

# 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.<sup>1</sup> It is clear that the prevalence of obesity is rising in Canada,<sup>2</sup> 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.<sup>3-6</sup> Self-reported information is also sensitive to the mode of collection; for example, telephone versus personal interviews.<sup>7</sup>

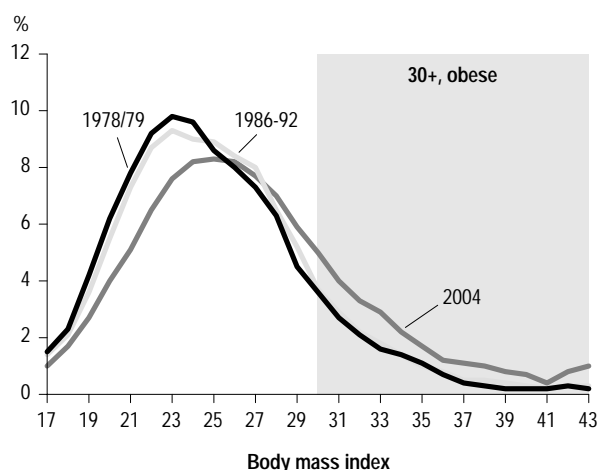
The 2004 Canadian Community Health Survey (CCHS): Nutrition, along with the 1978/79 Canada Health Survey (CHS) and the 1986-92 Canadian Heart Health Surveys (CHHS), can be used to make meaningful comparisons across time for the adult population aged 18 to 74. For all three surveys, interviewers measured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

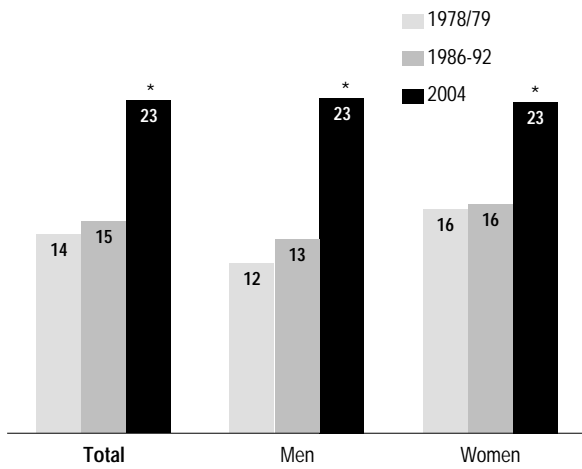
**Chart 1**  
Percentage distribution of household population aged 18 to 74, by body mass index (BMI), Canada excluding territories



*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

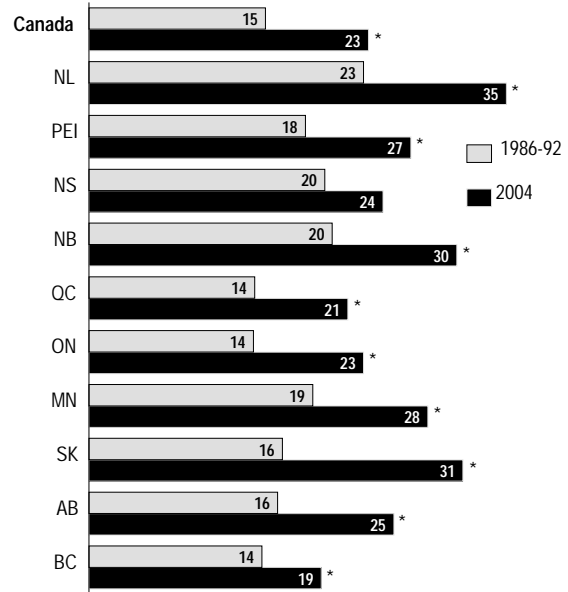


*Data sources:* 1978/79 Canada Health Survey; 1986-92 Canadian Heart Health Surveys; 2004 Canadian Community Health Survey: Nutrition  
*Note:* For each sex, estimates based on the Canada Health Survey and the Canadian Heart Health Surveys were age-standardized using the distribution of the corresponding 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

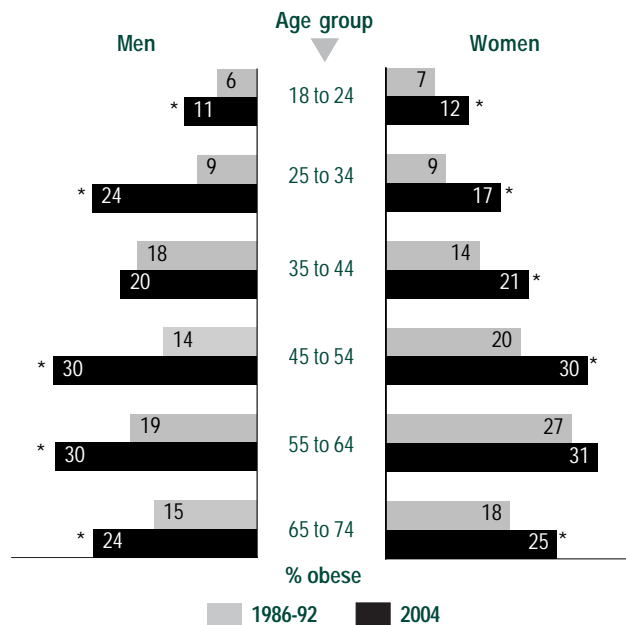
The likelihood of obesity for men increased in almost all age groups from 1986-92 to 2004 (Chart 4). The rise in obesity prevalence was particularly sharp for those aged 25 to 34, jumping from 9% to 24%. A similar increase occurred for men aged 45 to 54—from 14% to 30%. In the youngest group, the increase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

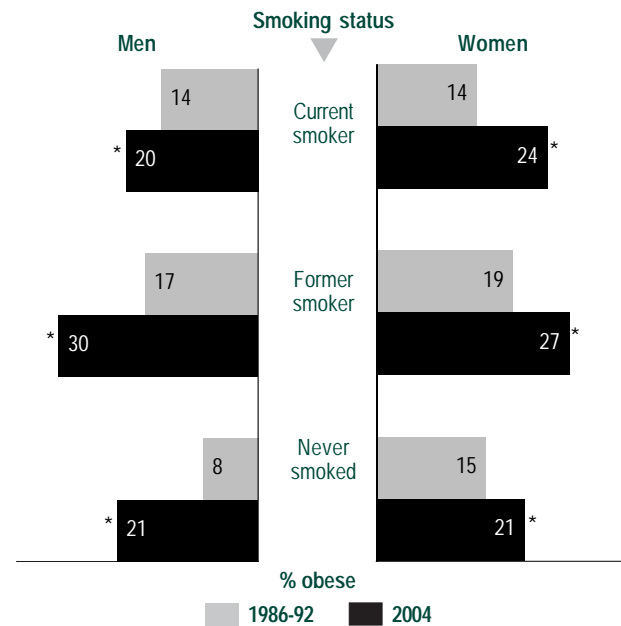


Data sources: 1986-92 Canadian Heart Health Surveys; 2004 Canadian Community Health Survey: Nutrition  
\*Significantly higher than estimate for 1986-92 ( $p < 0.05$ )

## 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



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,<sup>8</sup> 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.<sup>1</sup> 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)<sup>2</sup>). Although BMI does not measure body fat directly, it is highly correlated and can be used to indicate different levels of health risks.<sup>9</sup>

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.<sup>9</sup> 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.<sup>9</sup> 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.<sup>2</sup>

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.

## 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.<sup>10</sup> The 1970-72 Nutrition Survey was not used in this analysis of obesity because of its low response rate.<sup>10</sup>

The Canada Health Survey (CHS) took place from May 1978 through March 1979, and the response rate was 77%.<sup>11</sup> 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.<sup>12</sup> The CHHS response rate was 78%,<sup>12</sup> 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.

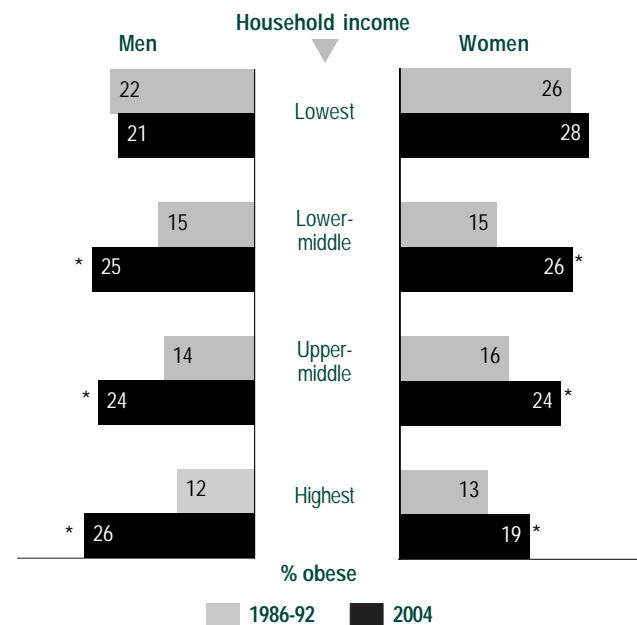
The three surveys used for this article excluded residents of the territories, Indian reserves, institutions, some remote areas, members of the regular Armed Forces, and civilian residents of military bases. All estimates were weighted to represent the appropriate target populations. Standard errors 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.<sup>13</sup> 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.<sup>14,15</sup> 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.

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%).

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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## References

- World Health Organization. *Obesity: Preventing and Managing the Global Epidemic* (WHO Technical Report Series, No. 894) Geneva: World Health Organization, 2000.
- Tjepkema M. Adult obesity. *Health Reports* (Statistics Canada, Catalogue 82-003) 2006; 17(3): 9-25.
- Booth ML, Hunter C, Gore CJ, et al. The relationship between body mass index and waist circumference: implications for estimates of the population prevalence of overweight. *International Journal of Obesity and Related Metabolic Disorders* 2000; 24(8): 1058-61.
- Roberts RJ. Can self-reported data accurately describe the prevalence of overweight? *Public Health* 1995; 109(4): 275-84.
- Rowland ML. Reporting bias in height and weight data. *Statistical Bulletin of the Metropolitan Insurance Company* 1989; 70(2): 2-11.
- Strauss RS. Comparison of measured and self-reported weight and height in a cross-sectional sample of young adolescents. *International Journal of Obesity and Related Metabolic Disorders* 1999; 23(8): 904-8.
- St-Pierre M, Béland Y. Mode effects in the Canadian Community Health Survey. *Proceedings of the Annual Meeting of the American Statistical Association, Survey Research Methods Section, August 2004*. Toronto: American Statistical Association, 2004.
- Flegal KM, Troiano RP, Pamuk ER, et al. The influence of smoking cessation on the prevalence of overweight in the United States. *The New England Journal of Medicine* 1995; 333(18): 1165-70.
- Health Canada. *Canadian Guidelines for Body Weight Classification in Adults* (Catalogue H49-179) Ottawa: Health Canada, 2003.
- Torrance GM, Hooper MD, Reeder BA. Trends in overweight and obesity among adults in Canada (1970-1992): evidence from national surveys using measured height and weight. *International Journal of Obesity* 2002; 26(6): 797-804.
- Health and Welfare Canada, Statistics Canada. *The Health of Canadians: Report of the Canada Health Survey*. Ottawa: Minister of Supply and Services, 1981.
- MacLean DR, Petrasovits A, Nargundkar M, et al. Canadian Heart Health Surveys: a profile of cardiovascular risk. Survey methods and data analysis. *Canadian Medical Association Journal* 1992; 146: 1969-74.
- Shah BV, Barnwell GB, Bieler GS. *SUDAAN User's Manual, Release 7.5*. Research Triangle Institute, North Carolina: Research Triangle Park, 1997.
- Rao JNK, Wu CFJ, Yue K. Some recent work on resampling methods for complex surveys. *Survey Methodology* (Statistics Canada, Catalogue 12-001) 1992; 18(2): 209-17.
- Rust KF, Rao JNK. Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research* 1996; 5: 281-310.

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	
	%	%	%
<b>Total, both sexes</b>	<b>14.0</b>	<b>14.6</b>	<b>23.1*</b>
Men†	13.1	13.4	23.2*
Women	14.9↑	15.8	22.9*
<b>Age group</b>			
<b>Men</b>			
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*
<b>Women</b>			
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*
<b>Smoking status</b>			
<b>Men</b>			
Current smoker	13.0	14.4	19.7*
Former smoker	17.0↑	16.8	29.7*↑
Never smoked	8.0↓	8.2	21.0*
<b>Women</b>			
Current smoker	12.6↓	14.0	23.9*
Former smoker	16.6↑	19.1	27.0*↑
Never smoked	15.4	15.3	20.7*↓
<b>Household income</b>			
<b>Men</b>			
Lowest†	18.0	21.9	20.7 <sup>E</sup>
Lower-middle	14.4	14.6	24.7*
Upper-middle	13.3↓	13.8	23.8*
Highest	12.1↓	11.8	25.9*
<b>Women</b>			
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		2004
	Crude estimate %	Age- standardized estimate %	%
<b>Canada</b>	<b>14.0</b>	<b>14.6</b>	<b>23.1*</b>
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* ↓
<b>Men</b>	<b>13.1</b>	<b>13.4</b>	<b>23.2*</b>
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 <sup>E</sup>
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
<b>Women</b>	<b>14.9</b>	<b>15.8</b>	<b>22.9*</b>
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)*