

PAPER

Temporal trends in overweight and obesity in Canada, 1981–1996

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OBJECTIVE: To assess changes in the prevalence of overweight and obesity among Canadian children and adults between 1981 and 1996 using recent recommendations for the classification of overweight and obesity.

DESIGN: Epidemiological study comparing the prevalence of overweight and obesity from the 1981 Canada Fitness Survey (CFS) to the 1996 National Longitudinal Survey of Children and Youth (NLSCY) and the 1996 National Population Health Survey (NPHS).

SUBJECTS: Adults 20–64 y of age and children 7–13 y of age from the CFS, NLSCY and NPHS.

MEASUREMENTS: BMI was calculated from directly measured or self-reported body mass and height. For adults 20–64 y of age, overweight and obesity were defined as BMI ≥ 25 kg/m² and BMI ≥ 30 kg/m², respectively. Age- and sex-specific cut-off points for children that correspond to the adulthood categories were used to define overweight and obesity for children 7–13 y of age.

RESULTS: The prevalence of overweight increased from 48 to 57% among men and from 30 to 35% among women, while the prevalence of obesity increased from 9 to 14% in men and from 8 to 12% in women. The corresponding increases were from 11 to 33% in boys and from 13 to 27% in girls for overweight and from 2 to 10% in boys and from 2 to 9% in girls for obesity.

CONCLUSION: The results indicate dramatic increases in the prevalence of both overweight and obesity in Canada over the last 15 y, and the problem is particularly pronounced among children.

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Introduction

There is consistent evidence that the prevalences of overweight and obesity are reaching epidemic levels in many developed and developing countries.¹ In the past few decades there have been significant increases in the prevalence of obesity among North American children^{2–4} and adults.^{5,6} International comparisons of the prevalences of overweight and obesity have been hampered in the past by the lack of a standard classification system.⁷ Typically, arbitrary centile cut-offs of selected reference data have been used to identify overweight or obese children, such as the 85th and 95th percentiles of body mass index (BMI).^{2,8,9} Alternatively, cut-

offs such as a BMI of 27 or 29 kg/m² have been used to define overweight or obesity among adults.^{10,11} The World Health Organization (WHO) and the US National Institutes of Health (NIH) have recently called for the standardization of the classification of overweight and obesity in adults, and an international classification system, based on the BMI, has been adopted by both agencies.^{1,12} Based on the new cut-offs, adults are considered to be overweight if their BMI is 25 kg/m² or greater, and they are obese if their BMI is 30 kg/m² or greater.

Following the adoption of the adult health-related BMI cut-offs for overweight and obesity, an expert committee considered it a priority to establish an international reference system for the identification of overweight and obesity among children and youth.¹³ These cut-offs have been recently developed and published by Cole *et al.*¹⁴ The new criteria for overweight and obesity differ from previous arbitrary centile cut-offs because they are linked to the adult health-related definitions of overweight and obesity.

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Briefly, the authors identified the centiles corresponding to overweight (BMI 25 kg/m²) and obesity (30 kg/m²) in 18-year-old males and females from six different population samples, and projected and smoothed these percentiles by least mean square (LMS) regression back into childhood and adolescence, pooling the results across countries.¹⁴ The resultant curves allowed age- and sex-specific BMI cut-offs during childhood and adolescence to be established with the values anchored to previously established health-related adult cut-offs.^{1,12}

It is hoped that the new classification systems for overweight and obesity in children and adults will be adopted by researchers and clinicians worldwide. The use of the new guidelines will make international comparisons more meaningful, whereas in the past these comparisons were difficult. Chinn and Rona¹⁵ have recently used the childhood cut-offs to examine changes in overweight and obesity from 1974 to 1994 in the UK. Their results suggest that, while the prevalence of obesity remains low (1–2%), dramatic increases in the prevalence of overweight and obesity have been seen during this time period.

Nationally representative measured height and body mass data are not systematically collected in Canada. Measured data from the 1981 Canada Fitness Survey (CFS) are available. In an effort to get some assessment of temporal trends in overweight and obesity in Canada, parental reported values from the 1996 National Longitudinal Survey of Children and Youth (NLSCY) and self-reported values from the 1996 National Population Health Survey (NPHS) were used, and represent the best data available.

The purpose of this study was to use the new recommended guidelines, as described above, to compare changes in the prevalence of overweight and obesity among Canadian children and adults from 1981 to 1996, and to compare the temporal trends in Canada with those in other countries.

Methods

Three nationally representative cross-sectional studies were used to assess temporal changes in BMI. Data from the 1981 CFS, the second wave (1996) of the NLSCY and the 1996 NPHS were used. The BMI (mass (kg)/height (m²)) was used to define overweight and obesity.

The CFS was conducted between February and July 1981 on a geographically stratified sample representing 97% of the Canadian population.¹⁶ A total of 23 400 people participated in the CFS, while anthropometric measurements were made on approximately 16 000 participants. There were several reasons why participants may not have completed the anthropometric measurements (injury, illness, absent at time of scheduled testing, equipment failure, fear, embarrassment, etc), and a selection bias cannot be ruled out. Details on the sampling procedures from the CFS have been published previously.^{16,17} Information was available to calculate BMI on 2879 children (aged 7–13 y) and 10 279 adults (aged 20–64 y) from the CFS. Age was defined as age at last birthday

(ie 7 = 7.00–7.99). Height and body mass were directly measured according to the standardized procedures of the CFS.¹⁸

The 1996 NLSCY data were collected between December 1996 and May 1997. The target population comprised all Canadian children from newborn to age 13. The participating households were selected from the sampling frame of Statistics Canada's Labour Force Survey (as was the CFS), which is representative of Canada's population. Details of the survey and sampling procedures are available elsewhere.¹⁹ In this survey, the height and body mass data were gathered through parental report, which in some cases (proportion not known) included direct measurement. BMI results were available for 6277 children aged 7–13 from the NLSCY. The NPHS, Statistics Canada's first ongoing population health survey,²⁰ is conducted every 2 y beginning in 1994. Data from the second wave (1996) were used in the present analysis. Self-reported body mass and height were gathered in this nationally representative survey. BMI data were available for 50 347 adults aged 20–64 from the NPHS.

Among adults 20–64 y of age, a BMI ≥ 25 was taken to represent overweight and a BMI ≥ 30 was used to signify obesity, following the recommendations of the WHO¹ and the US NIH.¹² Among children 7–13 y of age, the recently developed international age- and sex-specific cut-offs for overweight and obesity, derived by plotting a regression line though the adult cut-offs at age 18, were used.¹⁴ Weighted prevalences of overweight and obesity were calculated for each of the samples, using the individual sample weights provided in each of the databases, to assure the representativeness of the results. All analyses were performed using SAS procedures.²¹

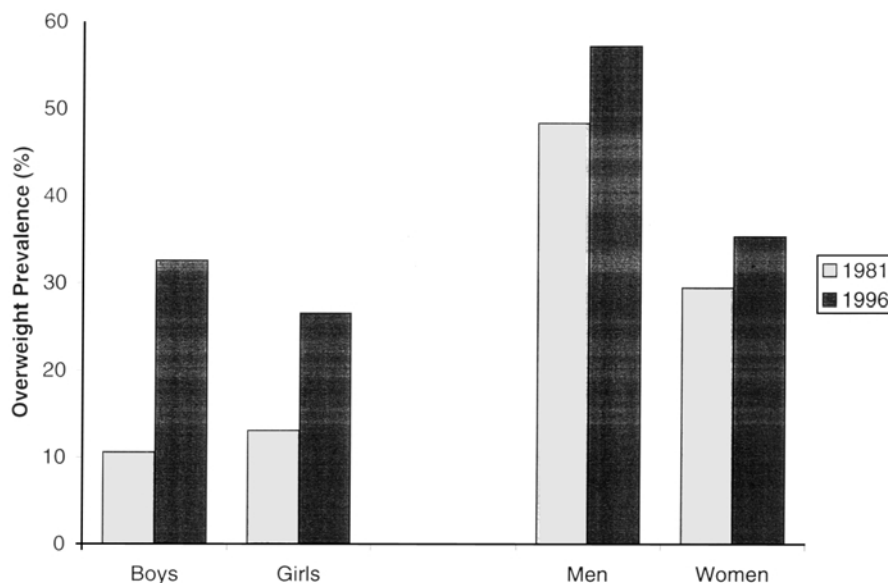
Results

Table 1 lists the sample sizes and weighted means and standard deviations for BMI from the CFS, NLSCY and NPHS by age and sex. Figures 1 and 2 illustrate the temporal trends in the prevalence of overweight and obesity respectively, based on BMI measurements, that have occurred in Canadian children and adults between 1981 and 1996. The prevalence of overweight increased from 48 to 57% among men and from 30 to 35% among women, while the prevalence of obesity increased from 9 to 14% in men and from 8 to 12% in women. The corresponding increases were from 11 to 33% in boys and from 13 to 27% in girls for overweight and from 2 to 10% in boys and from 2 to 9% in girls for obesity. An increased proportion of Canadians are becoming overweight and obese and the rate of change is markedly greater in children than adults.

Table 2 provides a direct comparison of the prevalence of childhood overweight and obesity between Canada, Scotland, England and Spain using the recently established international guidelines.¹⁴ This comparison suggests that the prevalence of childhood overweight in Canada exceeds that in Britain and Spain.

Table 1 Sample sizes, weighted means and standard deviations for BMI from the 1981 Canada Fitness Survey (CFS), the 1996 National Population Health Survey (NPHS), and the 1996 National Longitudinal Survey of Children and Youth (NLSCY)

Age (y)	CFS						NLSCY/NPHS					
	Males			Females			Males			Females		
	n	Mean	s.d.	n	Mean	s.d.	n	Mean	s.d.	n	Mean	s.d.
7	172	15.9	1.8	180	16.2	2.1	498	18.2	4.3	496	17.3	3.9
8	230	16.7	2.6	186	16.7	2.1	492	17.9	3.7	451	17.7	4.4
9	212	17.0	2.0	168	16.7	2.2	466	18.9	4.7	472	18.7	4.8
10	224	17.7	2.8	224	17.9	2.7	518	18.3	3.7	502	18.8	4.2
11	210	18.1	2.9	224	17.5	2.9	480	19.3	3.5	473	18.7	3.2
12	220	18.5	2.4	207	19.0	2.9	361	20.3	4.2	365	19.3	3.5
13	215	19.1	2.4	207	19.7	3.0	337	20.6	3.2	366	20.5	3.6
20–29	1639	23.9	3.3	1772	21.7	3.2	5282	24.8	3.6	5486	23.0	4.2
30–39	1408	25.1	3.6	1566	23.4	4.0	7575	25.9	3.7	7391	23.8	4.4
40–49	889	26.1	3.6	997	24.6	4.4	5986	26.5	3.9	5783	24.7	4.6
50–59	648	26.1	3.3	817	25.5	4.4	4368	26.7	3.9	4626	25.8	4.6
60–64	247	26.5	3.5	296	25.7	4.2	1852	26.6	3.7	1998	26.0	4.6

**Figure 1** Prevalence of overweight (%) among Canadian boys and girls (aged 7–13) and men and women (aged 20–64) in 1981 and 1996.

Discussion

The purpose of this paper was to assess changes in the prevalence of overweight and obesity of Canadian children and adults from 1981–1996. The results provide compelling evidence that there has been a progressive increase in the prevalence of overweight and obesity among Canadians, and that the problem is more pronounced in children. An international comparison suggests that the pediatric obesity epidemic is more advanced in Canada than in Britain and Spain. These findings reinforce the seriousness of the obesity

problem in Canada, which, if left unresolved, forecasts serious long-term health and economic consequences.

This study has two important limitations. First, BMI as an indicator of overweight or obesity has recognized limitations. Several factors including muscle-to-fat ratio, timing and tempo of the adolescent growth spurt, and sexual maturation are potentially confounding variables when using BMI as an index of adiposity.²² Nevertheless, BMI is generally accepted as a valid indicator of body composition for assessments on a population level.^{1,12} The second limita-

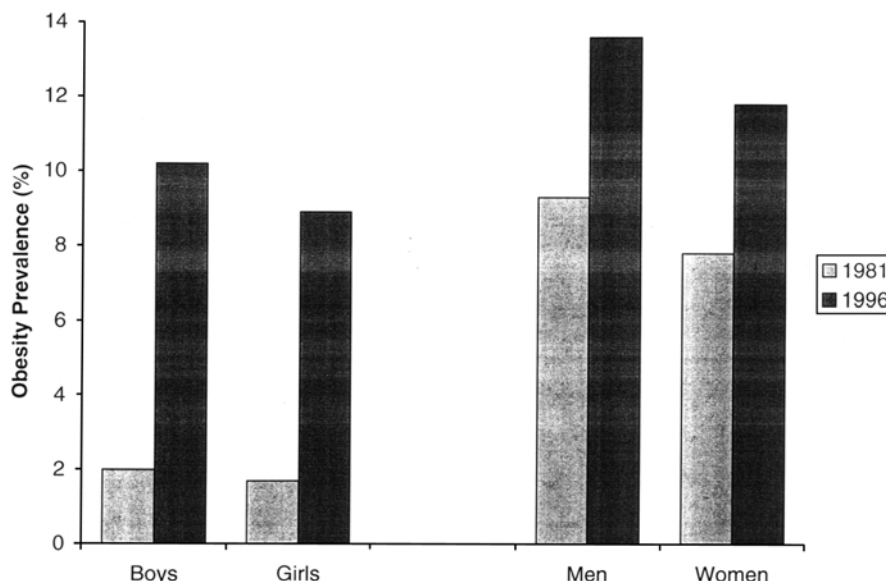


Figure 2 Prevalence of obesity (%) among Canadian boys and girls (aged 7–13) and men and women (aged 20–64) in 1981 and 1996.

Table 2 Comparison of the prevalences (%) of overweight among Canadian, Scottish, English and Spanish children aged 7–8 and 9–11 y

Age (y)	Prevalence of overweight				Change	
	1980–1984 ^a		1994–1996 ^b			
	7–8	9–11	7–8	9–11	7–8	9–11
Males						
Canada	7.5	13.7	38.9	30.2	31.4	16.5
Scotland	6.4	6.9	8.0	13.4	1.6	6.5
England	5.7	5.8	9.0	12.7	3.3	6.9
Spain		11.0		25.6		14.6
Females						
Canada	15.7	11.8	33.0	26.7	17.3	14.9
Scotland	11.3	10.6	15.1	19.6	3.8	9.0
England	10.6	9.9	12.5	16.7	1.9	6.8
Spain		15.2		21.6		6.4

^aData for Canada from the 1981 Canada Fitness Survey; data for Scotland and England from the UK National Study of Health and Growth;¹⁵ data for Spain from 1980 and 1995 cross-sectional surveys conducted in Zaragoza, Spain.²⁹

^bData for Canada from the 1996 National Longitudinal Survey of Children and Youth; data for Scotland and England from the UK National Study on Health and Growth;¹⁵ data for Spain from 1980 and 1995 cross-sectional surveys conducted in Zaragoza, Spain.²⁹

tion of this study, and perhaps the most important, is that the 1996 BMI estimates were derived from parents' reports (NLSCY) or self-reports (NPHS) of height and body mass. Systematic reporting bias could explain the temporal trends reported in this study and/or the substantial differences in childhood overweight prevalences compared to Britain and

Spain because both of these datasets are based on directly measured values. However, a comparison of directly measured vs self-reported body mass and height values for a sample of 12 to 16-y-old children from the NHANES III study demonstrated strong agreement between measured and reported values (correlations ranged between 0.87 and 0.94 for body mass and 0.82 and 0.91 for height, depending on age, gender and race).²³ Self-reported body mass and height resulted in the correct classification of obesity status in 94% of children and provided a reliable assessment of obesity-related behaviours (ie dieting, television watching, exercise). Strauss²³ found that female adolescents and obese adolescents were most likely to under-report body mass which, if anything, should bias the results in a conservative direction. Other research also suggests that self-reported height and body mass will typically result in underestimated BMIs and a reduction in obesity prevalence rates.^{24,25} Though data are lacking, it is likely that the trend of adults reporting height and body mass data that underestimate true BMI values is also evident when they report the results for their children. In those cases where children were consulted (proportion unknown) it is likely that BMI values were underestimated as previously reported by Strauss.²³

The finding of a higher prevalence of overweight in men in the present study is consistent with other Canadian data. In the Canadian Heart Health Surveys, conducted from 1986–1992, the prevalence of overweight was 57% in men and 39% in women, based on measured heights and body mass.²⁶ The time frame for the Canadian Heart Health Surveys falls between the two time points used in the present study, but the prevalence of overweight is similar to that for the 1996 NPHS, 57% in men and 35% in women. Given the

differences in prevalences that can be expected between measured and self-reported heights and body mass, this suggests that the prevalence of overweight we have reported for the 1996 NPHS is somewhat conservative.

The temporal trends in obesity among Canadian adults reported in the present study can be compared to trends in other countries based on studies that have used a BMI of $\geq 30 \text{ kg/m}^2$ to define obesity. The prevalence of adult obesity increased from 12.8% in the 1960–1962 US National Health Examination Survey to 22.5% in the 1988–1994 US National and Health and Nutrition Examination Survey (NHANES III), with the largest increase being from the NHANES II 1976–1978 (14.5%) to the NHANES III.⁶ An update on the spread of the obesity epidemic in the US from 1991–1998 in the Behavioral Risk Factor Surveillance System (BRFSS) revealed that the prevalence of obesity increased from 12.0% in 1991 to 17.9% in 1999.²⁵ The prevalence estimates in the latter study indicate a continued increase in the prevalence of obesity in the 1990s; however, the point estimates are lower than those reported in the NHANES III. The authors indicate that, because height and body mass were self-reported in the BRFSS, and measured in the NHANES III, this probably accounts for the differences, and the estimates from the BRFSS are likely conservative.²⁵

Among adults 20 y and older in The Netherlands, the prevalence of obesity increased from 3.7% in men and 6.0% in women in 1982–1984 to 5.1% in men and 7.1% in women in 1991–1993, based on BMI derived from self-reported height and body mass.²⁷ In England, the prevalence of obesity among 16–64-y-olds increased from 6.0% in men and 8.0% in women in 1980 to 15.0% in men and 16.5% in women in 1995.¹ Flegal recently summarized trends in overweight and obesity and found that, in addition to Canada, Finland, New Zealand, the UK, the US, and Western Samoa have shown large increases in the prevalence of obesity over the past 25 y.²⁸ It is interesting that the increases in obesity among Canadian adults are similar to those in England; however, the increases among children in Canada far exceed the increases seen among English children, as reported above.

The data from the 1998 NPHS have recently become available. We calculated the weighted prevalences of overweight and obesity among adults 20–64 y of age to determine if the trends reported in the main analyses in this paper (based on the 1996 NPHS) continued. Briefly, the prevalences of overweight and obesity were 50.7% (61.2% in men and 39.9% in women) and 14.9% (15.4% in men and 14.4% in women), respectively. These results suggest that the obesity epidemic is continuing in Canada, and that over half of Canadians are now overweight.

The standard deviations for the mean BMIs during childhood (Table 1) from the 1981 sample are noticeably smaller than those for the 1996 sample. The increased variance in the 1996 sample is believed to be a result of both an increased error from the parental report and the previously reported finding that the variation of BMI has increased from

1981 to 1996.² The distribution of BMI values of Canadian children is becoming flatter, more spread out, and skewed to the right, indicating more children are becoming overweight and obese.

Although the increases in the prevalences of overweight and obesity among Canadian adults is cause for concern, the dramatic increases among children are particularly frightening. Using arbitrary cut-offs to define overweight and obesity (85th and 95th age- and gender-specific percentiles), Tremblay and Willms recently reported increases of approximately two-fold for overweight and three-fold for obesity in Canadian children between 1981 and 1996.² Results from the present analyses suggest the prevalence of childhood obesity has increased five-fold (2–10%), reaffirming these findings. Increases in the prevalence of childhood obesity and overweight have also been recently reported in the US,^{2–4} UK,¹⁵ Spain²⁹ and Australia.³⁰ Given that there is a tendency for obese children to remain obese as adults,^{31,32} the obesity epidemic will not subside any time in the near future unless aggressive public health campaigns against obesity are implemented widely and quickly.

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