17-year-olds, whose overweight/obesity rate has more than doubled, and whose obesity rate has tripled.

The burden that childhood obesity places on the health care system is difficult to quantify because the related physical health problems are usually not evident until later in life. Nonetheless, the upturn in the prevalence of overweight/obesity among young people is important because excess weight in adolescence often persists into adulthood.[1,15-18] Longitudinal data indicate that once an adult is overweight, further weight gain is likely and very few lose enough weight to return to the normal weight range. (See Le Petit and Berthelot in this issue.)

Some of the factors associated with overweight and obesity among young people can be modified. Eating more fruit and vegetables, increasing physical activity and devoting less time to sedentary

activities such as watching television and playing video games may help reverse the upward trend. ●

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Appendix

Table A

Percentage overweight and obese, by selected socio-demographic characteristics, household population aged 2 to 17, Canada excluding territories, 2004

	Estimated population '000	Overweight %	Overweight 95% confidence interval	Obese %	Obese 95% confidence interval	Overweight/Obese %	Overweight/Obese 95% confidence interval
Total	**6,184**	**18.1**	**16.8, 19.3**	**8.2**	**7.3, 9.1**	**26.2**	**24.8, 27.7**
Sex							
Boys†	3,178	17.9	16.0, 19.8	9.1	7.7, 10.5	27.0	24.6, 29.3
Girls	3,007	18.3	16.4, 20.1	7.2	6.1, 8.4	25.5	23.4, 27.6
Age group							
2 to 5	**1,348**	**15.2**	**12.3, 18.0**	**6.3**	**4.6, 8.0**	**21.5**	**18.3, 24.6**
Boys†	684	13.1	9.4, 16.9	6.3^E	3.9, 8.6	19.4	15.0, 23.7
Girls	664	17.3	12.9, 21.6	6.4^E	4.0, 8.8	23.6	19.1, 28.2
6 to 11	**2,321**	**17.9**	**15.8, 19.9**	**8.0**	**6.4, 9.6**	**25.8***	**23.4, 28.3**
Boys†	1,173	17.0	13.9, 20.0	8.5	6.0, 11.0	25.4	21.6, 29.2
Girls	1,148	18.8	15.9, 21.6	7.5	5.2, 9.8	26.3	22.8, 29.8
12 to 17	**2,515**	**19.8**	**17.8, 21.8**	**9.4**	**7.9, 10.9**	**29.2**	**26.9, 31.5**
Boys†	1,320	21.1	18.3, 24.0	11.1	8.8, 13.4	32.3	28.9, 35.6
Girls	1,195	18.3	15.6, 21.0	7.4*	5.6, 9.3	25.8*	22.6, 28.9
Ethnicity							
White	4,907	18.1	16.7, 19.6	8.2	7.2, 9.3	26.3	24.7, 28.0
Black	186	17.6^E	8.6, 26.6	F	…	29.3^E	18.0, 46.0
Southeast/East Asian	343	12.2*^{E}	7.5, 17.0	5.4*^{E}	2.7, 8.2	17.7*^{E}	12.3, 23.0
Aboriginal (off-reserve)	84	21.5^E	12.5, 30.5	19.8*^{E}	10.8, 28.7	41.3*	30.4, 52.1
Other	665	20.4	15.8, 25.0	6.8^E	4.0, 9.6	27.2	22.1, 32.3
Household income							
Low	143	19.0^E	9.1, 28.8	6.0^E	2.8, 9.2	25.0^E	15.0, 34.9
Lower-middle/Middle/Upper-middle	3,574	18.5	16.8, 20.2	9.8*	8.5, 11.2	28.3*	26.4, 30.3
High†	1,856	17.0	14.6, 19.4	5.8	4.2, 7.3	22.8	20.0, 25.5
Highest level of education in household							
Secondary graduation or less	1,036	21.7*	18.5, 24.9	9.0	6.9, 11.1	30.7*	27.4, 34.1
Some postsecondary	477	17.2	12.0, 22.3	9.4^E	6.1, 12.7	26.5	20.5, 32.6
Postsecondary graduation†	4,570	17.4	15.9, 19.0	7.8	6.8, 8.9	25.3	23.5, 27.0

Data source: *2004 Canadian Community Health Survey: Nutrition*
Notes: *For age, the reference category is the previous age group; for ethnicity, the overall Canadian estimate. One respondent had a missing value for ethnicity, 952 for household income, and 137 for household education.*
† Reference category
* Significantly different from estimate for reference category (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)
F Coefficient of variation greater than 33.3% (suppressed because of extreme sampling variability)
⋯ Not applicable

Table B
Percentage overweight and obese, by selected health behaviours, household population aged 2 to 17, Canada excluding territories, 2004

	Estimated population '000	Overweight		Obese		Overweight/Obese	
		%	95% confidence interval	%	95% confidence interval	%	95% confidence interval
Total	**6,184**	**18.1**	**16.8, 19.3**	**8.2**	**7.3, 9.1**	**26.2**	**24.8, 27.7**
Daily fruit and vegetable consumption							
Less than 3 times	1,307	18.7	16.1, 21.3	10.2*	8.0,12.3	28.9*	25.6, 32.1
3 to less than 5 times	2,310	19.0	16.7, 21.4	9.0*	7.4,10.7	28.1*	25.5, 30.7
5 or more times†	2,552	16.8	14.7, 19.0	6.4	5.2, 7.7	23.3	21.0, 25.6
Weekly hours of physical activity (ages 6 to 11)							
Less than 7†	359	16.7	12.1, 21.3	9.3^E	5.2,13.4	26.0	20.2, 31.8
7 to less than 14	982	18.4	15.2, 21.7	8.2	5.7,10.6	26.6	22.8, 30.4
14 or more	957	18.0	14.5, 21.5	7.5^E	4.9,10.1	25.5	21.3, 29.7
Leisure-time physical activity (ages 12 to 17)							
Boys							
Active/Moderately active†	974	24.0	20.5, 27.5	9.3	7.2, 11.4	33.3	29.7, 37.0
Sedentary	346	13.0*	9.3, 16.7	16.3*^{E}	10.3,22.2	29.3	22.4, 36.2
Girls							
Active/Moderately active†	709	18.5	15.3, 21.8	6.3	4.2, 8.3	24.8	21.1, 28.5
Sedentary	486	18.0	13.4, 22.6	9.2^E	5.8,12.6	27.1	21.7, 32.6
Daily hours of screen time (ages 6 to 11)							
Less than or equal to 1†	484	12.5^E	8.0, 17.1	5.3^E	2.2, 8.4	17.8	12.6, 23.0
More than 1 to 2	1,013	15.3	12.4, 18.2	7.1^E	4.7, 9.5	22.4	18.9, 25.9
More than 2	824	24.1*	19.6, 28.6	10.6*	7.7,13.6	34.8*	29.9, 39.6
Weekly hours of screen time (ages 12 to 17)							
Less than 10†	614	13.9	11.0, 16.8	9.1^E	5.6,12.5	23.0	18.6, 27.4
10 to less than 20	699	21.9*	18.0, 25.9	6.6	4.7, 8.6	28.6	24.6, 32.6
20 to less than 30	728	20.2*	16.8, 23.6	11.2	8.3,14.0	31.4*	27.2, 35.6
30 or more	466	23.8*	18.9, 28.8	11.2^E	7.5,14.9	35.0*	29.4, 40.6

Data source: *2004 Canadian Community Health Survey: Nutrition*
Note: *There were 27 respondents with a missing value for fruit and vegetable consumption, 18 for physical activity for ages 6 to 11, 2 for screen time for ages 6 to 11, and 7 for screen time for ages 12 to 17.*
† Reference category
* Significantly different from estimate for reference category (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Chart A

Trends in prevalence of overweight/obese and obesity, household population aged 12 to 17, Canada excluding territories, selected years 1978/79 to 2004
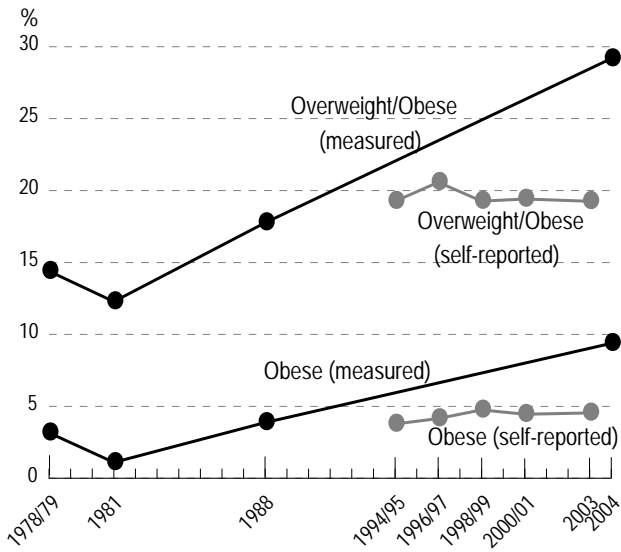
Chart B

Trends in prevalence of overweight/obese and obesity, household population aged 2 to 5, Canada excluding territories, selected years 1978/79 to 2004

Chart C

Trends in prevalence of overweight/obese and obesity, household population aged 6 to 11, Canada excluding territories, selected years 1978/79 to 2004

Obesity—a growing issue

Christel Le Petit and Jean-Marie Berthelot

Abstract

Objectives
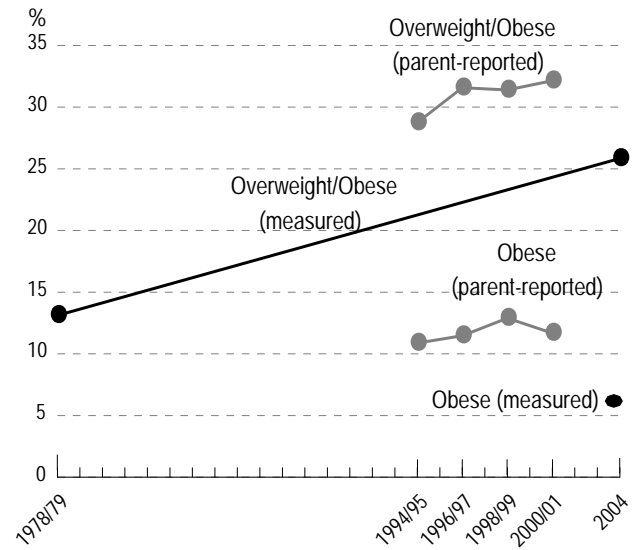This article, based on longitudinal data, follows a sample of people who were aged 20 to 56 in 1994/95 to determine the percentage who made the transition from normal to overweight, or from overweight to obese by 2002/03. Characteristics that increased the chances of overweight people becoming obese are examined.

Data sources
The data are from five cycles of the National Population Health Survey, 1994/95 through 2002/03.

Analytical techniques
Cox proportional hazards modelling was used to identify variables associated with an increased or decreased risk of becoming obese; 1,937 men and 1,184 women who were overweight in 1994/95 were selected.

Main results
Close to a third (32%) of people who were aged 20 to 56 and of normal weight in 1994/95 had become overweight by 2002/03. During the same period, almost a quarter of those who had been overweight in 1994/95 had become obese. Among people who were overweight, the risk of obesity was relatively high for younger men and members of low-income households. Overweight men who smoked or who had activity restrictions had a high risk of obesity. Physical activity helped women avoid obesity.

Keywords
body mass index, body weight, longitudinal studies, weight gain

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Obesity is recognized as a major public health problem that rivals smoking as a cause of illness and premature death. Obesity has been linked with type 2 diabetes, cardiovascular disease, hypertension, stroke, gallbladder disease, some forms of cancer, osteoarthritis and psychosocial problems.[1] The impact on life expectancy is considerable: among American non-smokers, obesity at age 40 has been associated with a loss of 7.1 years of life for women and 5.8 years for men.[2] The same American study estimated that even being overweight reduced both male and female non-smokers' life expectancy by more than three years.

Obesity results when people consume far more calories than they use (see *Calculating overweight and obesity*). This imbalance has been attributed to a variety of factors that characterize modern life: fast food, growing portion sizes, a sedentary lifestyle, and suburban designs that tend to discourage walking.[3]

Data source

This analysis is based on longitudinal data from the first five cycles of the National Population Health Survey (NPHS), 1994/95 through 2002/03. Since 1994/95, the NPHS has collected information about the health of the Canadian population every two years. It covers household and institutional residents in all provinces and territories except members of the regular Armed Forces, people living on Indian reserves or in some remote areas, and civilian residents of military bases. Although residents of health care institutions are part of the survey, they are excluded from this analysis.

In 1994/95, 20,095 individuals were selected for the longitudinal panel. Of these, 17,276 agreed to participate, for a response rate of 86.0%. The response rates for subsequent cycles, based on these 17,276 respondents, were: 92.8% in cycle 2 (1996/97); 88.2% in cycle 3 (1998/99); 84.8% in cycle 4 (2000/01); and 80.6% in cycle 5 (2002/03).

More detailed descriptions of the NPHS design, sample and interview procedures can be found in published reports.[4,5]

Analytical techniques

The proportion of people moving from one weight category to another was calculated using cross-tabulations between 1994/95 and each subsequent wave of the NPHS. Thus, the results show the net change between 1994/95 and 1996/97, 1994/95 and 1998/99, 1994/95 and 2000/01, and 1994/95 and 2002/03. Tests for trends for the proportions presented in Charts 1 to 4 were performed using logistic regressions, with time as the only independent variable.

To identify variables that were associated with an increased or decreased risk of becoming obese, Cox proportional hazards modelling was used. This technique allows for the study of relationships between individual characteristics and an outcome when that outcome can take place over a period of time. The method accounts for the possibility that some events do not occur over the study period, and it minimizes the bias associated with attrition.

For the proportional hazards modelling, respondents who were overweight in 1994/95 (BMI 25.0 to 29.9) and had no missing covariates were selected: 1,937 men and 1,184 women. During the study period, 447 of these men and 402 of the women became obese. After 1994/95, if their BMI in a subsequent cycle placed them in the obese category, this was considered an event. Given that weight gain is a continuous process that was measured only at discrete intervals (the NPHS interviews), many transitions to obesity occurred at the same time, after 2, 4, 6 or 8 years. The proper specification of such a model is with a ties = exact option of SAS, which corresponds to a continuous process (becoming obese) inadequately observed at fixed intervals (the NPHS interviews). To allow the use of survey weights, the model was specified with Proc Logistic, with a cloglog link, which is equivalent to a proportional hazards model, or the procedure Phreg, ties = exact in SAS.[6]

If the BMI value was missing for one or more cycles, but values for subsequent cycles were available, the cases were retained. This creates intervals of varying lengths between observations. To control for the fact that the longer the interval, the more likely a transition is to occur from one BMI category to another, wave length and wave length square were entered as independent variables in the model.

Relationships between the independent variables (age, household income, alcohol consumption, etc.) as of 1994/95 and becoming obese by 2002/03 were examined. The exceptions were leisure-time physical activity and usual daily physical activity; associations between values for these variables at each cycle and becoming obese were examined.

The analysis pertains to the 10 provinces, excluding the territories. All the analyses were weighted using the longitudinal weights constructed to represent the total population of the provinces in 1994.

The bootstrap method was used to account for the complex survey design in the calculation of confidence intervals and in the assessment of statistical significance.[7-9] The significance level was set at $p < 0.05$.

Limitations

This analysis is based on personal or telephone interviews. As with every survey, some non-response occurred. If the non-response was not random, bias could have been introduced in the analysis.

The data are self- or proxy-reported; they have not been validated against an independent source or with direct measures. It is possible that respondents provided what they considered socially acceptable answers about issues like weight, smoking or drinking.

Other errors might have occurred during data collection and capture. Interviewers might have misunderstood some instructions, and errors might have been introduced in data processing. However, considerable effort was made to ensure that such errors were kept to a minimum.

Information on nutrition was not available for this analysis.

The analysis in this report uses longitudinal data to follow a large sample of people over eight years to determine what percentage of them made the transition from normal to overweight, and the percentage who shifted from overweight to obese. Because the analysis is based on self-reported information (as opposed to direct measurements of height and weight), the actual extent of overweight and obesity is somewhat underestimated (see "Adult obesity" in this issue). However, the focus of this analysis is the likelihood of moving from one weight category to another, not the prevalence of excess weight. Characteristics that increased the chances of overweight people becoming obese are examined—information that can help target public health programs to prevent new cases of obesity. Once gained, excess weight may be hard to shed, so interventions that emphasize prevention may be more effective than weight reduction efforts.[10]

This study is based on the first five cycles of the National Population Health Survey (NPHS), which interviewed the same individuals every two years from 1994/95 to 2002/03 (see *Methods* and *Definitions*). Because patterns of weight gain differ by sex, separate analyses were conducted for men and women.

Steady gains

Among people whose weight was in the normal range in 1994/95 (based on self-reported height and weight), a shift into the overweight range by 2002/03 was relatively common (Chart 1). At the end of the eight years, about one-third of them (32%) had become overweight. Weight gain is usually a slow process; very few people (2%) whose weight was in the normal range in 1994/95 had become obese by 2002/03 (data not shown).

Once people are overweight, they tend to continue to gain weight. Almost a quarter of those who were overweight in 1994/95 had become obese by 2002/03 (Chart 2). Just 10% who were overweight in 1994/95 had moved into the normal weight range by 2002/03 (data not shown).

Chart 1
Percentage in normal weight range in 1994/95 who became overweight, household population aged 20 to 56 in 1994/95, Canada excluding territories, 1996/97 to 2002/03
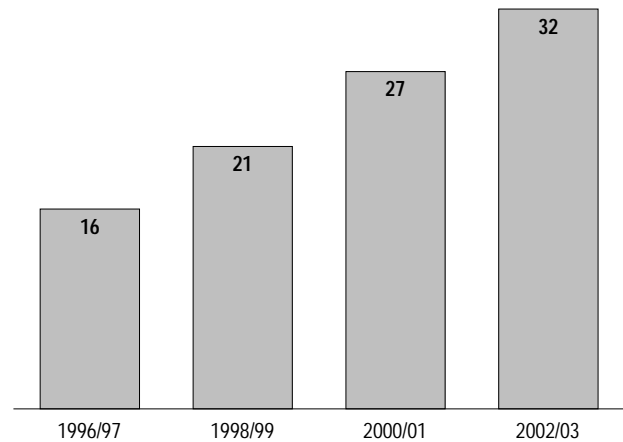
Data source: *1994/95 to 2002/03 National Population Health Survey, longitudinal file*
Note: *The slope of the increase is significantly different from 0 (p < 0.05).*

Chart 2
Percentage overweight in 1994/95 who became obese, household population aged 20 to 56 in 1994/95, Canada excluding territories, 1996/97 to 2002/03
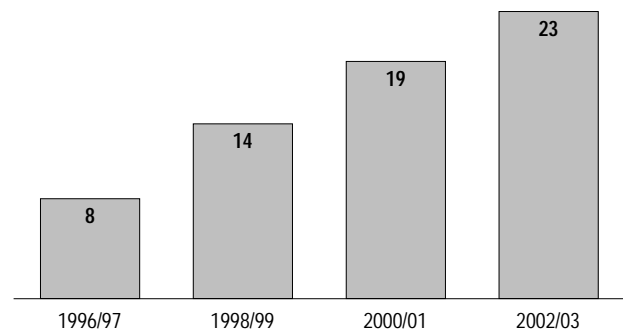
Data source: *1994/95 to 2002/03 National Population Health Survey, longitudinal file*
Note: *The slope of the increase is significantly different from 0 (p < 0.05).*

Chart 3
Percentage in normal weight range in 1994/95 who became overweight, by sex, household population aged 20 to 56 in 1994/95, Canada excluding territories, 1996/97 to 2002/03

■ Men
□ Women

	1996/97	1998/99	2000/01	2002/03
Men	20	26	34	38
Women	12	17	21	28
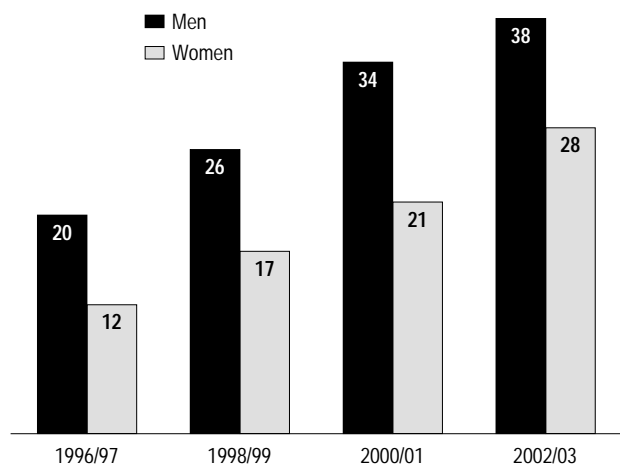
Data source: *1994/95 to 2002/03 National Population Health Survey, longitudinal file*
Note: *The slope of the increase is significantly different from 0 (p < 0.05).*

Chart 4
Percentage overweight in 1994/95 who became obese, by sex, household population aged 20 to 56 in 1994/95, Canada excluding territories, 1996/97 to 2002/03

■ Men
□ Women

	1996/97	1998/99	2000/01	2002/03
Men	8	13	18	20
Women	10	18	22	28
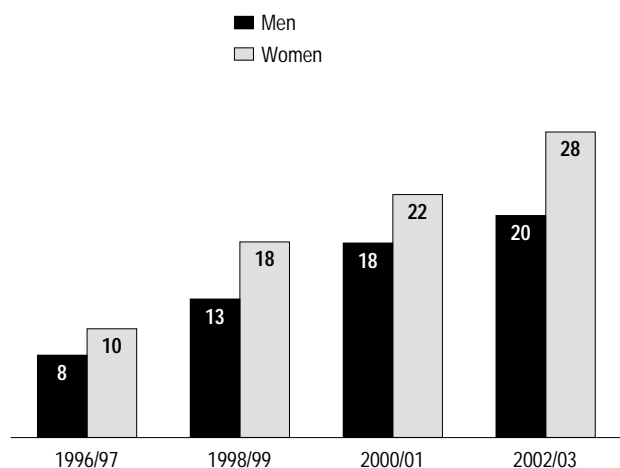
Data source: *1994/95 to 2002/03 National Population Health Survey, longitudinal file*
Note: *The slope of the increase is significantly different from 0 (p < 0.05).*

Patterns differ for men and women

Men were more likely than women to make the transition from normal to overweight (Chart 3). By 2002/03, 38% of the men whose weight was in the normal range in 1994/95 had become overweight, compared with 28% of the women.

However, the likelihood of going from overweight to obese was greater for women (Chart 4). At the end of the eight years, 28% of women and 20% of men who were overweight at the outset had become obese.

The shift to obesity occurs in the context of a variety of demographic, socio-economic, lifestyle and health variables. Moreover, these factors are often related to each other. For instance, an older person with an activity restriction may be sedentary, and people in low-income households may be more likely to smoke than those in more affluent households. When such potentially confounding effects were taken into account, along with the extent of overweight in 1994/95, several factors emerged as being related to an overweight individual's chances of becoming obese.

Calculating overweight and obesity

Overweight and obesity are based on *body mass index* (BMI), which is calculated by dividing weight in kilograms by height in metres squared. For example, the BMI of an individual 1.7 metres tall (5 feet 7 inches) weighing 70 kilograms (154 pounds) would be:

$$70 \div 1.7^2 = 24.2$$

If this person weighed 80 kilograms (176 pounds), his or her BMI would be:

$$80 \div 1.7^2 = 27.7$$

The BMI categories used for this article are: underweight (less than 18.5); normal weight (18.5 to 24.9); overweight (25.0 to 29.9); and obese (30.0 or more).

Younger men more likely to become obese

Young adults, especially men, had an elevated risk of obesity (Table 1). During the eight-year period, overweight men in their twenties and thirties were more likely than those in their fifties to become obese. For overweight women in their twenties, the risk of becoming obese was high compared with that for women in their fifties, but failed to reach statistical significance (p=0.07).

Lower income, higher risk

Members of the highest income quintile households were less likely to become obese than were those in the lowest income category. Among overweight men, the risk of becoming obese was about 40% less for those in the two highest household income quintiles than for those in the lowest quintile. Overweight women in the middle and upper-middle income quintiles also had a significantly lower risk of obesity, again around 40%, compared with women in the lowest quintile.

Table 1

Adjusted hazards ratios for overweight men and women aged 20 to 56 becoming obese, by selected characteristics, household population, Canada excluding territories, 1994/95 to 2002/03

	Men		Women			Men		Women	
	Adjusted hazards ratio	95% confidence interval	Adjusted hazards ratio	95% confidence interval		Adjusted hazards ratio	95% confidence interval	Adjusted hazards ratio	95% confidence interval
Body mass index in 1994/95	2.05*	1.85, 2.28	1.90*	1.70, 2.12	**Leisure-time physical activity‡**				
Age group					Sedentary†	1.00	…	1.00	…
20 to 29	2.48*	1.54, 4.00	1.61	0.97, 2.68	Light	1.08	0.74, 1.58	0.89	0.59, 1.34
30 to 39	1.60*	1.06, 2.41	1.17	0.75, 1.83	Moderate	1.07	0.76, 1.50	0.73	0.51, 1.06
40 to 49	1.33	0.88, 2.00	1.17	0.75, 1.83	Intense	1.06	0.77, 1.45	0.92	0.55, 1.55
50 to 56†	1.00	…	1.00	…	**Usual daily physical activity‡**				
Household income quintile					Sit†	1.00	…	1.00	…
Lowest†	1.00	…	1.00	…	Stand or walk	0.80	0.55, 1.16	0.72*	0.52, 1.00
Lower-middle	0.77	0.49, 1.23	0.79	0.52, 1.20	Lift light loads	1.02	0.68, 1.52	0.72	0.48, 1.08
Middle	0.67	0.41, 1.09	0.60*	0.37, 0.97	Heavy work	0.75	0.47, 1.17	0.77	0.26, 2.21
Upper-middle	0.60*	0.37, 0.97	0.60*	0.38, 0.92	**Self-perceived health**				
Highest	0.54*	0.33, 0.85	0.63	0.39, 1.01	Excellent/Very good†	1.00	…	1.00	…
Marital status					Good	1.30	0.97, 1.74	0.75	0.54, 1.05
Single†	1.00	…	1.00	…	Fair/Poor	1.04	0.58, 1.88	0.66	0.37, 1.19
Married/Common-law	1.18	0.82, 1.71	1.19	0.75, 1.91	**Activity restriction**				
Separated/Divorced/Widowed	0.84	0.47, 1.51	0.86	0.50, 1.48	No†	1.00	…	1.00	…
Alcohol consumption					Yes	1.44*	1.02, 2.03	1.41	0.97, 2.07
Never†	1.00	…	1.00	…	**Region**				
Regular	0.64	0.38, 1.10	0.65	0.37, 1.15	Atlantic	0.85	0.59, 1.24	1.00	0.67, 1.50
Occasional	0.56	0.29, 1.08	0.54*	0.30, 0.97	Quebec	1.04	0.70, 1.54	1.13	0.77, 1.67
Former	1.20	0.64, 2.25	0.64	0.34, 1.23	Ontario†	1.00	…	1.00	…
Smoking					Prairies	1.05	0.73, 1.51	1.09	0.73, 1.62
Never†	1.00	…	1.00	…	British Columbia	1.02	0.71, 1.48	1.15	0.67, 1.96
Daily	1.49*	1.06, 2.08	1.13	0.80, 1.60					
Occasional	1.33	0.75, 2.34	0.56	0.26, 1.20					
Former	1.26	0.91, 1.76	0.93	0.67, 1.30					

Data source: *1994/95 to 2002/03 National Population Health Survey, longitudinal file*
Notes: *The models are based on records for 1,937 men and 1,184 women who were aged 20 to 56 and overweight in 1994/95. Because of rounding, a hazards ratio with 1.00 as the upper confidence limit is significant.*
† Reference group
‡ Measured at each survey cycle
* Significantly different from estimate for reference group (p < 0.05)

Except for the two physical activity measures, the independent variables used in this analysis pertain to respondents' characteristics in 1994/95.

Respondents aged 20 to 56 in 1994/95 were selected. By the fifth cycle of the National Population Health Survey (2002/03), they were aged 28 to 64. Pregnant women were excluded.

Household income quintiles were determined based on household income adjusted to account for household size (household income / square root of household size):

Quintile	Household income
Lowest	Less than $12,500
Lower-middle	$12,500 to $20,207
Middle	$20,208 to $27,500
Upper-middle	$27,501 to $40,414
Highest	More than $40,414

Three *marital status* categories were specified: never married; married, common-law or living with partner; and separated, divorced or widowed.

Alcohol consumption refers to four types of drinkers: regular, occasional, former, and never. Respondents were told that "drink" meant one bottle or can of beer or a glass of draft; one glass of wine or a wine cooler; or one straight or mixed drink with 1.5 ounces of hard liquor. "Regular" means the respondent reported drinking more than once a month in the year before the survey interview, and "occasional," less than once a month during that time. Respondents who had not had a drink in the past 12 months but had had an alcoholic drink sometime before that were classified as "former" drinkers. Those in the "never" category reported never having had a drink.

Smoking was classified as: never, daily, occasional, and former.

Respondents' level of physical activity at each survey cycle was calculated (time-varying covariate). Level of *leisure-time physical activity* was based on a combination of energy expenditure during a given activity and the frequency with which respondents engaged in that activity. Energy expenditure (EE) is kilocalories expended per kilogram of body weight per day (KKD). An EE less than 1.5 KKD is considered low; 1.5 to 2.9 KKD, moderate; and 3 or more KKD, high. The frequency of physical activity was grouped in two categories, based on the number of times respondents participated in each activity for at least 15 minutes: regular (at least 12 times a month) or irregular (11 times or fewer per month). Four physical activity categories were defined:

- *Intense:* high energy expenditure (at least 3 KKD) during regular physical activity
- *Moderate*: moderate energy expenditure (1.5 to 2.9 KKD) during regular physical activity
- *Light*: light energy expenditure (less than 1.5 KKD) during regular physical activity
- *Sedentary:* irregular physical activity, independent of energy expenditure

Usual daily physical activity was based on respondents' usual daily activities and work habits over the previous three months:

- Usually sit and don't walk around very much
- Stand or walk quite a lot
- Lift or carry light loads
- Do heavy work or carry very heavy loads

Self-perceived health was measured on a five-category scale: poor, fair, good, very good or excellent. For this analysis, three categories were specified: excellent or very good, good, and fair or poor.

Respondents were considered to have an *activity restriction* if they reported being limited in the kind or amount of activities they could do at home, at work, in school or in other activities, or indicated they had a long-term disability or handicap.

The provinces were grouped into five *regions*: Atlantic (Newfoundland, New Brunswick, Nova Scotia, Prince Edward Island), Quebec, Ontario, Prairies (Saskatchewan, Manitoba, Alberta), and British Columbia.

The relationship between household income and obesity may reflect the cost of food, as foods high in fat and sugar are often less expensive. Low-income families must balance grocery expenditures with spending on other necessities such as housing and clothing.[11] As well, food costs have been shown to be higher in low-income neighborhoods, and travelling to shop in areas where prices are better may not be feasible.[12]

Occasional drinking

The risk of becoming obese was almost 50% lower for overweight women who reported occasional drinking, compared with those who never drank. While a similar pattern was observed for men, the association did not reach statistical significance (p=0.08).

An association between alcohol consumption and a slight weight loss for women has been reported in other studies.[13,14] Also, people who drink only occasionally may practise health-conscious behaviours, especially with regard to their diet, that reduce their risk of becoming obese.

High risk for male smokers

Overweight men who smoked daily in 1994/95 were almost 50% more likely than those who had never smoked to have become obese by 2002/03. This is contrary to cross-sectional studies that have found that smokers are less likely than never-smokers to be obese. However, those studies also showed that former smokers are more likely to be obese than people who have never smoked.[15] Further analysis of the NPHS data indicated that these results reflected, in part, a weight gain among people who quit smoking after 1994/95 (data not shown).

Activity

It is no surprise that overweight people who were restricted in their daily activities—at home, at work or at school—were at increased risk of becoming obese. While the association was statistically significant only for men, an indication of a similar relationship was present for women (p=0.07). Because of their physical restrictions, many of these people may be relatively inactive, which increases their risk of gaining weight.

Physical activity, in fact, seemed to offer overweight women some protection against obesity. Those whose daily activities involved a lot of walking or standing were less likely to become obese than were overweight women who tended to sit most of the day. Even when the effects of the other variables were considered, this association remained statistically significant. As well, overweight women whose leisure time entailed moderate physical activity were at less risk of becoming obese than were those who were sedentary. However, when the other variables were taken into account, this relationship was not significant (p=0.10). No statistically significant association between physical activity, as measured

in the survey, and obesity was observed for overweight men.

Region not a factor

Despite geographic differences in the prevalence of obesity, no association was found between region of residence and the risk of becoming obese. Thus, an overweight individual's chances of becoming obese are influenced by factors such as age, income, smoking and physical activity, and not by the simple fact of residing in a specific part of the country.

Concluding remarks

Between 1994/95 and 2002/03, a third of people who started out in the normal weight range had become overweight, and almost a quarter of those who were overweight had become obese.

Not surprisingly, being overweight is an important predictor of obesity; in fact, it is an intermediate step. But even when the extent of overweight in 1994/95 was taken into account, several other factors were independently associated with becoming obese. Among people who were overweight, the risk of obesity was relatively high for younger men and for members of low-income households. Overweight men who smoked were at risk of becoming obese, while occasional drinking was associated with a reduced risk of obesity among overweight women. Overweight men with activity restrictions were more likely to become obese than were those who did not have such restrictions. Physical activity offered overweight women some protection against obesity.

Although this study does not include children, it has been shown that parental obesity significantly increases the risk for children.[16] Therefore, identifying groups of adults who are likely to gain weight and targeting them for intervention may be an indirect way of preventing their children from becoming obese.

Once weight is gained, it may be hard to lose. Greater knowledge of the dynamics behind the trend toward obesity among Canadians is key to effective public health interventions. ●

An electronic version of this article, "Obesity: A Growing Issue," was released on April 7, 2005, as part of the Healthy Today, Healthy Tomorrow? Findings from the National Population Health Survey *series (82-618-MWE, free). This publication is available at: http://www.statcan.ca/english/research/82-618-MIE/82-618-MIE2005003.htm*

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Health Matters

Short, descriptive reports,
presenting recent information
from surveys and
administrative databases

Trends in adult obesity by Margot Shields and Michael Tjepkema

Keywords: *body mass index, body weight, income, smoking*

In recent years, the percentage of Canadian adults with excess weight has increased considerably, part of a worldwide trend in both developed and developing countries.[1] It is clear that the prevalence of obesity is rising in Canada,[2] but how this change is reflected among different segments of the population is less well known. This article examines trends in the prevalence of obesity—based on actual height and weight measurements—by province, age, smoking status and household income.

Measuring height and weight

In population health surveys, obesity is commonly assessed using body mass index (BMI) categories. BMI is calculated based on an individual's height and weight (see *Measuring body composition*). Many national surveys in Canada have collected information to measure BMI, but varying procedures and collection methods have made it difficult to compare estimates from different times. Surveys that rely on respondents' own reports of their height and weight tend to result in underestimates of the prevalence of overweight and obesity.[3-6] Self-reported information is also sensitive to the mode of collection; for example, telephone versus personal interviews.[7]

The 2004 Canadian Community Health Survey (CCHS): Nutrition, along with the 1978/79 Canada Health Survey (CHS) and the 1986-92 Canadian Heart Health Surveys (CHHS), can be used to make meaningful comparisons across time for the adult population aged 18 to 74. For all three surveys, interviewers measured the height and weight of

nationally representative samples of adults. Because the age distribution of the population has changed, the 1978/79 and 1986-92 estimates have been age-standardized to the 2004 population distribution to compare the prevalence of obesity over time.

Marked shift by 2004

Overall, the distribution of Canadian adults aged 18 to 74 by BMI was similar in 1978/79 and 1986-92. By 2004, however, there was a marked shift towards heavier weights (Chart 1, Table A)—a move reflected in changes in obesity estimates for

Chart 1
Percentage distribution of household population aged 18 to 74, by body mass index (BMI), Canada excluding territories
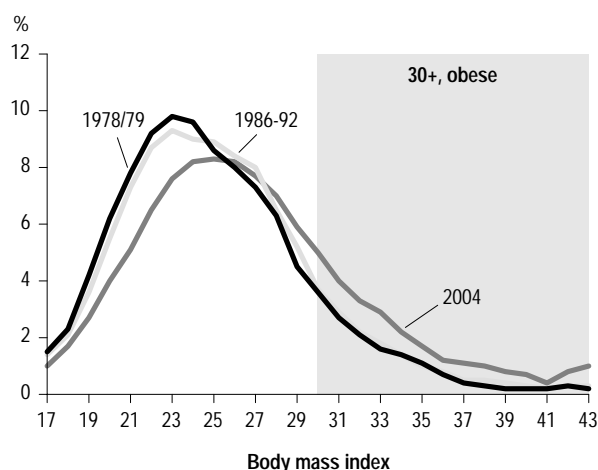
Data sources: 1978/79 Canada Health Survey; 1986-92 Canadian Heart Health Surveys; 2004 Canadian Community Health Survey: Nutrition

both men and women (Chart 2). In 1978/79, the age-adjusted obesity estimate for men was 12%. There was little change for the 1986-92 period, when 13% of men were obese, but, by 2004, the percentage had almost doubled to 23%. The pattern for women was similar: 16% were obese in 1978/79 and again in 1986-92, but by 2004, the proportion had risen significantly, to 23%.

Chart 2
Percentage obese, by sex, household population aged 18 to 74, Canada excluding territories
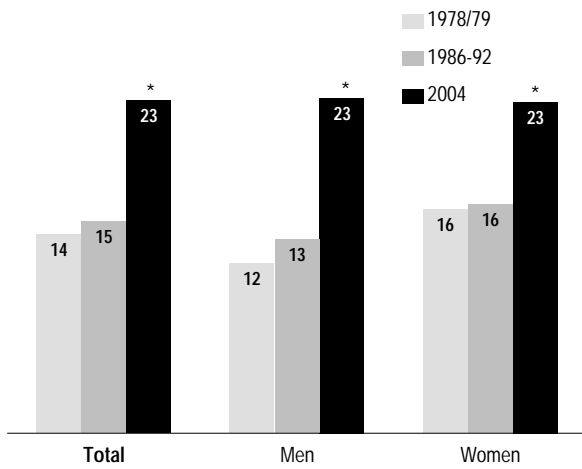
Data sources: 1978/79 Canada Health Survey: 1986-92 Canadian Heart Health Surveys; 2004 Canadian Community Health Survey: Nutrition
Note: For each sex, estimates based on the Canada Health Survey and the Canadian Heart Health Surveys were age-standardized using the distribution of the corresponding 2004 CCHS population.
*Significantly higher than estimate for 1986-92 (p < 0.05)

Provincial differences

From 1986-92 to 2004, the prevalence of obesity increased significantly in almost all provinces (Chart 3). Nova Scotia was the exception. Although there was a significant rise in obesity among women in this province, the prevalence among men remained stable (Table B). The most substantial upturns in overall prevalence—more than 10 percentage points—were in Saskatchewan, Newfoundland and Labrador, and New Brunswick.

Chart 3
Percentage obese, by province, household population aged 18 to 74, Canada excluding territories

Data sources: 1986-92 Canadian Heart Health Surveys; 2004 Canadian Community Health Survey: Nutrition
Note: For each province, the estimate based on the Canadian Heart Health Surveys was age-standardized using the distribution of the corresponding 2004 CCHS population.
*Significantly higher than estimate for 1986-92 (p < 0.05)

Men becoming obese at younger ages

The likelihood of obesity for men increased in almost all age groups from 1986-92 to 2004 (Chart 4). The rise in obesity prevalence was particularly sharp for those aged 25 to 34, jumping from 9% to 24%. A similar increase occurred for men aged 45 to 54—from 14% to 30%. In the youngest group, the increase was small, but significant: from 6% to 11%.

In 1986-92, the prevalence of obesity among men aged 25 to 34 was relatively low: 9% compared with the overall prevalence of 13% (Table A). By 2004, however, men in this age group no longer had such an advantage. In fact, they were more

than twice as likely as men aged 18 to 24 to be obese, which suggests that men are now becoming obese at younger ages.

From 1986-92 to 2004, the prevalence of obesity among women rose significantly in most age groups: the 55-to-64 group was the exception (Chart 4). Compared with men, increases in obesity among women were more uniform across age groups.

Chart 4
Percentage obese, by sex and age group, household population aged 18 to 74, Canada excluding territories

Men / Age group / Women

Age group	Men 1986-92	Men 2004	Women 1986-92	Women 2004
18 to 24	6	* 11	7	12 *
25 to 34	9	* 24	9	17 *
35 to 44	18	20	14	21 *
45 to 54	14	* 30	20	30 *
55 to 64	19	* 30	27	31
65 to 74	15	* 24	18	25 *

% obese
■ 1986-92 ■ 2004
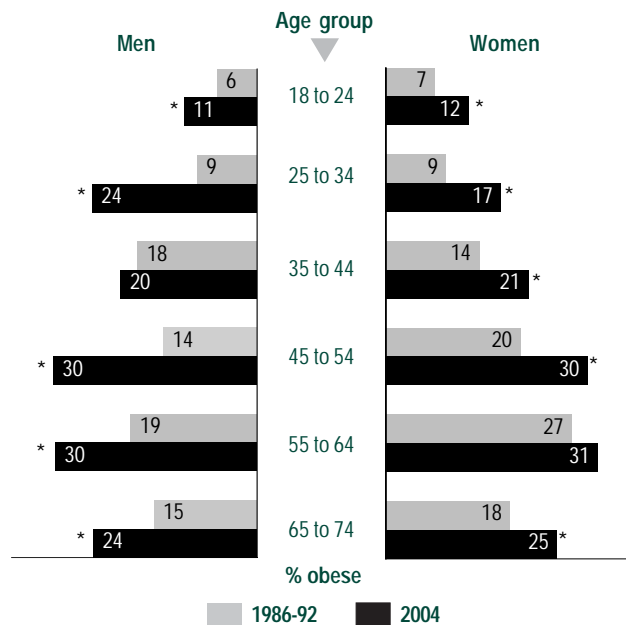
Data sources: 1986-92 Canadian Heart Health Surveys; 2004 Canadian Community Health Survey: Nutrition
*Significantly higher than estimate for 1986-92 (p < 0.05)

Smoking status

Regardless of smoking status, from 1986-92 to 2004, the prevalence of obesity rose for both sexes (Chart 5). Among men, increases were sharper for former smokers and those who had never smoked (both 13 percentage points).

Chart 5
Percentage obese, by sex and smoking status, household population aged 18 to 74, Canada excluding territories
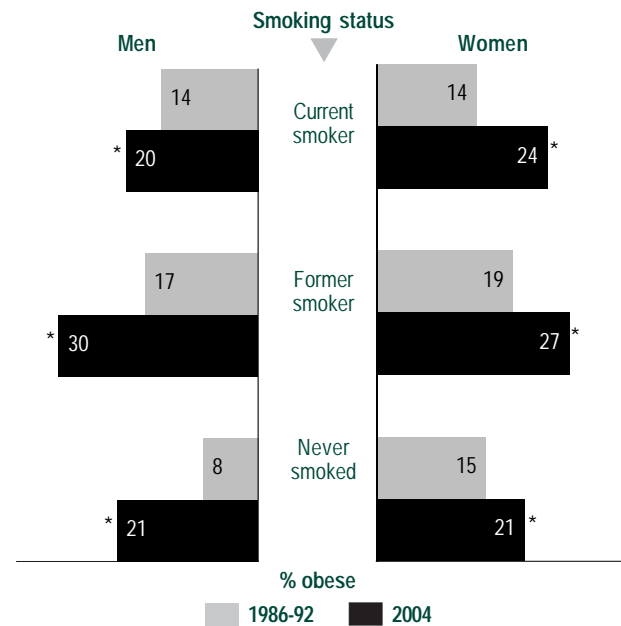
Men / Smoking status / Women

Smoking status	Men 1986-92	Men 2004	Women 1986-92	Women 2004
Current smoker	14	* 20	14	24 *
Former smoker	17	* 30	19	27 *
Never smoked	8	* 21	15	21 *

% obese
■ 1986-92 ■ 2004

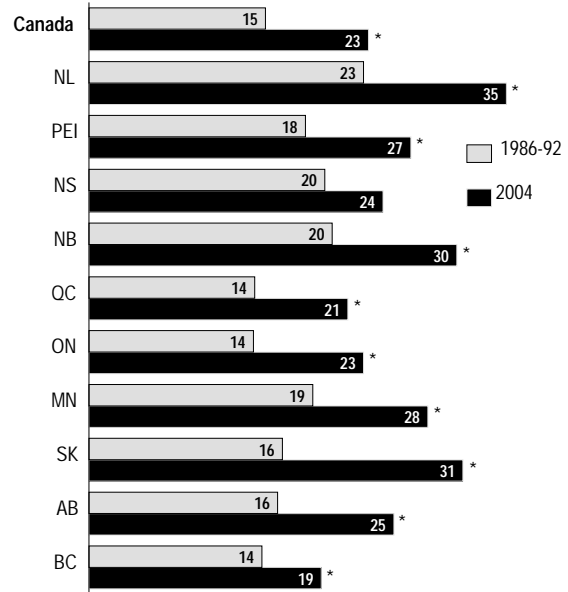*Data sources: 1986-92 Canadian Heart Health Surveys; 2004 Canadian Community Health Survey: Nutrition*
Notes: For each sex/smoking status group, the estimate based on the Canadian Heart Health Surveys was age-standardized using the distribution of the corresponding 2004 CCHS population.
*Significantly higher than estimate for 1986-92 (p < 0.05)

Consistent with American research,[8] men and women who were former smokers were more likely to be obese (Table A). But former smokers are, on average, older, and because obesity estimates tend to be higher at older ages, it is possible that age is driving this association. In fact, when associations between smoking status and obesity were examined in multivariate models controlling for age, among women, being a former smoker was no longer associated with a higher likelihood of obesity in either 1986-92 or 2004. On the other hand, among men, the finding that former smokers were more likely to be obese persisted for both periods (data not shown).

Measuring body composition

Body composition can be measured in different ways, such as underwater weighing, skin-fold thickness, dual-energy X-ray absorptiometry (DEXA), and isotope dilution.[1] Some of these methods require expensive equipment and/or highly trained professionals and are therefore not feasible in large-scale surveys. A common alternative is body mass index (BMI), which compares an individual's weight to his or her height (BMI = weight (kilograms)/height (metres)[2]). Although BMI does not measure body fat directly, it is highly correlated and can be used to indicate different levels of health risks.[9]

According to World Health Organization and Health Canada guidelines, a BMI between 25.0 and 29.9 is classified as *overweight* and is associated with an increased risk of developing health problems. A BMI of 30.0 or more is classified as *obese* and is associated with an even greater risk of developing health problems.

Assessing body weight using BMI has a number of limitations. BMI does not measure body fat or the distribution of body fat, which is important because excess fat in the abdominal area is associated with increased health risks.[9] BMI may misclassify young adults who have not reached full growth, people who are naturally very lean or very muscular, people who are very tall or very short, and certain ethnic or racial groups.[9] For these reasons, BMI is a good measure at the population level, but not necessarily at the individual level.

Income and obesity

In 1986-92, obesity tended to be less prevalent among people in higher income households. Men in high and upper-middle income households were less likely than those with incomes in the lowest group to be obese (Table A). For women, those in the high, upper-middle, and lower-middle income groups all had obesity estimates more than 10 percentage points below those for women in the lowest income group.

By 2004, relationships with income had changed. For women, only those in the highest income group

maintained a relatively low obesity estimate. For men, the association with income disappeared, and when narrower income groups were examined, there was even some evidence that men in high income households were more likely to be obese.[2]

The changing relationship between obesity and income is also revealed in comparisons of prevalence estimates for 1986-92 and 2004. For both sexes, obesity estimates were significantly higher for the lower-middle, upper-middle and highest income categories in 2004 (Chart 6). For the lowest income category, though, there was no

Subpopulation definitions and limitations

Comparing obesity estimates across time for various subpopulations is often difficult because of differences in the way concepts are measured or in the way questions are asked. Even so, meaningful comparisons can be made between the 1986-92 Canadian Heart Health Surveys (CHHS) and the 2004 Canadian Community Health Survey (CCHS) for province, age, smoking status and household income.

The Canadian Heart Health Surveys were conducted at different times; for example, as early as 1986 in Nova Scotia, and as late as 1992 in Ontario (Table B). This limits provincial comparisons.

The measurement of *smoking status* differed slightly: in the CHHS, smoking captured cigarettes, cigars and pipes, but in the CCHS, it was limited to cigarettes.

The 1986-92 CHHS used the following ranges for *total gross household income* for the previous year: less than $12,000; $12,000 to $24,999; $25,000 to $49,999; or $50,000 or more. The 2004 CCHS asked for an exact amount. To form comparable categories, the weighted distribution for the four income groups for the 1986-92 CHHS was calculated (9%, 18%, 39% and 34%) and applied to the exact income for the 2004 CCHS. Based on this distribution, the 2004 income categories were: less than $17,500; $17,500 to $34,999; $35,000 to $70,999; and $71,000 or more.

change. Furthermore, the increase for men was particularly sharp among those in the highest income households, rising from 12% in 1986-92 to 26% by 2004. Among women, the corresponding increase was less pronounced (from 13% to 19%).

Data sources

Several Canadian surveys have collected information on body mass index (BMI). Some have been based on respondents' reports of their height and weight; others on measurements of height and weight. Because of inherent problems with self-reported data, only surveys based on actual measurements were considered for this analysis. In Canada, six national surveys have collected data on measured height and weight: the 1970-72 Nutrition Survey; the 1978/79 Canada Health Survey; the 1981 Canadian Fitness Survey; the 1988 Campbell Well-being Survey; the 1986-92 Canadian Heart Health Surveys; and, most recently, the 2004 Canadian Community Health Survey: Nutrition. Previous research has suggested that the 1981 Canadian Fitness and the 1988 Campbell Well-being surveys are not directly comparable with the others because their focus was fitness, not health. It has been suggested that this may have led to some bias regarding participation in the fitness portion of the surveys.[10] The 1970-72 Nutrition Survey was not used in this analysis of obesity because of its low response rate.[10]

The Canada Health Survey (CHS) took place from May 1978 through March 1979, and the response rate was 77%.[11] A sub-sample of respondents was selected to participate in the survey's physical measures component, which included direct measurements of height and weight. The response rate for this component was 72%, yielding an overall response rate of 55%. Measurements of height and weight were obtained for 4,029 respondents aged 18 to 74.

The Canadian Heart Health Surveys (CHHS) were conducted between 1986 and 1992 in all 10 provinces using health insurance registration files to select a probability sample.[12] The CHHS response rate was 78%,[12] and BMI based on actual measurements was obtained for 86% of these respondents, for an overall response rate of 67%. Measured height and weight were obtained for 19,841 respondents aged 18 to 74.

The 2004 Canadian Community Health Survey (CCHS) was designed to gather information about nutritional status at the provincial level (see http://www.statcan.ca/english/concepts/hs/index.htm). The response rate was 76.5%. Height and weight measurements were obtained for 57.5% of adults aged 18 or older, yielding an overall response rate of 44%. (For more information on reasons for non-response and associated potential biases, see the *Limitations* section in Michael Tjepkema's article in this issue.) The analysis in this report is based on 10,586 adults aged 18 to 74.

The three surveys used for this article excluded residents of the territories, Indian reserves, institutions, some remote areas, members of the regular Armed Forces, and civilian residents of military bases. All estimates were weighted to represent the appropriate target populations. Standard errors and coefficients of variation for estimates from the 1978/79 CHS were estimated with SUDAAN, which uses a Taylor series linearization method to account for the complex survey sample design.[13] For the 1986-92 CHHS, the formula for simple random sampling was used to estimate standard errors with the incorporation of a design effect (1.5) to adjust for the design of the CHHS. Standard errors for the 2004 CCHS were estimated using the bootstrap technique.[14,15] A significance level of 0.05 was applied in all cases.

To compare the prevalence of obesity, data from the 1978/79 CHS and the 1986-92 CHHS were age-standardized within each sub-population using the age distribution of the corresponding sub-population from the 2004 CCHS. Six age groups were used: 18 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 or older.

Chart 6
Percentage obese, by sex and household income, household population aged 18 to 74, Canada excluding territories
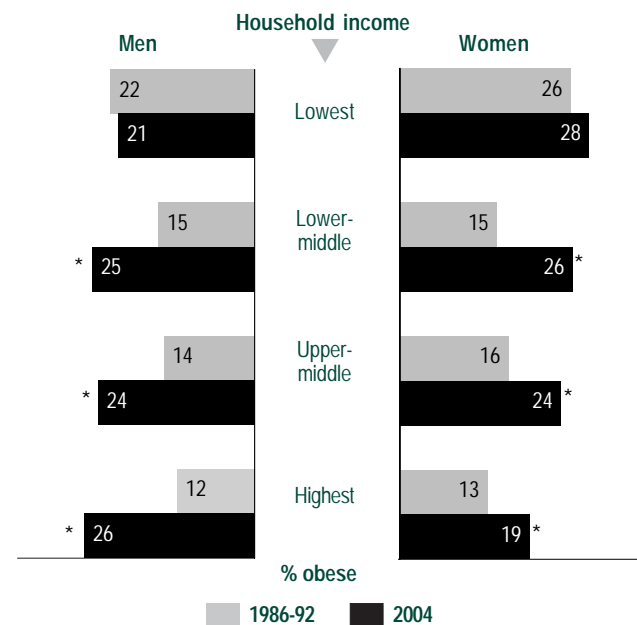
Data sources: 1986-92 Canadian Heart Health Surveys; 2004 Canadian Community Health Survey: Nutrition
Note: For each sex/household income group, the estimate based on the Canadian Heart Health Surveys was age-standardized using the distribution of the corresponding 2004 CCHS population.
Significantly higher than estimate for 1986-92 (p < 0.05)

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Table A

Percentage obese, by selected characteristics, household population aged 18 to 74, Canada excluding territories, 1986-92 and 2004

	1986-92		2004
	Crude estimate	Age-standardized estimate	
	%	%	%
Total, both sexes	**14.0**	**14.6**	**23.1***
Men†	13.1	13.4	23.2*
Women	14.9 ↑	15.8	22.9*
Age group			
Men			
18 to 24	5.9 ↓		10.7*E ↓
25 to 34	8.8 ↓		24.2*
35 to 44	17.5 ↑		20.0
45 to 54	13.7		29.9* ↑
55 to 64	18.5 ↑		29.6* ↑
65 to 74	15.1 ↑		24.0*
Women			
18 to 24	7.1 ↓		12.1* ↓
25 to 34	8.8 ↓		16.9* ↓
35 to 44	13.7		20.9*
45 to 54	19.7 ↑		29.6* ↑
55 to 64	27.3 ↑		31.1 ↑
65 to 74	18.2 ↑		25.1*
Smoking status			
Men			
Current smoker	13.0	14.4	19.7*
Former smoker	17.0 ↑	16.8	29.7* ↑
Never smoked	8.0 ↓	8.2	21.0*
Women			
Current smoker	12.6 ↓	14.0	23.9*
Former smoker	16.6 ↑	19.1	27.0* ↑
Never smoked	15.4	15.3	20.7* ↓
Household income			
Men			
Lowest†	18.0	21.9	20.7E
Lower-middle	14.4	14.6	24.7*
Upper-middle	13.3 ↓	13.8	23.8*
Highest	12.1 ↓	11.8	25.9*
Women			
Lowest†	25.5	25.5	28.3
Lower-middle	14.1 ↓	14.5	25.8*
Upper-middle	14.8 ↓	16.2	24.1*
Highest	12.5 ↓	13.1	19.4* ↓

Data sources: *1986-92 Canadian Heart Health Surveys; 2004 Canadian Community Health Survey: Nutrition*
Note: *For each subpopulation, the estimate based on the Canadian Heart Health Surveys was age-standardized using the age distribution of the corresponding 2004 CCHS subpopulation.*
† Reference category; for age group and smoking status, each estimate was compared with the estimate for the other categories combined.
* For age groups, significantly higher than crude estimate for 1986-1992; for other variables, significantly higher than age-standardized estimate for 1986/92 (p < 0.05)
↑ Significantly higher than estimate for reference category (p < 0.05)
↓ Significantly lower than estimate for reference category (p < 0.05)
E Coefficient of variation between 16.6% and 33.3% (interpret with caution)

Table B

Percentage obese, by province and sex, household population aged 18 to 74, Canada excluding territories, 1986-92 and 2004

Province (date, Canadian Heart Health Surveys)	1986-92 Crude estimate %	1986-92 Age-standardized estimate %	2004 %
Canada	**14.0**	**14.6**	**23.1***
Newfoundland (1988/89)	21.6 ↑	22.7	34.5* ↑
Prince Edward Island (1988)	16.0	17.9	26.6*
Nova Scotia (1986)	18.6 ↑	19.5	24.3
New Brunswick (1988)	18.2 ↑	20.1	30.4* ↑
Quebec (1990)	12.7	13.7	21.4*
Ontario (1992)	13.1	13.6	22.7*
Manitoba (1989/90)	17.3 ↑	18.5	28.5* ↑
Saskatchewan (1989/90)	15.8	16.0	30.9* ↑
Alberta (1990)	14.9	15.6	25.2*
British Columbia (1989)	14.1	14.3	19.2* ↓
Men	**13.1**	**13.4**	**23.2***
Newfoundland (1988/89)	21.9 ↑	22.9	33.4* ↑
Prince Edward Island (1988)	16.8 ↑	19.5	22.0
Nova Scotia (1986)	19.6 ↑	21.0	18.8^E
New Brunswick (1988)	17.4 ↑	19.7	32.4* ↑
Quebec (1990)	12.7	13.6	20.7*
Ontario (1992)	11.1 ↓	10.9	23.3*
Manitoba (1989/90)	18.1 ↑	19.0	30.9* ↑
Saskatchewan (1989/90)	16.9 ↑	17.5	29.0*
Alberta (1990)	14.6	15.4	28.4*
British Columbia (1989)	12.0	12.2	18.1
Women	**14.9**	**15.8**	**22.9***
Newfoundland (1988/89)	21.3 ↑	23.0	35.7* ↑
Prince Edward Island (1988)	15.2	16.4	31.0* ↑
Nova Scotia (1986)	17.6	18.3	29.6*
New Brunswick (1988)	19.0 ↑	20.5	28.4
Quebec (1990)	12.8 ↓	13.9	22.1*
Ontario (1992)	15.1	16.2	22.2*
Manitoba (1989/90)	16.5	18.0	26.0*
Saskatchewan (1989/90)	14.8	14.4	32.9* ↑
Alberta (1990)	15.1	15.9	21.9*
British Columbia (1989)	16.1	16.5	20.3

Data sources: 1986-92 Canadian Heart Health Surveys; 2004 Canadian Community Health Survey: Nutrition

Notes: For each subpopulation, the estimate based on the Canadian Heart Health Surveys was age-standardized using the age distribution of the corresponding 2004 CCHS subpopulation. For each province, the reference category is the estimate for Canada minus that province.

* Significantly higher than age-standardized estimate for 1986-1992 ($p < 0.05$)
↑ Significantly higher than estimate for reference category ($p < 0.05$)
↓ Significantly lower than estimate for reference category ($p < 0.05$)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Regional differences in obesity

by Margot Shields and Michael Tjepkema

Keywords: body mass index, body weight, census metropolitan area, rural population, urban population

In 2004, nearly one-quarter (23%) of Canadians aged 18 or older were obese, and an additional 36% were overweight (data not shown). This means that close to 6 in 10 adults had excess body weight. Excess weight was also apparent among children and adolescents: 8% were obese and 18% were overweight, for a combined obesity/overweight prevalence of 26% among 2- to 17-year-olds.

These estimates of obesity and overweight are based on data from the 2004 Canadian Community Health Survey: Nutrition, and were derived using body mass index (BMI) (see *Body mass index*). The 2004 CCHS was the first time in many years that interviewers measured the height and weight of a nationally representative sample of Canadians. Most previous surveys relied on respondents to report their height and weight, a practice that tends to underestimate the prevalence of obesity and overweight.[1-4]

This article examines provincial and urban-rural differences in the percentage of Canadians who have excess weight. Comparisons for adults focus on obesity, the weight category associated with the greatest health risks.[5] Because small sample sizes prevent a separate examination of obesity for children and adolescents, comparisons for 2- to 17-year olds reflect the obese and overweight categories combined.

Adults

In 2004, the prevalence of obesity among adults varied by province. Compared with the national average of 23%, percentages were relatively high among residents of Newfoundland and Labrador

Chart 1
Percentage obese, by province, household population aged 18 or older, Canada excluding territories, 2004
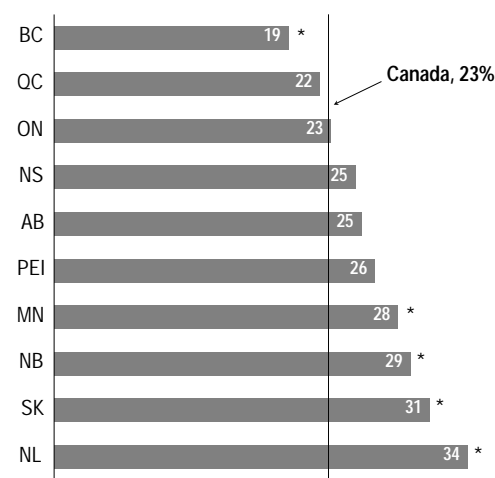
Data source: 2004 Canadian Community Health Survey: Nutrition
* Significantly different from estimate for Canada (p < 0.05)

(34%), Saskatchewan (31%), New Brunswick (29%) and Manitoba (28%) (Chart 1). On the other hand, at 19%, the prevalence of obesity was significantly low in British Columbia.

In general, adults living in cities (census metropolitan areas or CMAs – see *Definitions*) were less likely than those outside CMAs to be obese: 20% versus 29% (Chart 2, Table 1). The prevalence of obesity was significantly lower among CMA than non-CMA residents in Nova Scotia, Ontario, Manitoba, Alberta and British Columbia, and approached significance in Quebec (p=0.08). However, in Newfoundland and Labrador, New Brunswick and Saskatchewan, the prevalence of obesity among adults in CMAs and non-CMAs did not differ significantly.

Table 1

Percentage obese or obese/overweight, by selected geographical factors, household population aged 18 or older, Canada excluding territories, 2004

	Estimated population	Obese	Obese/ Overweight
	'000	%	%
Canada	23,985	**23.1**	**59.1**
CMA[†]	15,660	20.2	56.0
Non-CMA	8,325	28.5 ↑	65.1↑
Newfoundland and Labrador	405	**33.9** ↑	**71.0**↑
CMA	159	36.4	70.0
Non-CMA	246	32.3	71.6
Prince Edward Island	104	**26.3**	**66.5**↑
Nova Scotia	719	**24.7**	**59.7**
CMA	284	18.4[E]	47.8
Non-CMA	435	28.8 ↑	67.4↑
New Brunswick	570	**29.2** ↑	**64.4**
CMA	124	34.7[E]	68.9
Non-CMA	446	27.7	63.2
Quebec	5,820	**21.8**	**56.3**
CMA	3,706	19.5	53.3
Non-CMA	2,115	25.8	61.6↑
Ontario	9,304	**22.7**	**58.6**
CMA	6,772	20.8	57.0
Non-CMA	2,532	27.6 ↑	62.8
Manitoba	827	**28.2** ↑	**62.5**
CMA	525	25.2	58.2
Non-CMA	301	33.5 ↑	70.0↑
Saskatchewan	703	**30.8** ↑	**68.1**↑
CMA	298	29.4	61.3
Non-CMA	405	31.9	73.2↑
Alberta	2,346	**25.2**	**60.9**
CMA	1,711	22.6	58.4
Non-CMA	634	32.2 ↑	67.6
British Columbia	3,189	**19.2** ↓	**59.0**
CMA	2,081	13.3	53.5
Non-CMA	1,108	30.2 ↑	69.4↑
Metropolitan Zone			
CMA (population 2+ million)	8,069	16.6 ↓	51.3↓
CMA (population 100,000 to <2 million)	7,592	24.2	60.9
CA[‡] (population 10,000 to <100,000)	3,907	29.9 ↑	63.8↑
Strong MIZ[§]	1,111	23.9	62.6
Moderate MIZ[§]	1,710	26.5	68.3↑
Weak MIZ[§]	1,397	28.4 ↑	64.6↑
No MIZ[§]	199	43.5 ↑	80.6↑

Data source: *2004 Canadian Community Health Survey: Nutrition*
Notes: *Reference group for province and metropolitan zone is Canada; for non-CMA, reference group is CMA.*
† Census metropolitan area
‡ Census agglomeration
§ Metropolitan influenced zone
↑ Significantly higher than estimate for reference group (p < 0.05)
↓ Significantly lower than estimate for reference group (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

There was far less provincial variability in obesity prevalence when non-CMA residents were considered. The only province where the non-CMA obesity estimate differed significantly from the national estimate (29%) was Manitoba, at 34%.

The size of the CMA in which adults lived was also related to their likelihood of being obese (Chart 3). In CMAs with a population of at least

Body mass index

Body mass index (BMI), a measure of weight adjusted for height, is calculated as follows:

Metric: BMI = weight (kilograms)/height (metres)^2
Non-metric: BMI = (weight (pounds)/height (inches)^2) x 703

Two BMI categories are identified in this article, according to standards adopted by Health Canada for classifying excess weight in adults:[5]

Overweight (BMI 25.0 to 29.9)
Obese (BMI 30.0 or more)

For example, the weight ranges that would place an individual whose height is 1.78m (5'10") in the overweight and obese categories are:

	kilograms	pounds
Overweight	79.1 - 94.8	174 - 208
Obese	94.9+	209+

The overweight category is associated with increased health risks; the obese category, with a high risk of developing health problems.

Recently, the International Obesity TaskForce (IOTF) agreed on an approach to measure overweight and obesity among children and adolescents.[6] The group recommended extrapolating the adult cut-points of 25 and 30 to create sex- and age-specific values for children and adolescents. Based on data collected between 1963 and 1993 from the United States, Great Britain, the Netherlands, Brazil, Hong Kong and Singapore, BMI centile curves that passed through the points of 25 and 30 at age 18 were derived. The obesity/overweight estimates for 2- to 17-year-olds in this analysis are based on the IOTF criteria. (See *Calculating overweight and obesity in children and adolescents* in Shields in this issue for the cut-points.)

2 million, 17% were obese. The figure was 24% in CMAs with a population of 100,000 to 2 million, and 30% in census agglomerations (CAs), which are urban centres with a population of 10,000 to 100,000.

Small sample sizes make it difficult to examine the prevalence of obesity in specific CMAs; therefore, results should be interpreted with caution. The prevalence was relatively low among adults in the two largest CMAs—Toronto (16%) and Vancouver (12%)—while a high proportion of adults in St. John's were obese (36%) (Table 2).

When the combined obesity/overweight estimates for specific CMAs were compared with the national figure (59%), other differences emerged. The estimate was high for adults in Hamilton (74%) and St. Catharine's-Niagara (69%), and low for those in Montréal (52%). The

Definitions

Census metropolitan areas (CMAs) and *census agglomerations (CAs)* (http://www12.statcan.ca/english/census01/Products/Reference/dict/geo009.htm) consist of one or more adjacent municipalities situated around a major urban core. To form a CMA, the urban core must have a population of at least 100,000. To form a CA, the urban core must have a population of at least 10,000.

Census metropolitan area and census agglomeration influenced zones (MIZ) are used to classify municipalities not included in a CMA or CA (http://www12.statcan.ca/english/census01/Products/Reference/dict/geo010.htm). Municipalities are assigned to one of four categories depending on the percentage of residents who commute to work in the urban core of a CMA or CA:

- Strong MIZ: more than 30% of residents commute to work in a CMA or CA.
- Moderate MIZ: 5% to 30% of residents commute to work in a CMA or CA.
- Weak MIZ: 0% to 5% of residents commute to work in a CMA or CA.
- No MIZ: fewer than 40 or no residents commute to work in a CMA or CA.

Chart 2
Percentage obese, by province and CMA†/non-CMA residence, household population aged 18 or older, Canada excluding territories, 2004
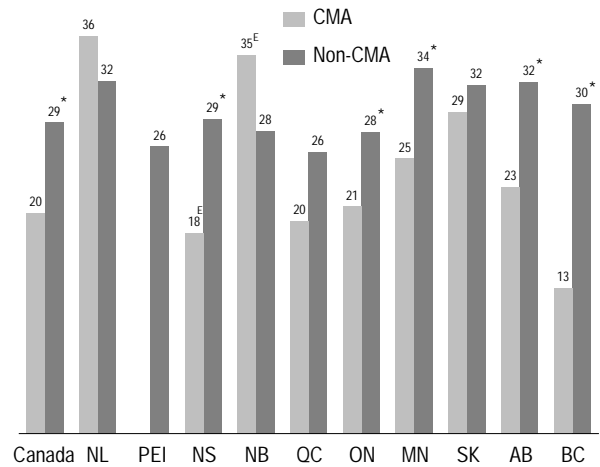
Data source: 2004 Canadian Community Health Survey: Nutrition
† Census metropolitan area
* Signficantly different from estimate for CMA (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Chart 3
Percentage obese, by metropolitan zone, household population aged 18 or older, Canada excluding territories, 2004
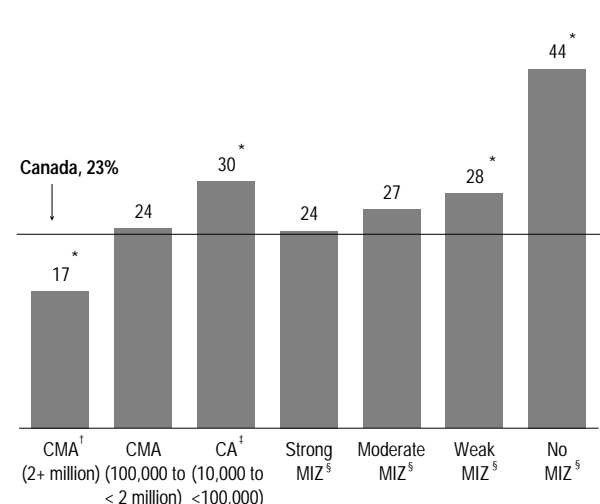
Data source: 2004 Canadian Community Health Survey: Nutrition
† Census metropolitan area
‡ Census agglomeration
§ Metropolitan influenced zone
* Signficantly different from estimate for Canada (p < 0.05)

Table 2

Percentage obese or obese/overweight, by census metropolitan area, household population aged 18 or older, Canada excluding territories, 2004

	Estimated population	Obese			Overweight/ Obese		
				Significantly different from:			Significantly different from:
	'000	%	Can	Prov	%	Can	Prov
Canada	23,985	**23.1**			**59.1**		
Newfoundland and Labrador	405	**33.9**			**71.0**		
St. John's	159	36.4	↑		70.0	↑	
Nova Scotia	719	**24.7**			**59.7**		
Halifax	284	18.4ᴱ		↓	47.8		↓
New Brunswick	570	**29.2**			**64.4**		
Saint John	124	34.7ᴱ			68.9		
Quebec	5,820	**21.8**			**56.3**		
Saguenay	141	18.9ᴱ			52.3		
Québec	552	17.3ᴱ			56.8		
Sherbrooke	97	F			52.4		
Trois-Rivières	139	F			56.6ᴱ		
Montréal	2,577	21.2			51.6	↓	↓
Gatineau	199	F			63.6		
Ontario	9,304	**22.7**			**58.6**		
Ottawa	636	19.7ᴱ			62.0		
Kingston	81	28.9ᴱ			70.1		
Oshawa	208	29.6ᴱ			63.5		
Toronto	3,772	15.6	↓	↓	50.9	↓	↓
Hamilton	452	34.6ᴱ		↑	74.3	↑	↑
St. Catherine's/ Niagara	346	23.1ᴱ			69.3	↑	↑
Kitchener	450	30.7			62.3		
London	470	26.6ᴱ			61.6		
Windsor	99	33.2ᴱ			56.5ᴱ		
Greater Sudbury	72	26.1ᴱ			62.1		
Thunder Bay	185	32.6ᴱ			60.0		
Manitoba	827	**28.2**			**62.5**		
Winnipeg	525	25.2		↓	58.2		↓
Saskatchewan	703	**30.8**			**68.1**		
Regina	151	31.8ᴱ			58.1		
Saskatoon	147	27.0ᴱ			64.5		
Alberta	2,346	**25.2**			**60.9**		
Calgary	765	25.7			53.8		↓
Edmonton	946	20.1		↓	62.2		
British Columbia	3,189	**19.2**			**59.0**		
Abbotsford	110	25.0ᴱ			58.3		
Vancouver	1,720	11.7ᴱ	↓	↓	51.8		↓
Victoria	251	19.0ᴱ			62.6		

Data source: 2004 Canadian Community Health Survey: Nutrition
↑ *Significantly higher than estimate for Canada/province (p < 0.05)*
↓ *Significantly lower than estimate for Canada/province (p < 0.05)*
E *Coefficient of variation 16.6% to 33.3% (interpret with caution)*
F *Coefficient of variation greater than 33.3% (suppressed because of extreme sampling variability)*

prevalence of obesity/overweight was also low in Halifax (48%), but only approached statistical significance (p=0.055).

Commuting patterns

Municipalities outside CMAs and CAs are assigned to one of four categories depending on the percentage of residents who commute to a CMA or CA to work. This percentage, known as MIZ, determines whether a given municipality is considered to be a strongly influenced zone, a moderately influence zone, a weakly influenced zone, or a zone that is not influenced (see *Definitions*)

The prevalence estimates of obesity among adults living in strongly influenced or moderately influenced zones were similar to the national figure (23%): 24% and 27%, respectively (Table 1, Chart 3). Obesity was significantly more prevalent among adults in weakly influenced zones (28%).

Data source

Data from the 2004 Canadian Community Health Survey: Nutrition were used to estimate the prevalence of overweight and obesity among the population aged 2 or older. The 2004 CCHS was designed to gather information about the nutritional status of Canadians at the provincial level (http://www.statcan.ca/english/concepts/hs/index.htm). The survey does not include residents of the three territories, Indian reserves, institutions and some remote areas; full-time members of the regular Armed Forces; and civilian residents of military bases. The response rate was 76.5%.

Among those who responded to the CCHS, measurements of height and weight were obtained for 57.5% of adults aged 18 or older (12,428) and 65.5% of 2- to 17-year-olds (8,661), yielding overall response rates of 44% and 50%, respectively. (See *Limitations* in Tjepkema and Shields in this issue, for more information about non-response.)

To account for the multi-stage sample design of the CCHS, the bootstrap technique was used to calculate coefficients of variation and to test for statistical significance of differences between prevalence estimates.[7,8]

And residents of non-influenced zones were almost twice as likely to be obese (44%), compared with the national average.

Urban sprawl, immigrants

Studies based on US data have found associations between obesity and urban sprawl, which is a pattern of development in metropolitan areas whereby large percentages of the population live in lower-density residential areas. Although a measure of urban sprawl is not available in the CCHS, the finding that residents of municipalities farthest from urban centres are the most likely to be obese is consistent with the American research. It has been suggested that the consequences of urban sprawl include increased reliance on automobiles, decreased motivation to walk to destinations, and reduced opportunities for exercise because of the time required to travel to recreational facilities.[9]

A possible explanation for the low obesity rates in the largest cities is the tendency for immigrants to settle in these areas. Immigrants, particularly recent arrivals, are less likely to be obese than are people born in Canada.[10] Nonetheless, the relatively low prevalence of obesity among CMA residents persisted when examined in a multivariate model that controlled for immigrant status and number of years since immigrating (data not shown).

Fewer differences for children

The prevalence of obesity/overweight among children and adolescents tended to be high in the Atlantic provinces (Chart 4, Table 3). The proportion of 2- to 17-year olds who were obese/overweight was above the national level (26%) in Newfoundland and Labrador (36%), New Brunswick (34%) and Nova Scotia (32%), as well as in Manitoba (31%). Children and adolescents in Alberta (22%) and Quebec (23%) were less likely to be obese/overweight.

Excess weight among children and adolescents was generally not related to urban-rural residence

Table 3

Percentage obese/overweight, by selected geographical factors, household population aged 2 to 17, Canada excluding territories, 2004

	Estimated population	Obese/ Overweight
	'000	%
Canada	6,184	26.2
CMA†	3,802	25.8
Non-CMA	2,382	27.0
Newfoundland and Labrador	93	35.6 ↑
CMA	31	31.5ᴱ
Non-CMA	62	37.7
Prince Edward Island	29	30.2
Nova Scotia	172	32.0 ↑
CMA	51	32.0
Non-CMA	120	32.0
New Brunswick	138	34.3 ↑
CMA	37	38.6ᴱ
Non-CMA	101	32.7
Quebec	1,368	22.6 ↓
CMA	829	23.0
Non-CMA	539	21.9
Ontario	2,513	27.5
CMA	1,775	27.3
Non-CMA	738	27.9
Manitoba	234	30.8 ↑
CMA	139	32.1
Non-CMA	95	29.0
Saskatchewan	197	29.1
CMA	68	29.8ᴱ
Non-CMA	129	28.8
Alberta	669	21.8 ↓
CMA	406	18.6 ↓
Non-CMA	263	26.9
British Columbia	772	26.4
CMA	467	26.3
Non-CMA	305	26.5
Metropolitan Zone		
CMA (population 2+ million)	1,917	26.6
CMA (population 100,000 to <2 million)	1,886	24.9
CA‡ (population 10,000 to <100,000)	1,086	27.7
Strong MIZ§	361	29.8
Moderate MIZ	438	22.8
Weak MIZ	442	27.1
No MIZ	55	29.3ᴱ

Data source: *2004 Canadian Community Health Survey: Nutrition*
Notes: *Reference group for province and metropolitan zone is Canada; for non-CMA, reference group is CMA.*
† Census metropolitan area
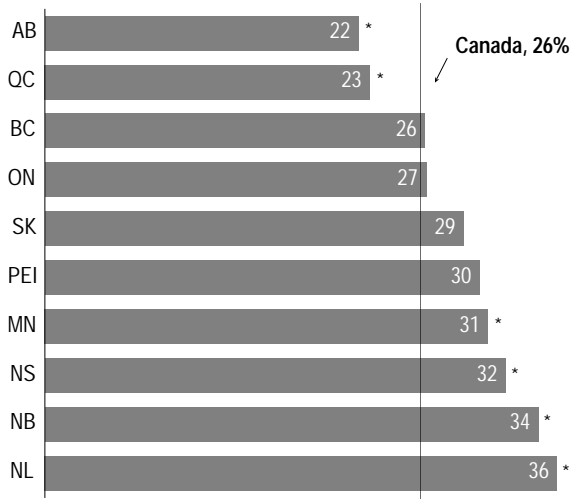*‡ Census agglomeration*
§ Metropolitan influenced zone
↑ Significantly higher than estimate for reference group (p < 0.05)
↓ Significantly lower than estimate for reference group (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Chart 4
Percentage obese/overweight, by province, household population aged 2 to 17, Canada excluding territories, 2004

Data source: *2004 Canadian Community Health Survey: Nutrition*
* Significantly different from estimate for Canada (p < 0.05)

(Table 3). At the national level, the proportion who were obese/overweight was similar in large CMAs, smaller CMAs, CAs and the four MIZ groups. The only province with a significant difference was Alberta, where 2- to 17-year-old CMA residents were less likely to be obese/overweight than were those in non-CMAs.

In a small number of CMAs, the prevalence of obesity/overweight among children and adolescents differed significantly from the national level (26%). The proportion was high in Gatineau (48%), Kingston (46%) and Winnipeg (32%), and low in Québec City (15%), Ottawa (16%) and Calgary (16%) (Table 4). Again, these differences are based on small sample sizes.

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Table 4

Percentage obese/overweight, by census metropolitan area, household population aged 2 to 17, Canada excluding territories, 2004

| | | Obese/Overweight | | |
| | Estimated population | | Significantly different from: | |
	'000	%	Canada	Province
Canada	6,184	**26.2**		
Newfoundland and Labrador	93	**35.6**		
St. John's	31	31.5^E		
Nova Scotia	172	**32.0**		
Halifax	51	32.0		
New Brunswick	138	**34.3**		
Saint John	37	38.6^E		
Quebec	1,368	**22.6**		
Saguenay	50	24.3^E		
Québec	117	14.5^E	↓	
Sherbrooke	37	F		
Trois-Rivières	26	F		
Montréal	552	23.0		
Gatineau	46	48.1^E	↑	↑
Ontario	2,513	**27.5**		
Ottawa	176	16.3^E	↓	↓
Kingston	18	46.4^E	↑	↑
Oshawa	81	33.3^E		
Toronto	1,009	28.3		
Hamilton	124	24.5^E		
St. Catherine's/Niagara	76	31.8^E		
Kitchener	97	32.0^E		
London	82	28.3^E		
Windsor	39	21.1^E		
Greater Sudbury	28	22.4^E		
Thunder Bay	43	27.0^E		
Manitoba	234	**30.8**		
Winnipeg	139	32.1	↑	
Saskatchewan	197	**29.1**		
Regina	29	22.0^E		
Saskatoon	39	35.7^E		
Alberta	669	**21.8**		
Calgary	214	16.0^E	↓	↓
Edmonton	192	21.4^E		
British Columbia	772	**26.4**		
Abbotsford	65	19.4^E		
Vancouver	355	27.4		
Victoria	47	27.2^E		

Data source: *2004 Canadian Community Health Survey: Nutrition*
↑ Significantly higher than estimate for Canada/province (p < 0.05)
↓ Significantly lower than estimate for Canada/province (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)
F Coefficient of variation greater than 33.3% (suppressed because of extreme sampling variability)

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Leading Causes of Death	84F0503XPB	Paper	$20
Vital Statistics Compendium, 1996	84-214-XPE	Paper	$45
	84-214-XIE	Internet	$33
Other			
Validation study for a record linkage of births and deaths in Canada	84F0013XIE	Internet	Free
Postal Code Conversion File Plus (PCCF+) *(To obtain the PCCF+, clients must purchase the PCCF)*	82F0086XDB	Diskette	Free

† All prices exclude sales tax.
‡ See inside cover for shipping charges.

Health Statistics Division provides a custom tabulation service to meet special resource needs and supplement published data on a fee-for-service basis. Custom tables can be created using a variety of health and vital statistics data sources maintained by the Division.

To order custom tabulations, contact:

Client Custom Services Unit
Health Statistics Division
Statistics Canada
Ottawa, Ontario
K1A 0T6
Telephone: (613) 951-1746
Fax: (613) 951-0792
Email: HD-DS@statcan.ca

Microdata Files

To order the products listed below, contact:

Client Custom Services Unit
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Statistics Canada
Ottawa, Ontario
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Telephone: (613) 951-1746
Fax: (613) 951-0792
Email: HD-DS@statcan.ca

Canadian Community Health Survey		Product number	Format	Price (CDN$)†‡
Canadian Community Health Survey, 2000-2001 Cycle 1.1 public-use microdata file Cross-sectional data in flat ASCII files, User's Guide, data dictionary, indexes, layout, Beyond 20/20 Browser for the health file		82M0013XCB	CD-ROM	$2,000 Free for the Health Sector

National Population Health Survey				
Cycle 4, 2000-01				
Custom tables	Household	82C0013	Price varies with information requirements	
Cycle 3, 1998-99				
Household	Cross-sectional data in flat ASCII files, User's Guide, data dictionary, indexes, layout, Beyond 20/20 browser for the health file	82M0009XCB	CD-ROM	$2,000
Custom tables	Household Institutions	82C0013 82C0015	Price varies with information requirements. Price varies with information requirements.	
Cycle 2, 1996-97				
Household	Cross-sectional data in flat ASCII files, Beyond 20/20 browser for the health file	82M0009XCB	CD-ROM	$500
Health care institutions	Cross-sectional flat ASCII file	82M0010XCB	CD-ROM Clients who purchase 1996/97 Household file will receive Institutions file free of charge.	$250
Custom tables	Household Institutions	82C0013 82C0015	Price varies with information requirements. Price varies with information requirements.	
Cycle 1, 1994-95				
Household	Data, Beyond 20/20 browser flat ASCII files, User's Guide	82F0001XCB	CD-ROM	$300
Health care institutions	Flat ASCII files	82M0010XDB	Diskette	$75
Custom tables	Household Institutions	82C0013 82C0015	Price varies with information requirements. Price varies with information requirements.	

† All prices exclude sales tax.
‡ See inside cover for shipping charges.

POPULATION HEALTH SURVEYS

Other Information
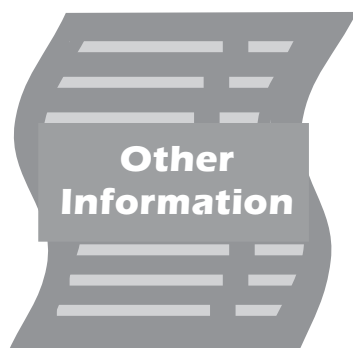
Canadian Community Health Survey (CCHS)

Cycle 1.1: The CCHS provides cross-sectional estimates of health determinants, health status and health system utilization for 133 health regions across Canada, plus the territories.

Cycle 1.2: The CCHS - Mental Health and Well-being provides provincial cross-sectional estimates of mental health determinants, mental health status and mental health system utilization.

Cycle 2.1: The second cycle of CCHS provides cross-sectional estimates of health determinants, health status and health system utilization for 134 health regions across Canada.

National Population Health Survey (NPHS)

Household - The household component covers household residents in all provinces, excluding Indian Reserves, Canadian Forces Bases and some remote areas in Québec and Ontario.

Institutions - The institutional component covers long-term residents (expected to stay longer than six months) in health care facilities with four or more beds in all provinces, excluding the Yukon and the Northwest Territories.

North - The northern component covers household residents in the Yukon and the Northwest Territories, excluding Indian Reserves, Canadian Forces Bases and some of the most northerly remote areas.

Health Services Access Survey (HSAS)

The Health Services Access Survey provides detailed information about access to health care services such as 24/7 first contact services and specialized services. Data are available at the national level.

Joint Canada/United States Survey of Health (JCUSH)

The Joint Canada/United States Survey of Health collected information about health, use of health care and functional limitations from Canadian and U.S. residents.

For more information about these surveys, visit our web site at
http://www.statcan.ca/english/concepts/hs/index.htm

Canadian Statistics

Obtain free tabular data on various aspects of Canada's economy, land, people and government.

For more information about these tables, visit our web site at
http://www.statcan.ca/english/Pgdb/health.htm

The Research Data Centres Program

The Research Data Centres (RDC) program is part of an initiative by Statistics Canada, the Social Sciences and Humanities Research Council (SSHRC) and university consortia to help strengthen Canada's social research capacity and to support the policy research community.

RDCs provide researchers with access, in a secure university setting, to microdata from population and household surveys. The centres are staffed by Statistics Canada employees. They are operated under the provisions of the *Statistics Act* in accordance with all the confidentiality rules and are accessible only to researchers with approved projects who have been sworn in under the *Statistics Act* as 'deemed employees.'

RDCs are located throughout the country, so researchers do not need to travel to Ottawa to access Statistics Canada microdata. For more information, contact Gustave Goldman at (613) 951-1472, Program Manager, Research Data Centres.

For more information about this program, visit our web site at
http://www.statcan.ca/english/rdc/index.htm