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August, 2012



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Published by authority of the Minister responsible for
Statistics Canada

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P	preliminary
r	revised
X	suppressed to meet the confidentiality requirements of the <i>Statistics Act</i>
E	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

Overweight and obesity in children and adolescents: Results from the 2009 to 2011 Canadian Health Measures Survey

by Karen C. Roberts, Margot Shields, Margaret de Groh, Alfred Aziz and Jo-Anne Gilbert

Abstract

Background

The 2009 to 2011 Canadian Health Measures Survey provides the most recent measured body mass index (BMI) data for children and adolescents. However, different methodologies exist for classifying BMI among children and youth. Based on the most recent World Health Organization classification, nearly a third of 5- to 17-year-olds were overweight or obese. The prevalence of obesity differed between boys and girls (15.1% versus 8.0%), most notably those aged 5 to 11, among whom the percentage of obese boys (19.5%) was more than three times that of obese girls (6.3%). These estimates indicate a higher prevalence of overweight/obesity among children than do estimates based on International Obesity Task Force cut-offs. Although the prevalence of overweight and obesity among children in Canada has not increased over the last decade, it remains a public health concern, given the tendency for excess weight to persist through to adulthood and lead to negative health outcomes.

Keywords

Body mass index, child, adolescent, population surveillance

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Since the late 1970s, the prevalence of overweight and obesity has risen among children and adolescents in Canada.¹ Excess weight in childhood has been linked to insulin resistance, type 2 diabetes, hypertension, poor emotional health, and diminished social well-being.^{2,3} As well, obese children tend to become obese adults, making childhood obesity a public health concern.⁴⁻⁶

Routine surveillance of overweight and obesity is important for the development and assessment of efforts aimed at reducing excess weight in children and adolescents. The most common approach to classifying weight is the body mass index (BMI), which estimates adiposity based on weight relative to height.⁷⁻¹⁰ The use of measured, rather than reported, height and weight to derive BMI is strongly recommended, especially for children and adolescents.¹¹

Since the Canada Health Survey (age 0 and up) in 1978/1979, only a few national population-level surveys have directly measured the height and weight of children and adolescents: the 1981 Canada Fitness Survey (age 7 or older), the 1988 Campbell's Survey on the Well-being of Canadians (age 7 or older), the 2004 Canadian Community Health Survey (CCHS), Cycle 2.2 Nutrition (age 2 or older), and the 2007 to 2009 Canadian Health Measures

Survey (CHMS) (age 6 or older). The most recent CHMS cycle (2009 to 2011) included children aged 3 or older.

BMI classification guidelines for adults have been in place for decades,⁹ with cut-offs for specific categories based on scientific evidence of increasing health risks with increased BMI. Establishing a standard BMI classification system for children has been more challenging, because of variations in growth rates and the difficulty of linking estimated adiposity levels in childhood to weight-related health outcomes that tend to manifest later in life. A number of classification systems for use at the population level have been developed to estimate overweight and obesity in children.¹² Since 2004, Canada has used the age-/sex-specific classification cut-offs established by the International Obesity Task Force (IOTF).^{13,14} In 2007, the World Health Organization (WHO) released a new set of age-/sex-specific

The data

Estimates are based on data from the second cycle (2009 to 2011) of the Canadian Health Measures Survey (CHMS). The CHMS is an ongoing survey designed to provide comprehensive direct health measures data at the national level.¹⁵ Ethics approval was obtained from Health Canada's Research Ethics Board.¹⁶ The 2009 to 2011 CHMS covered the population aged 3 to 79 in private households. It excluded residents of Indian Reserves, institutions and some remote regions, and full-time members of the regular Canadian Forces. More than 96% of the population aged 3 to 79 is represented.¹⁷

Data were collected at 18 sites across Canada from August 2009 to December 2011. In addition to a questionnaire administered in the respondent's home, the survey involved physical measures (including height and weight) in a mobile examination centre. Participation was voluntary. Written informed consent was obtained from respondents aged 14 or older. For younger children, a parent or legal guardian provided written consent, in addition to written assent from the child (where possible). The *CHMS Cycle 2 Data User Guide*¹⁷ contains details about the 2009 to 2011 survey content and sample design.

Of the households selected for the survey, 75.9% agreed to participate. In each responding household, one or two members were selected: 90.5% of selected household members completed the household questionnaire, and 81.7% of the responding household members participated in the subsequent physical measures component. The final response rate, after adjusting for the sampling strategy, was 55.5%.¹⁷ This article is based on 2,123 respondents aged 5 to 17, for whom measured values of height and weight were collected.

Height was measured to the nearest 0.1 centimetre using a ProScale M150 digital stadiometer (Accurate Technology Inc., Fletcher, USA), and weight, to the nearest 0.1 kilogram with a Mettler Toledo VLC with Panther Plus terminal scale (Mettler Toledo Canada, Mississauga, Canada).

Body mass index was derived as weight in kilograms divided by height in metres squared. Based on BMI, children and adolescents were classified according to thinness, normal weight, overweight or obesity using two sets of age- and sex-specific cut-offs, one set specified by the WHO,¹⁸ and the other, by the IOTF.^{13,14}

The WHO cut-off criteria used to classify children younger than age 5 as overweight or obese¹⁹ differ slightly from those used for children aged 5 or older,¹⁸ and the WHO does not recommend combining across age groups. Because the sample size for 3- and 4-year-old children in the 2009 to 2011 CHMS was too small to provide reliable estimates using these cut-offs, this age group was not included in this report.

All estimates were based on weighted data. Statistical analyses were performed using SAS and SUDAAN software. Standard errors, coefficients of variation and 95% confidence intervals were calculated with the *bootstrap* technique.^{20,21} The number of degrees of freedom was specified as 13 to account for the 2009 to 2011 CHMS sample design.¹⁷ Significance levels were set at $p < 0.05$.

Table 1
Percentage distribution of children and adolescents, by body mass index (BMI) category (based on World Health Organization cut-offs), age group and sex, household population aged 5 to 17, 2009 to 2011

	Thinness			Normal weight			Overweight			Obesity		
	95% confidence interval			95% confidence interval			95% confidence interval			95% confidence interval		
	%	from	to	%	from	to	%	from	to	%	from	to
Total	2.2 ^E	1.1	4.1	66.4	62.8	69.8	19.8	16.6	23.4	11.7	9.9	13.7
Age group (years)												
5 to 11	F	...	...	65.5	61.7	69.2	19.7	16.4	23.4	13.1	10.5	16.3
12 to 17	F	...	...	67.2	60.2	73.6	19.9	15.0	25.8	10.2	7.3	14.1
Boys	F	...	...	62.3	56.3	68.0	19.4	15.1	24.4	15.1	12.6	17.9
Age group (years)												
5 to 11	F	...	...	59.0	51.9	65.7	19.8	14.8	26.0	19.5	15.5	24.1
12 to 17	F	...	...	65.6	55.3	74.6	18.9 ^E	12.6	27.5	10.7*	7.5	15.0
Girls	1.0 ^E	0.6	1.6	70.8	64.6	76.3	20.2	15.8	25.6	8.0 [†]	5.7	11.1
Age group (years)												
5 to 11	1.5 ^E	0.7	3.1	72.6 [†]	69.8	75.2	19.6	16.1	23.6	6.3 ^E	4.1	9.8
12 to 17	F	...	...	69.0	58.5	77.9	20.9	14.9	28.6	9.6 ^E	6.0	15.1

* significantly different from ages 5 to 11 ($p < 0.05$)

† significantly different from boys ($p < 0.05$)

^E use with caution

F too unreliable to be published

... not applicable

Source: 2009 to 2011 Canadian Health Measures Survey.

Table 2
Percentage distribution of children and adolescents, by body mass index category based on World Health Organization (WHO) and International Obesity Task Force (IOTF) cut-offs, age group and sex, household population aged 5 to 17, 2009 to 2011

Characteristics	Thinness						Normal weight						Overweight						Obesity					
	WHO			IOTF			WHO			IOTF			WHO			IOTF			WHO			IOTF		
	95% confidence interval			95% confidence interval			95% confidence interval			95% confidence interval			95% confidence interval			95% confidence interval			95% confidence interval					
	%	from	to	%	from	to	%	from	to	%	from	to	%	from	to	%	from	to	%	from	to	%	from	to
Total	2.2 ^E	1.1	4.1	1.6 ^E	0.8	3.2	66.4	62.8	69.8	73.6	69.7	77.3	19.8	16.6	23.4	16.4	13.4	19.9	11.7	9.9	13.7	8.4	6.8	10.2
Age group (years)																								
5 to 11	F	...	...	1.0 ^E	0.5	1.9	65.5	61.7	69.2	76.4	72.6	79.9	19.7	16.4	23.4	14.7	12.1	17.9	13.1	10.5	16.3	7.9	5.8	10.5
12 to 17	F	...	...	F	...	...	67.2	60.2	73.6	70.9	63.9	77.0	19.9	15.0	25.8	18.0	13.8	23.1	10.2	7.3	14.1	8.9	6.3	12.3
Sex																								
Boys	F	...	...	F	...	...	62.3	56.3	68.0	72.7	65.8	78.6	19.4	15.1	24.4	15.8	11.7	21.1	15.1	12.6	17.9	9.5	7.4	12.2
Girls	1.0 ^E	0.6	1.6	1.2 ^E	0.7	2.2	70.8	64.6	76.3	74.7	68.7	79.9	20.2	15.8	25.6	17.0	13.0	21.8	8.0*	5.7	11.1	7.1	5.0	10.0

* significantly different from boys (p<0.05)

^E use with caution

F too unreliable to be published

... not applicable

Source: 2009 to 2011 Canadian Health Measures Survey.

classification cut-offs for children and adolescents aged 5 to 19.¹⁸

Although the IOTF classification has been used extensively, a systematic review has found that it underestimates obesity.²² Furthermore, the IOTF classification is only appropriate for use at the population level and cannot be used to assess excess weight at the individual level.¹³ The WHO growth charts¹⁸ have gained acceptance for use at the individual level, and in 2010, key professional associations recommended that health care professionals employ them to monitor the growth of Canadian children.²³ Adaptation and implementation of the WHO growth charts is underway in several jurisdictions (for example, British Columbia, Alberta, Saskatchewan, Yukon, New Brunswick and Nova Scotia).²⁴ Estimating overweight and obesity based on the WHO growth references ensures that the methods used to determine excess weight in children and adolescents are consistent at the individual and population levels.

With measured height and weight data from the 2009 to 2011 CHMS, this report presents population estimates of overweight and obesity among Canadian children and adolescents based on the WHO cut-off values and compares them with the IOTF thresholds (see *The data*).

Obesity prevalence

According to the WHO approach, close to one third (31.5%) of 5- to 17-year-olds, an estimated 1.6 million, were classified as overweight (19.8%) or obese (11.7%) in 2009 to 2011 (Table 1). The percentage who were overweight was similar across age groups. However, the prevalence of obesity differed between boys and girls (15.1% versus 8.0%), most notably at ages 5 to 11, among whom the percentage of boys who were obese (19.5%) was more than three times

the percentage of girls who were obese (6.3%) (Table 1).

WHO versus IOTF approaches

The WHO cut-offs identified a greater percentage of children as overweight or obese than did the IOTF cut-offs: 31.5% versus 24.8% (Table 2). At ages 5 to 11, the difference was more pronounced than at ages 12 to 17. According to the WHO cut-offs, an estimated 32.8% of 5- to 11-year-olds were overweight or obese, compared with an estimated 22.6% based on the IOTF cut-offs.

Table 3
Mean body mass index (BMI) and percentage distribution by BMI category (based on World Health Organization cut-offs) of children and adolescents, household population aged 6 to 17, 2004, 2007 to 2009, and 2009 to 2011

Characteristics	2004			2007 to 2009			2009 to 2011		
	95% confidence interval			95% confidence interval			95% confidence interval		
	from	to	from	to	from	to	from	to	
Mean BMI	20.19	20.03	20.35	20.09	19.55	20.63	20.03	19.67	20.40
BMI category (%)									
Thinness	1.4 ^E	1.0	2.0	1.6 ^E	0.8	3.2	2.3 ^E	1.2	4.5
Normal weight	63.8	61.9	65.7	66.4	60.4	71.9	66.6	62.7	70.3
Overweight	21.4	19.9	23.1	17.7	13.9	22.2	19.5	15.9	23.6
Obesity	13.3	12.1	14.7	14.3	11.5	17.5	11.6	9.8	13.7

^E use with caution

Note: There are no significant differences over time.

Source: 2004 Canadian Community Health Survey – Nutrition; 2007 to 2009 Canadian Health Measures Survey; 2009 to 2011 Canadian Health Measures Survey.

A comparison of the classification systems showed that 72% of the children classified as obese based on the WHO approach would also be classified as obese based on the IOTF approach; the remaining 28% would be classified as overweight. Likewise, 66% of the children classified as overweight based on the WHO approach would also be classified as overweight based on the IOTF approach; the remaining 34% would be classified as normal weight.

The higher prevalence of obesity observed using the WHO approach is consistent with previous reports.^{12,25} In a summary of the results of a number of studies, Reilly et al. noted that many of them demonstrated that the IOTF classification underestimates the prevalence of excess weight, particularly obesity, in children and adolescents.²²

No significant differences were observed in the estimates of overweight and obesity among children and adolescents aged 6 to 17 when data from the 2004 CCHS, the 2007 to 2009

CHMS, and the 2009 to 2011 CHMS were compared using the WHO cut-offs (Table 3) or IOTF cut-offs (data not shown).

This analysis concerns only one measure of adiposity—BMI. A recent Canadian study²⁶ showed that over time, waist circumference among Canadians of all ages has increased more than BMI. Evidence for adults indicates that changes in the distribution of body fat, such as increases in waist circumference, are associated with elevated health risk,²⁷ and suggests that even if the population prevalence of BMI does not change, changes in the distribution of body fat may increase health risk.²⁶

Conclusion

The factors associated with overweight and obesity are complex,⁷ and include health behaviours, such as eating habits and daily physical activity, and broader social, environmental and biological determinants that influence these health

behaviours.^{28,29} However, the sample size did not permit examination of trends in rates by these characteristics.

The 2009 to 2011 CHMS provides the most recent BMI data, based on measured height and weight, for children and adolescents in Canada. According to the WHO approach, close to a third of 5- to 17-year-olds were identified as overweight or obese, compared with about a quarter according to the IOTF cut-offs. Classification differences between approaches were greatest at ages 5 to 11. Although these estimates have not changed significantly in recent years, more data points are needed to determine if the pace of increase in prevalence is slowing, as has been observed in some countries.³⁰ Regardless, the estimates remain high and are a public health concern, given the tendency for excess weight in childhood to persist through to adulthood. ■

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