

Trends in weight change among Canadian adults

Heather M. Orpana, Mark S. Tremblay and Philippe Finès

Abstract

Objectives

Longitudinal analyses were used to examine the rate of change of self-reported weight among adults over two-year intervals from 1996/1997 to 2004/2005, and to determine if the pace at which Canadians' weight is changing has slowed down or accelerated. Associations between weight change and sex, age group and body mass index (BMI) category are also examined.

Data sources

The data are from the 1996/1997 through 2004/2005 National Population Health Survey.

Analytical techniques

Average weight changes over two-year intervals were calculated by sex, age group and BMI category. Linear regression was used to determine if the rate of weight change was stable, increased or decreased over time.

Main results

From 1996/1997 to 2004/2005, Canadian adults gained, on average, 0.5 to 1 kg per two-year period. Although people aged 18 to 64 continued to gain weight, the amount gained decreased significantly in the most recent interval, 2002/2003 to 2004/2005. This downturn is due, in part, to a significant decrease in the proportion of men gaining weight during that period. However, among people who gained weight, the amount gained in two years increased over the entire eight-year period.

Keywords

body mass index, body weight, longitudinal studies, obesity, overweight, weight gain

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Consistent with trends in other countries,^{1,2} the prevalence of obesity has been rising in Canada. From 1978/1979 to 2004, the percentage of Canadian adults who were obese rose from 14% to 23%.³ The increasing prevalence of obesity is a major public health concern, as excess weight has been associated with type 2 diabetes, cardiovascular disease, psychosocial difficulties, osteoarthritis, and premature mortality.⁴

Cross-sectional data about the prevalence of obesity, however, do not provide information about rates of weight change among individuals. Longitudinal data are needed for insight about patterns of change that are behind the increase in obesity in Canada. For instance, a recent longitudinal study showed that almost a third of Canadians whose weight had been in the acceptable range in 1994/1995 became overweight in the following eight years, and about a quarter of those who had been overweight became obese.⁵

As an extension to that analysis, an understanding of obesity requires information about the rate at which individuals are gaining (or losing) weight. Longitudinal studies in the United States have demonstrated that, in

Methods

Data source

This analysis is based on data from five cycles (cycles 2 to 6) of the National Population Health Survey (NPHS), conducted by Statistics Canada from 1996/1997 to 2004/2005. Every two years since 1994/1995, the NPHS has collected data about health status, health behaviours and other determinants of health. The survey is representative of the household residents in all provinces in 1994/1995. It excludes the territories, Indian reserves, Crown Lands, health care institutions, and residents of Canadian Forces bases and some remote areas in Ontario and Quebec. Although the NPHS also has an institutional component covering residents of long-term care institutions such as nursing homes, that sample was not analyzed in this article.

In 1994/1995, 20,095 household residents were selected to be members of the NPHS longitudinal panel. Of these, 86.0% agreed to participate, yielding a sample of 17,276. Response rates in subsequent cycles were 92.8% in 1996/1997; 88.3% in 1998/1999; 84.8% in 2000/2002; 80.5% in 2002/2003; and 77.4% in 2004/2005. More detailed descriptions of the NPHS design, sample and interview procedures are available in other papers and reports.⁶

Data were collected primarily through computer-assisted personal interviews in 1994/1995, and primarily through computer assisted-telephone interviews thereafter. To rule out the potential impact of collection mode on the results, only data from 1996/1997 to 2004/2005 were analyzed. Telephone interviews comprised over 96% of all interviews in 1996/1997 and 1998/99; over 98% in 2000/2001 and 2002/2003; and more than 99% in 2004/2005.

Analytical techniques

The sample for this analysis consisted of people who were aged 10 to 60 in 1994/1995. Individuals were included in this analysis if they had reached age 18 by the beginning of a given interval (starting in 1996/1997), and were excluded if they were 65 or older at the end of a given interval. For instance, a respondent who was 62 in 1996 would have been included in the 1996/1997-to-1998/1999 interval, but excluded thereafter. Records for women who were pregnant at the beginning or the end of an interval were excluded for that interval.

For the first interval (1996/1997 to 1998/1999), there were 9,387 respondents aged 18 to 64 at the beginning and end; 318 cases were missing data on weight; and 203 women were excluded because they were pregnant. Thus, the sample size for the first interval was 8,866 cases. For the second, third and fourth intervals, there were 8,689, 8,098, and 7,517 respondents aged 18 to 64 at the beginning and end of the interval. Of these, 220, 160, and 139 cases, respectively, were missing data on weight, and 156, 152,

and 139 women were excluded because of pregnancy. The resulting samples were 8,313, 7,786, and 7,239. Additionally, for analyses using body mass index (BMI), cases with missing height were excluded: 7, 6, 12 and 8 cases for the first, second, third and fourth intervals, respectively.

Average weight change for the four two-year intervals from 1996/1997 to 2004/2005 was calculated for men and women. To reduce the effect of outliers, individuals who gained or lost more than 25 kg were given a value of 25 kg. For the first interval, 28 cases of weight loss and 23 cases of weight gain were truncated at 25 kg; for the second interval, 32 and 31 cases; for the third interval, 27 cases of weight loss and 42 cases; and for the fourth interval, 30 cases each of weight loss and weight gain were truncated.

To determine whether the rate of change in body weight was increasing or decreasing over time, multiple linear regression was conducted using a person-period dataset, predicting two-year weight differences from time, time squared, sex, age group and BMI category at the beginning of the interval. Age group and BMI category were time-varying covariates. Records for individuals missing data on any variable for a given interval were excluded, but this accounted for less than 4% of records for any interval. As well, if respondents had complete data for another interval, the record for that interval was retained in the analysis. Thus, for the regression model, the sample was 8,866 records for the 1996/1997 to 1998/1999 interval; 8,313 for the 1998/1999 to 2000/2001 interval; 7,786 for the 2000/2001 to 2002/2003 interval; and 7,239 records for the 2002/2003 to 2004/2005 interval.

To clarify patterns underlying observed differences in weight change, the proportion of people gaining weight, losing weight or remaining stable (no change in reported weight), as well as mean gain among those who gained weight and mean loss among those who lost weight, were calculated for each two-year interval. Confidence intervals for the sex-specific prevalences of weight gain, weight loss and weight stability were calculated and prevalences were compared to determine if they differed significantly over time. To test for the association between time and weight gain or weight loss, a linear regression was performed only on records where an individual experienced a gain or loss.

In order to take the complex survey design of the NPHS into account, the bootstrap method was used to generate confidence intervals of the estimates for all analyses. Bootstrap weights for individuals were applied to each record for an individual.⁷ Significance was set at $p < 0.05$, and the weights for the longitudinal square file were used to weight the records to reflect the Canadian household population in 1994/1995. All analyses were conducted in SAS 9.

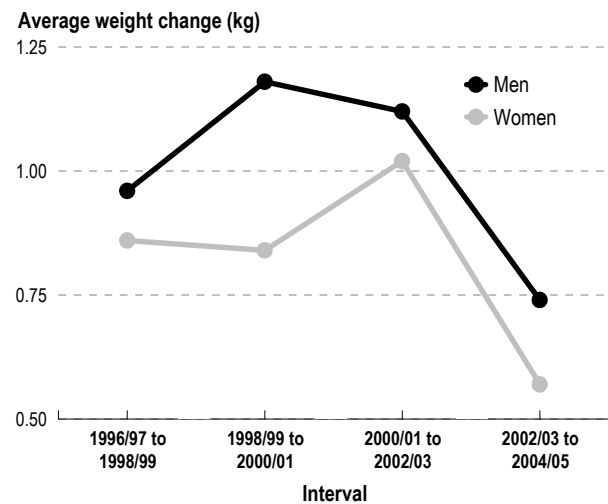
general, adults gain weight up to ages 55 to 60, after which they start to lose weight.⁸⁻¹⁰ Few studies have examined rates of weight change in a representative sample of Canadians. Analyses of data from the 1981 Canada Fitness Survey and the 1988 follow-up, the Campbell Survey of the Well-being of Canadians, demonstrated that body mass index (BMI) was relatively stable over the period between the surveys, but the researchers did not estimate the rate of change.¹¹ Another study based on the same data estimated that in families of at least two people, the weight change from 1981 to 1988 was a gain of 2.9 kilograms (kg) for fathers and a gain of 3.5 kg for mothers.¹² However, both these studies examined only two points in time, and so could not determine whether rates of weight gain were changing or remaining stable.

The purpose of this analysis, which is based on longitudinal data from the National Population Health Survey (NPHS), is to examine two-year changes in the self-reported weight of the Canadian adult household population from 1996/1997 to 2004/2005, and to determine if the rate of change has been speeding up, slowing down, or has remained stable (see *Methods, Definitions and Limitations*).

Rate of gain slowing

Canadians continue to gain weight, but indications are that the pace has slowed down. Over the two years from 1996/1997 to 1998/1999, the average self-reported weight of people aged 18 to 64 rose 0.96 kg for men and 0.86 kg for women (Chart 1). During the 2000/2001-to-2002/2003 interval, average gains were higher: 1.12 kg for men, and 1.02 kg for women. Over the next two years from 2002/2003 to 2004/2005, Canadians' weight continued to rise, but the average amount gained was less: 0.74 kg for men and 0.57 kg for women. Regression results (Appendix Table A) indicate that this pattern of weight gain is statistically significant. Thus, while Canadian adults were still gaining weight, they were gaining significantly less than in the earlier periods.

Chart 1
Average weight change (kilograms) over two years, by sex, household population aged 18 to 64, Canada excluding territories, 1996/1997 to 2004/2005



Source: 1996/1997 to 2004/2005 National Population Health Survey, longitudinal Health file

Amount gained varies

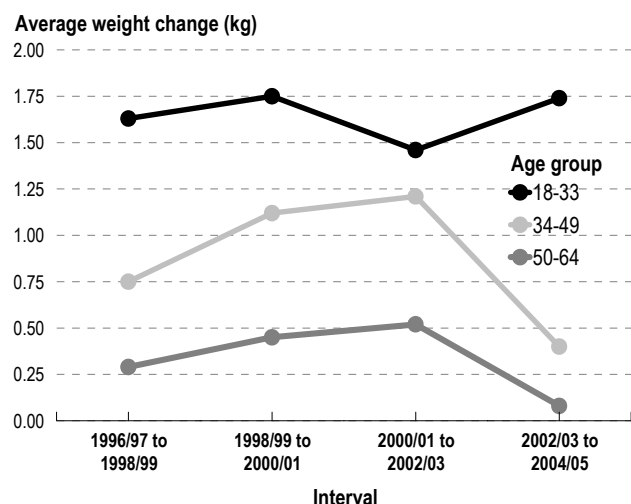
Changes in weight were significantly associated with sex, age group and BMI (Appendix Table A).

Over the eight years from 1996/1997 to 2004/2005, the average self-reported weight of men and women in all age groups increased. However, in each two-year interval, people aged 18 to 33 reported significantly greater average gains than did 34- to 49-year-olds, and people aged 50 to 64 reported significantly smaller gains (Charts 2 and 3).

The decline in the average amount gained in the 2002/2003-to-2004/2005 interval applied to men and women in most age groups. The exception was men aged 18 to 33 who, on average, gained more weight in the last interval than in the preceding one.

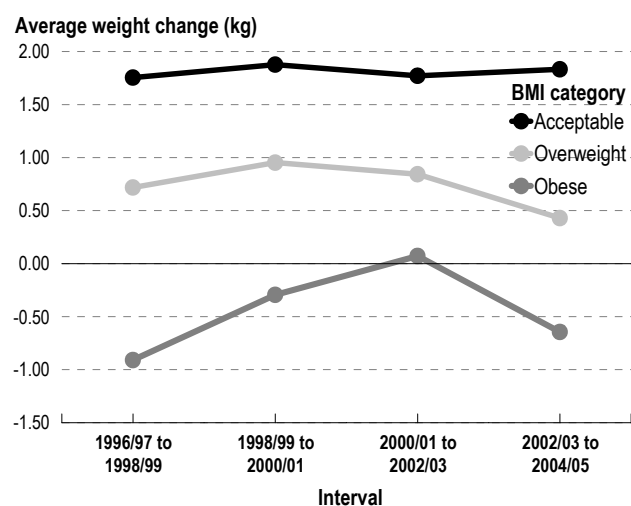
An individual's BMI was associated with how much his or her self-reported weight changed in each two-year interval (Charts 4 and 5). On average, overweight people gained 0.8 kg less, and obese individuals, 1.9 kg less, than did people whose weight was in the acceptable BMI range (Appendix Table A). In fact, during most two-year intervals, people who were obese experienced a mean loss in self-reported weight.

Chart 2
Average weight change (kilograms) over two years, by age group at beginning of interval, male household population aged 18 to 64, Canada excluding territories, 1996/1997 to 2004/2005



Source: 1996/1997 to 2004/2005 National Population Health Survey, longitudinal Health file

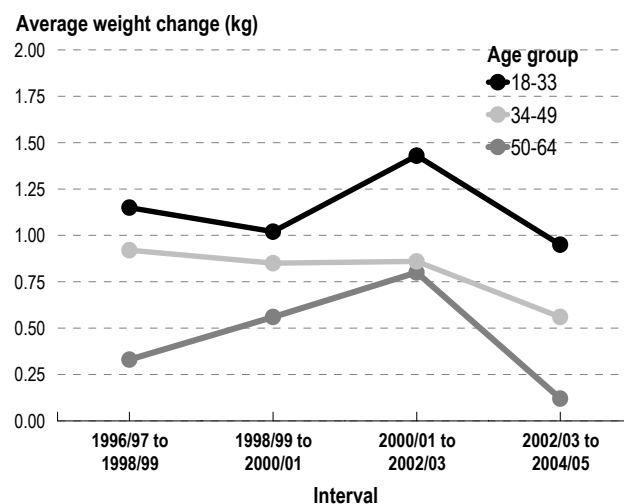
Chart 4
Average weight change (kilograms) over two years, by BMI category at beginning of interval, male household population aged 18 to 64, Canada excluding territories, 1996/1997 to 2004/2005



Source: 1996/1997 to 2004/2005 National Population Health Survey, longitudinal Health file

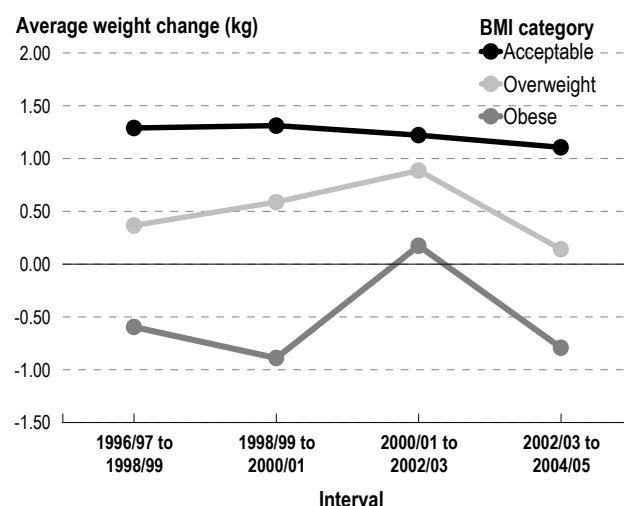
The decline in the average weight gain in the last two-year interval could reflect several processes: an increase in the number of people losing weight, an increase in the amount of weight lost, a decrease in the number of people gaining

Chart 3
Average weight change (kilograms) over two years, by age group at beginning of interval, female household population aged 18 to 64, Canada excluding territories, 1996/1997 to 2004/2005



Source: 1996/1997 to 2004/2005 National Population Health Survey, longitudinal Health file

Chart 5
Average weight change (kilograms) over two years, by BMI category at beginning of interval, female household population aged 18 to 64, Canada excluding territories, 1996/1997 to 2004/2005



Source: 1996/1997 to 2004/2005 National Population Health Survey, longitudinal Health file

weight, a decrease in the amount of weight gained, or a combination of these factors. Further analyses were undertaken to examine which of these processes were behind the slowdown in the amount of weight gained.

Definitions

Weight was self-reported and converted to the nearest kilogram for respondents answering in pounds. Similarly, height was self-reported and converted into metres for respondents answering in feet and inches.

Body mass index (BMI) was calculated by dividing weight in kilograms by height in metres squared. According to Health Canada guidelines,¹³ individuals whose BMI was less than 18.5 were considered underweight; those whose BMI ranged from 18.5 to 24.9 were considered to be an acceptable weight; those whose BMI ranged from 25.0 to 29.9, overweight; and those whose BMI was 30 or more, obese.

Three adult age groups were identified: 18 to 33, 34 to 49 and 50 to 64.

Smaller percentage gaining

During each of the first three intervals, almost half of adults reported that they gained weight, but from 2002/2003 to 2004/2005, 44% of men and 46% of women did so (Table 1). For men, but not women, this was a significantly lower proportion than in all previous intervals.

As well, 32% of men reported a loss in weight from 2002/2003 to 2004/2005, a significantly higher percentage than in the first two intervals. Among women, the proportion losing weight did not differ significantly from one interval to another,

ranging from 29% in the first three intervals to 32% in the last.

Those who gain, gain more

For the men who gained weight, the average amount rose from 4.56 kg in the first interval to 4.99 kg in the last, a statistically significant increasing trend (Table 1). The average gain among the women who gained weight varied, ranging from 4.39 kg to 4.78 kg. A statistically significant trend of an increase in the amount gained among women was also observed.

Among the men who lost weight, there was no statistically significant trend in the amount lost, with the average ranging from 4.42 kg to 4.68 kg. By contrast, among the women who lost weight, the average loss rose significantly from 4.35 kg in the first interval to 4.91 kg in the last.

Thus, the overall decline in the average weight gain in the last interval (2002/2003 to 2004/05) appears to be driven by a combination of factors; that is, a smaller proportion of men gaining weight and greater losses among the women who lost weight.

A dynamic process

An important consideration in examining trends in weight change is that the same people did not gain,

Table 1
Prevalence of weight change and average change (kilograms) over two-year interval, by sex, household population aged 18 to 64, Canada excluding territories, 1996/1997 to 2004/2005

	Trend in mean weight change [†]	Interval															
		1996/1997 to 1998/1999			1998/1999 to 2000/2001			2000/2001 to 2002/2003			2002/2003 to 2004/2005						
		%	Number	kg	sd	%	Number	kg	sd	%	Number	kg	sd				
Men																	
Gain	(p < 0.05)	49	2,114	4.56	0.10	51	1,988	4.82	0.11	49	1,819	4.98	0.13	44 [‡]	1,499	4.99	0.14
Loss	(not significant)	28	1,194	-4.56	0.18	27	1,109	-4.68	0.18	29	1,049	-4.42	0.17	32 [§]	1,106	-4.61	0.17
Stable		23	969	--		22	855	--		22	815	--		23	792	--	
Women																	
Gain	(p < 0.05)	49	2,253	4.39	0.10	48	2,131	4.50	0.11	49	2,033	4.78	0.14	46	1,767	4.62	0.12
Loss	(p < 0.05)	29	1,342	-4.35	0.12	29	1,274	-4.54	0.13	29	1,206	-4.46	0.15	32	1,247	-4.91	0.20
Stable		22	994	--		22	956	--		22	864	--		22	828	--	

[†] Based on linear regression of mean weight gain or loss on time

[‡] Significantly different from first three intervals (p < 0.05)

[§] Significantly different from intervals 1996/1997 to 1998/99 and 1998/99 to 2000/2001 (p < 0.05)

Note: All percentages are accurate within +/- 2 percentage points.

Source: 1996/1997 to 2004/2005 National Population Health Survey, Longitudinal Health file

Limitations

The data in these analyses were obtained primarily by computer-assisted telephone interviews and were self- or proxy-reported. Self-reported data may be affected by response biases such as social desirability; self-reported weight is generally an underestimate of measured weight.³ If an individual's reporting bias changed over time, it could affect the results. It is possible that the increased media attention obesity has received in recent years may have changed the magnitude of this bias; however, other analyses (US data) indicate no significant change in the extent of the bias associated with self-reports of weight and height during the 1988-to-1994 and 1999-to-2002 periods.¹⁴

As in all surveys, non-response may introduce bias into the survey results. While the 1994/1995 longitudinal square weights adjust for non-response at the initial measurement, they do not adjust for subsequent non-response. Differential non-response may have affected the results. However, because regression using the person-period dataset does not require a respondent to answer at each cycle in order to include them in the analysis, this bias is somewhat attenuated. Future analyses should take non-response patterns into account to investigate the possibility that selective attrition is affecting the results.

Because the data can be conceptualized as observations nested within individuals, a growth curve model would be an appropriate approach to analyzing the data.¹⁵ Initial analyses were conducted using a growth curve model in SAS; however, the estimates of SAS PROC MIXED have been reported to be biased when survey weights are used in the estimation¹⁶ and the bootstrapping procedure was not available to estimate variance. Thus, an alternative approach using a person-period data set was adopted. While it is less efficient than a growth curve model, it is unbiased and allowed for variance estimation using the bootstrap procedure.

lose or maintain their weight over all two-year intervals. For example, of the women who lost weight from 1996/1997 to 1998/1999, almost 64% gained weight over the subsequent interval from 1998/1999 to 2000/2001. Conversely, of the women who gained weight in the first interval, approximately 38% lost weight in the following interval, while approximately 39% gained weight in the subsequent interval. The pattern was similar for men with more than two-thirds of those who lost weight in one interval gaining weight in the next.

Cumulative effects

The average weight changes among adults in each two-year interval were gains of 0.5 kg to 1 kg (1.1 to 2.2 lbs), and the overall change during the entire eight years was an average gain of 4.01 kg (8.8 lb) for men and 3.44 kg (7.6 lb) for women. While these amounts may appear relatively small, such changes are cumulative, resulting in a further shift of the distribution of an already predominantly overweight and obese population toward unhealthy weights.³ Even a small shift in the population distribution toward excess weight can have important consequences for the incidence of weight-related diseases.¹⁷

Concluding remarks

The results of this analysis describe the pattern of weight change among Canadian adults from 1996/1997 to 2004/2005. There has been a slowdown in the average amount of weight gained and an increase in the number of men losing weight. At the same time, the amount gained by those who gain weight has increased.

Further research is warranted to identify the correlates and causes of these trends. While poor nutrition and lack of physical activity have been identified as primary contributors to weight gain, alternative explanations such as environmental factors are important and should also be considered.¹⁸ Longitudinal analysis in particular is needed to inform public health strategies aimed at addressing the problem of obesity in Canada. Analysis of subsequent cycles of the National Population Health Survey will make it possible to determine if the decrease in the rate of weight gain continues in the future.

Although Canadian adults are still, on average, gaining weight, public health messages promoting healthy eating and physical activity have proliferated, and it is possible that without these interventions, the recent rate of weight gain might have been higher. ●

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Appendix

Table A

Results of linear regression predicting two-year weight change in kilograms from time, time squared, sex, age group and body mass index category, household population aged 18 to 64, Canada excluding territories, 1996/1997 to 2004/2005

	β	95% confidence interval
Intercept	0.67*	0.24 to 1.10
Time	0.60*	0.21 to 1.00
Time squared	-0.13*	-0.20 to -0.05
Men [†]	0.40*	0.28 to 0.53
18 to 33 [‡]	0.30*	0.15 to 0.46
50 to 64 [‡]	-0.33*	-0.47 to -0.18
Underweight [§]	1.56*	0.97 to 2.15
Overweight [§]	-0.82*	-0.99 to -0.66
Obese [§]	-1.88*	-2.13 to -1.63

* $p < 0.05$

[†] Reference group is females.

[‡] Reference group is 34 to 49.

[§] Reference group is acceptable weight.

Source: 1996/1997 to 2004/2005 National Population Health Survey, longitudinal Health file