Chapter 5
The Epidemiology of Childhood Obesity in Canada, Mexico and the United States

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Introduction

Published reports based on different definitions indicate that in Canada, Mexico and the United States childhood overweight and obesity have increased dramatically since 1980, with the US leading the way. The prevalence of overweight, using the International Obesity Task Force (IOTF) definitions (Cole et al. 2000) in 7–13 year old girls doubled in Canada between 1981 and 1996 and tripled in boys (Tremblay et al. 2002). In 2004 in Canada, 26% of children and adolescents aged 2–17 were overweight or obese and 8% were obese (Shields 2006). Among children under 5 years of age in Mexico, overweight prevalence (z-score of weight-for-height above +2 of World Health Organization/ National Center for Health Statistics/Centers for Disease Control and Prevention (WHO/NCHS/CDC)

The findings and conclusions in this chapter are those of the authors and not necessarily those of the CDC.

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references (Dibley et al. 1987)) increased from 4.2 to 5.3% between 1988 and 1999 (Rivera et al. 2002). In the US, between 1980 and 2006 the prevalence of high body mass index (BMI ≥95th percentile of the sex specific 2000 CDC growth charts) increased from 6 to 16% among children and teens 2 through 19 years of age (Ogden et al. 2002, 2003, 2007, 2008).

This chapter provides an overview of childhood obesity in Canada, Mexico and the United States. Nationally representative surveys contribute comparable information on prevalence, trends, and risk factors related to childhood obesity in each country.

Geographic and Socio-Economic Characteristics

In 2007, the North American continent had a population of almost 440 million people and a surface area of 21,581,100 km^2. The largest country in terms of area and the smallest in terms of population is Canada with a surface area of 9,984,700 km^2 and a population of approximately 33 million people. Mexico has the smallest surface area at 1,964,400 km^2 with a population of over 105 million and the US's area is 9,632,000 km^2 with a population of almost 301 million. The per capita gross domestic product (GDP) in Canada was $43,368 in 2007. In Mexico it was only $8,385 and in the United States it was $45,046. In the same year, life expectancy in Canada was 81 years while in Mexico it was 75 years and in the US it was 78 years. Infant mortality was lowest in Canada at 4.8 deaths per 1,000 live births, followed by the US at 6.3 deaths per 1,000 live births and Mexico at 16.7 deaths per 1,000 live births (UN Statistics 2009; World and Statistics 2009).

Definitions and Measurement of Overweight and Obesity

The definition of excess body fat or adiposity is not clear-cut and body fat is difficult to measure directly. Consequently, obesity is often defined as excess body weight rather than as excess fat. In epidemiologic studies, body mass index (BMI) calculated as weight in kilograms divided by height in meters squared is used to express weight adjusted for height (Dietz and Robinson 1998; Krebs et al. 2007).

Measured weight and height are more accurate than self-reported data. Cost considerations, however, often lead to surveys and epidemiologic studies not being conducted in-person, so that height and weight are self-reported rather than measured. Inaccurate estimates may result because respondents tend to overestimate their heights and underestimate their weights. Or, in the case of children, parents often do not know their child's measurements or under-estimate their child's height (Connor Gorber et al. 2007; Davis and Gergen 1994; Kuczmarski et al. 2001; Perry et al. 1995; Rowland 1990).

In children, the terminology for different levels of weight or BMI varies considerably (Flegal et al. 2006). The terms overweight, obesity and at risk for overweight can be found in the literature. Even when the same term is used (e.g. "overweight") the meaning of that term may not be the same in different countries or across studies. Whatever the terminology used, definitions are generally based on weight and not on adiposity per se. In children, it is unclear what risk-related criteria to use to determine risk-based definitions of overweight or obesity. As a result, statistical definitions based on the 85th and 95th percentiles of sex specific BMI-for-age in a specified reference population are often used in childhood (Barlow and Dietz 1998; Himes and Dietz 1994; Krebs et al. 2007).

Many reference data sets for childhood BMI exist and BMI reference data are used or recommended as part of monitoring of children's growth in many countries (Cole et al. 1998). Reference data are usually based on representative data from a given country, although the World Health Organization charts (for those under 5 years of age) are based on a different approach. They were created from healthy, breastfed children from around the world and are intended to present a standard of physiologic growth and not a descriptive reference (WHO 2006). In this chapter, the CDC 2000 growth charts (Kuczmarski et al. 2002), developed from five US nationally representative

surveys (the National Health Examination Surveys II and III in the 1960s, the National Health and Nutrition Examination Surveys (NHANES) I and II in the 1970s, and, for children under 6 years, NHANES III, 1988–1994), were used to define high BMI. These charts represent a revision of the 1977 NCHS growth charts (Hamill et al. 1977).

The choice of cut-off points within the reference population depends upon what assumptions are made. Expert committees in the United States have recommended using a BMI-for-age at or above the 95th percentile of a specified reference population to screen for "overweight" (Barlow and Dietz 1998; Himes and Dietz 1994) and, more recently, have recommended that this cut-off be labeled "obesity" (Krebs et al. 2007) in adolescents and younger children. Similarly, children with BMI values between the 85th and 95th percentiles were considered "at risk for overweight" but, more recently have been labeled "overweight" by expert committees. In this chapter, we focus on one level of high BMI; at or above the 95th percentile on the 2000 CDC growth charts. Throughout the text "high BMI" refers to BMI-for-age ≥95th percentile of the sex specific CDC growth charts consequently, all estimates from Canada, Mexico, and the US in the text are comparable to each other. Some tables and figures do include estimates of the prevalence of BMI-for-age between the 85th and 95th percentiles.

Prevalence and Trends

Prevalence estimates of high BMI-for-age are usually derived from surveys or population studies because systematic data cannot generally be gathered from medical records or vital statistics. Virtually all data on prevalence and trends are based on measurements of weight and height using the classifications described above rather than on body fat due to the logistical difficulties involved in making measurements of body fat in population studies.

In Canada, national survey data with measured heights and weights for children 2–19 years of age are currently available from two surveys: the 1978/1979 Canada Health Survey (CHS) and the 2004 Canadian Community Health Survey (CCHS). The CHS was one of Canada's first national surveys on the health status of its population and collected detailed assessments of physical health (Health and Welfare Canada, Statistics Canada 1981). The CCHS is designed to provide timely cross-sectional estimates of health determinants, health status and health system utilization in Canada and has been conducted on an ongoing basis since 2001. The household survey usually collects only self-reported information, however, in 2004 physical measures of height and weight were collected for all respondents as part of the survey's focus on nutritional status (Statistics Canada 2005). Both surveys were designed to provide nationally representative data using a stratified multistage cluster sampling design. In the CHS, nurses collected the height and weight measurements, while in the CCHS measures were collected by trained interviewers. In both surveys, measurements were collected in the home for children aged 2 years old and over. Recently the Canadian Health Measures Survey, modeled on the US NHANES, was launched to provide nationally representative direct physical measures data including anthropometry as well as blood and urine sampling. Data from this survey will be available in 2010 (Statistics Canada 2005) and will significantly improve Canada's ability to estimate trends in high BMI over time and across population sub-groups.

Table 5.1 shows the prevalence of high BMI in children and adolescents aged 2–19 years in Canada for 1978/1979 and 2004. There have been increases in high BMI in all age groups for girls and for boys aged 6–19 years old. Overall, for children aged 2–19 years, the prevalence of high BMI has more than doubled in Canada, from 6% in 1978/1979 to 12.3% in 2004. Approximately 14% of 2–5 year olds had BMI's greater than or equal to the 95th percentile on the CDC growth charts in 2004, while for 6–11 year olds and teens 12% were at or above this cut-point.

Data on high BMI among Mexican children are available from three national surveys conducted by the Secretary of Health in 1988 and the Mexican National Institute of Public Health in 1999 and 2006 (Olaiz et al. 2006; Resano-Pérez et al. 2003; Sepúlveda et al. 1990). The National Nutrition

Table 5.1 Prevalence and trends of high body mass index (BMI)-for-age[a] among children, aged 2–19 years, Canada excluding territories, 1978/1979[b] and 2004[c]

	2–19 years				2–5 years				6–11 years				12–19 years			
Survey	85th ≤ BMI <95th		BMI ≥ 95th		85th ≤ BMI <95th		BMI ≥ 95th		85th ≤ BMI <95th		BMI ≥ 95th		85th ≤ BMI <95th		BMI ≥ 95th	
Sex	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE
All																
1978/1979[b]	10.9	0.8	6.0	0.7	17.8	1.9	13.3	2.0	11.0	1.5	5.3[d]	1.5	8.1[d]	1.4	3.6[d]	0.8
2004[c]	15.7*	0.7	12.3*	0.5	16.5	1.6	13.7	1.3	15.5*	1.0	12.4*	1.0	15.6*	1.0	11.7*	0.7
Boys																
1978/1979[b]	12.5	1.4	6.9	1.0	21.5	3.4	18.1	2.7	14.1	2.3	3.6[d]	1.2	7.9	1.1	[e]	
2004[c]	15.7	0.9	13.8*	0.9	16.0	2.1	15.0	1.9	15.4	1.4	13.8*	1.6	15.7*	1.3	13.3*	1.2
Girls																
1978/1979[b]	9.2	1.5	5.0[d]	1.1	13.7[d]	4.6			7.9[d]	2.2			8.4[d]	2.3	2.9[d]	0.7
2004[c]	15.8*	0.9	10.8*	0.7	17.0	2.3	12.4[e]	1.7	15.6*	1.4	11.0[e]	1.3	15.5*	1.3	10.0*	1.1

*Significantly different from estimate for 1978/1979

[a]85th percentile ≤ BMI-for-age <95th percentile; BMI-for-age ≥ 95th percentile. BMI (body mass index) is weight in kilogram divided by height and meters squared. The 85th and 95th percentiles are based on the 2000 CDC growth charts and represent the revised version of the 1977 NCHS growth charts

[b]1978/1979 Canada Health Survey

[c]2004 Canadian Community Health Survey: Nutrition

[d]Use with caution (coefficient of variation between 16.6 and 33.3%)

[e]Too unreliable to be published (coefficient of variation greater than 33.3%)

Note: *SE* standard error

Survey in 1988, the National Nutrition Survey in 1999 and the National Health and Nutrition Survey in 2006 were national, cross-sectional, multi-stage, stratified and representative surveys of the country. The 1988 survey included boys and girls under 5 years of age and teenage girls while the 1999 survey included boys and girls under 12 years of age and teenage girls. In 2006, all children and teens under age 20 years were sampled. The surveys included measurements of weight and height.

Table 5.2 shows the prevalence of high BMI in 1988, 1999 and 2006. Significant increases have occurred for both boys and girls between 1999 and 2006. Among school-age children 6–11 years of age 8.9% were at or above the 95th percentile of BMI-for-age in 1999 while in 2006 15% were at this level. The prevalence among teenage girls rose from 5.6 to 10.1% over the same period.

In the US, the NHANES program provides national estimates of high BMI-for-age for adolescents and children. A series of cross-sectional, nationally representative examination surveys conducted by the National Center for Health Statistics of the CDC, the NHANES surveys were designed using stratified multistage probability samples (CDC 2009). The program began in the 1960s and was periodically conducted until 1999 when it became a continuous survey. Currently, NHANES includes over sampling of Mexican Americans and African Americans, among other groups, in order to improve estimates for these groups. All of the surveys included a standardized physical examination in a mobile examination center with measurement of stature and weight in children 2 years and older (National Center for Health Statistics 1994; McDowell et al. 1981; Miller 1973).

Estimates of the prevalence of high BMI in the US for children and adolescents between the early 1960s and 2006 are shown in Table 5.3. After little change was seen in the 1960s and 1970s there was an increase between NHANES II and NHANES III and a further increase between NHANES III and NHANES 1999–2000. Between 1999–2000 and 2005–2006, however, there was no significant trend (Ogden et al. 2008). As seen in Table 5.3, there was a significant trend ($P < 0.05$) for the entire time period (1960s–2006). In 2005–2006 over 17% of teens (12–19 years of age) were at or above the 95th percentile on the BMI-for-age growth charts while 15.1% of 6–11 and 11.0% of 2–5 year olds were at or above the same cut-point.

Figure 5.1 shows the prevalence of high BMI for Canada, Mexico and the US together. The most recent prevalence of high BMI among girls, but not boys, was significantly higher in the US compared to Mexico although no significant differences were found in the prevalence of high BMI between Canada and the US for the total population, boys or girls.

Distribution of Body Mass Index

Changes in the prevalence of high BMI do not present a complete picture of the trends in BMI. A more complete picture can be seen in the smoothed distributions of BMI between two time periods. In Canada this is depicted with data for adolescents aged 12–19 year olds for 1978/1979 and 2004. The mean BMI rose from 21.0 to 22.6 kg/m^2 between these two time periods resulting in a shift in the BMI distribution toward higher BMIs (Fig. 5.2). This trend was most pronounced for those with BMIs at or higher than 25 or 30 kg/m^2, which corresponds to the cut-points used to classify adults as overweight or obese. For Mexico the picture is shown separately for 12–19 year old teen girls (Fig. 5.3), 6–11 year old children (Fig. 5.4) and 2–5 year old children (Fig. 5.5). A dramatic shift to the right can be seen among teen girls between 1988 and 2006. To a lesser extent a shift occurred among 6–11 year old children while among 2–5 year old children there has been a much smaller change in the distribution. For the US this picture is shown using data in 1976–1980 and 2003–2006 for teens 12–19 years of age. The distribution of BMI between NHANES II (1976–1980) and NHANES 2003–2006 has shifted to the right (Fig. 5.6), but the shift is greater at the upper percentiles of the distribution, indicating that the distribution has become more skewed and the heaviest individuals have gotten even heavier.

Table 5.2 Prevalence and trends of high body mass index (BMI)-for-age[a] among children, aged 2–19 years, Mexico, 1988[b], 1999[c] and 2006[d]

	2–19 years				2–5 years				6–11 years				12–19 years			
Survey	85th ≤ BMI <95th		BMI ≥ 95th		85th ≤ BMI <95th		BMI ≥ 95th		85th ≤ BMI <95th		BMI ≥ 95th		85th ≤ BMI <95th		BMI ≥ 95th	
Sex	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE
All																
1988[e]	–	–	–	–	11.5	0.6	10.4	0.8	–	–	–	–	–	–	–	–
1999	–	–	–	–	16.8	0.6	10.6	0.5	12.5	0.5	8.9	0.4	–	–	–	–
2006	15.4	0.3	12.4	0.4	13.6*	0.7	11.0	0.6	15.0*	0.6	14.6*	0.5	16.6	0.5	11.5	0.5
Boys																
1988[e]	–	–	–	–	12.1	0.9	10.9	0.9	–	–	–	–	–	–	–	–
1999	–	–	–	–	16.2	0.8	11.3	0.7	12.6	0.7	9.3	0.6	–	–	–	–
2006	14.4	0.4	14.0	0.5	13.0*	0.8	12.3	0.9	14.8*	0.8	16.6*	0.7	14.8	0.7	12.9	0.9
Girls																
1988[e]	–	–	–	–	10.8	0.8	10.0	1.3	–	–	–	–	6.8	0.4	2.3	0.3
1999	15.6	0.4	7.7	0.3	17.5	0.9	9.9	0.7	12.4	0.7	8.6	0.6	17.2	0.7	5.6	0.5
2006	16.4	0.5	10.9*	0.4	14.2*	1.1	9.6	0.8	15.1*	0.7	12.7*	0.8	18.3	0.7	10.1*	0.6

*Significantly different ($P < 0.05$) from estimate for 1999

[a]85th percentile ≤ BMI-for-age <95th percentile; BMI-for-age ≥95th percentile. BMI (body mass index) is weight in kilogram divided by height and meters squared. The 85th and 95th percentiles are based on the 2000 CDC growth charts and represent the revised version of the 1977 NCHS growth charts

[b]Mexican National Nutrition Survey 1988 (ages <5 years and teenage girls)

[c]Mexican National Nutrition Survey 1999 (ages <12 years and teenage girls)

[d]Mexican National Health and Nutrition Survey 2006 (ages <20 years)

[e]For pre-school children the group is 2–4 years of ages

Note: *SE* standard error

Table 5.3 Prevalence and trends* of high body mass index (BMI)-for-age[a] among children, age 2–19 years, United States, 1960–2006

	2–19 years				2–5 years				6–11 years				12–19 years			
	85th≤BMI <95th		BMI≥95th		85th≤BMI <95th		BMI≥95th		85th≤BMI <95th		BMI≥95th		85th≤BMI <95th		BMI≥95th	
Survey[b]	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE
All																
1963–1965									8.8	0.4	4.3	0.4				
1966–1970[c]													9.7	0.4	4.6	0.3
1971–1974	10.4	0.6	5.1	0.3	10.9	1.1	4.8	0.6	10.0	0.8	4.0	0.5	10.5	0.8	6.1	0.6
1976–1980	9.2	0.4	5.5	0.4	9.2	0.5	5.0	0.6	9.0	0.9	6.5	0.7	9.2	0.6	5.0	0.5
1988–1994	13.0	0.7	10.0	0.5	10.9	0.6	7.2	0.7	13.5	1.0	11.3	1.0	13.8	1.1	10.5	0.9
1999–2000	14.3	0.9	13.9	0.9	11.7	1.2	10.3	1.7	14.7	2.0	15.1	1.4	15.2	1.2	14.8	0.9
2001–2002	14.6	0.6	15.4	0.9	12.8	1.3	10.6	1.8	15.9	1.0	16.3	1.6	14.4	1.0	16.7	1.1
2003–2004	16.5	0.8	17.1	1.3	12.3	1.4	14.0	1.6	18.5	1.4	18.8	1.3	17.0	1.4	17.4	1.7
2005–2006	14.6	0.9	15.5	1.3	11.6	1.7	11.0	1.2	14.3	1.8	15.1	2.1	16.2	1.0	17.8	1.8
Boys																
1963–1965									8.3	0.6	4.0	0.4				
1966–1970[c]													9.4	0.6	4.5	0.4
1971–1974	10.5	0.8	5.2	0.5	12.3	1.3	4.9	0.8	10.6	1.3	4.3	0.8	9.7	1.2	6.0	0.8
1976–1980	9.4	0.6	5.4	0.4	8.2	0.7	4.6	0.6	9.7	1.1	6.7	0.8	9.5	1.0	4.8	0.5
1988–1994	12.6	0.9	10.2	0.7	10.7	1.0	6.2	0.8	13.7	1.5	11.6	1.3	12.7	1.4	11.3	1.3
1999–2000	15.0	1.9	14.0	1.2	12.5	2.2	9.5	2.3	16.2	3.2	15.8	1.8	15.2	1.6	14.8	1.3
2001–2002	14.2	0.6	16.4	1.0	13.5	1.6	10.7	2.4	15.1	1.4	17.5	1.9	13.9	1.7	17.6	1.3
2003–2004	16.6	1.0	18.2	1.5	12.2	2.3	15.1	1.7	16.6	1.8	19.9	2.0	18.5	1.5	18.2	1.9
2005–2006	14.7	1.2	15.9	1.5	13.3	2.6	10.5	1.7	15.2	2.2	16.2	2.5	14.9	1.4	18.2	2.4
Girls																
1963–1965									9.3	0.5	4.5	0.6				
1966–1970[c]													10.1	0.6	4.7	0.3
1971–1974	10.2	0.8	5.0	0.4	9.4	1.2	4.8	0.8	9.3	1.2	3.6	0.6	11.2	1.3	6.2	0.8
1976–1980	9.0	0.6	5.7	0.6	10.3	0.9	5.4	1.0	8.2	1.3	6.4	1.0	9.0	0.8	5.3	0.8
1988–1994	13.4	0.9	9.8	0.8	11.0	0.9	8.2	1.0	13.2	1.5	11.0	1.4	15.0	1.6	9.7	1.1
1999–2000	13.6	0.8	13.8	1.1	11.0	1.8	11.2	2.5	13.1	1.6	14.3	2.1	15.2	1.9	14.8	1.0
2001–2002	15.0	0.9	14.3	1.3	12.3	1.8	10.5	1.8	16.7	1.7	14.9	2.4	14.9	1.2	15.7	1.9

Table 5.3 (continued)

	2–19 years				2–5 years				6–11 years				12–19 years			
	85th≤BMI <95th		BMI≥95th		85th≤BMI <95th		BMI≥95th		85th≤BMI <95th		BMI≥95th		85th≤BMI <95th		BMI≥95th	
Survey[b]	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE
2003–2004	16.5	0.9	16.0	1.4	12.5	1.8	12.8	2.5	20.4	2.5	17.6	1.3	15.3	1.9	16.4	2.3
2005–2006	14.5	0.9	15.0	1.5	9.8	1.6	11.5	1.2	13.3	2.1	14.1	2.4	17.6	1.4	17.3	2.1

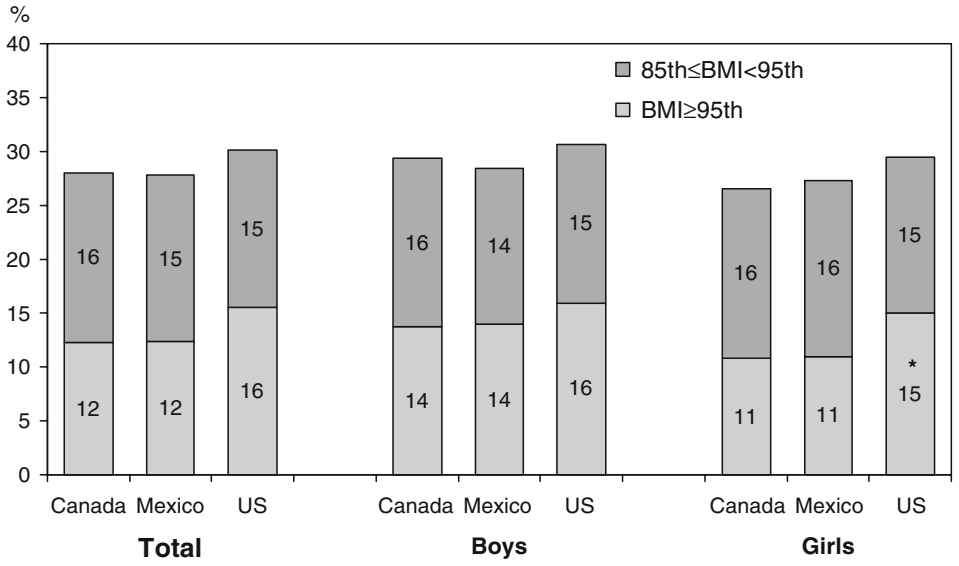
*Significant increasing trend for all trends (total, boys, girls at each BMI level) ($P<0.05$)

[a]85th percentile ≤ BMI-for-age <95th percentile; BMI-for-age ≥95th percentile. BMI (body mass index) is weight in kilogram divided by height and meters squared. The 85th and 95th percentiles are based on the 2000 CDC growth charts and represent the revised version of the 1977 NCHS growth charts

[b]US National Health Examination Survey (1963–1965; 1966–1970); National Health and Nutrition Examination Survey (I, 1971–1974; II, 1976–1980; III, 1988–1994; 1999–2000; 2001–2002; 2003–2004; 2005–2006)

[c]1966–1970: 12–17 years

Note: *SE* standard error



* Significantly different from estimate for Mexico ($P < 0.05$)

Fig. 5.1 Prevalence of high body mass index (BMI)-for-age among children aged 2–19 years, Canada (2004), Mexico (2006) and United States (2005–2006). *Sources*: 2004 Canadian Community Health Survey: Nutrition; Mexican National Health and Nutrition Survey 2006; US National Health and Nutrition Examination Survey 2005–2006

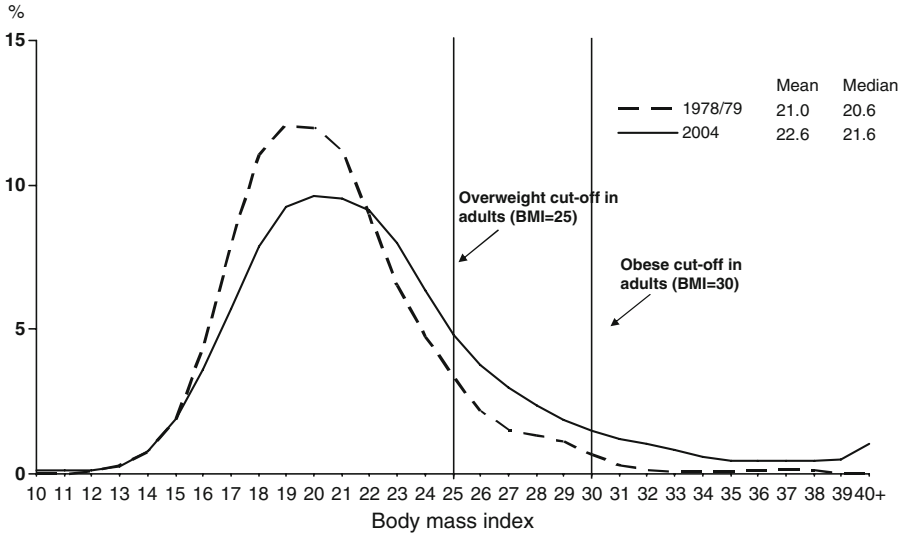


Fig. 5.2 Percentage distribution of children aged 12–19 years, by body mass index (BMI), Canada excluding territories, 1978/1979 and 2004. *Sources*: 2004 Canadian Community Health Survey: Nutrition; 1978/1979 Canada Health Survey

Socio-Demographic Differences

Although high BMI is a problem for the general population, some sub-groups of the population experience a greater prevalence than other groups. Prevalence estimates may vary by race/ethnic group, sex, age group, income, and/or education level. Moreover, the classifications used to define race/ethnic groups, income or education levels may vary between countries. The results shown below reflect the usual sub-group classifications made in Canada, Mexico and the US.

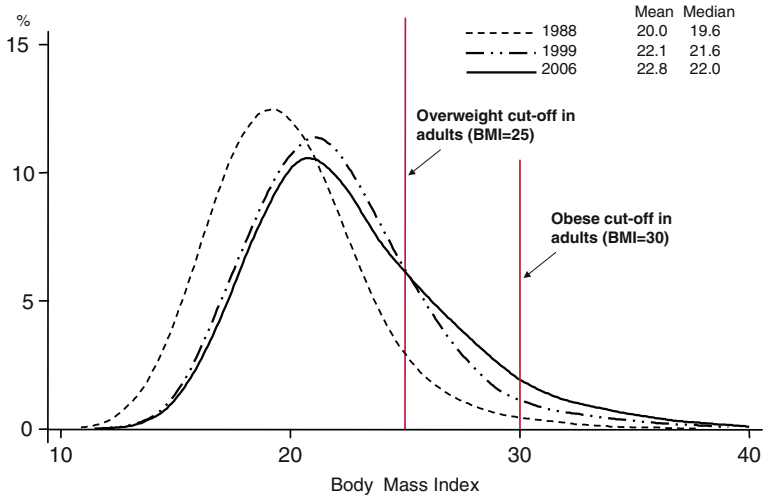


Fig. 5.3 Percentage distribution of girls aged 12–19 years, by body mass index (BMI), Mexico, 1988, 1999 and 2006. *Sources*: 1988 Mexican National Nutrition Survey; 1999 Mexican National Nutrition Survey; 2006 Mexican National Health and Nutrition Survey

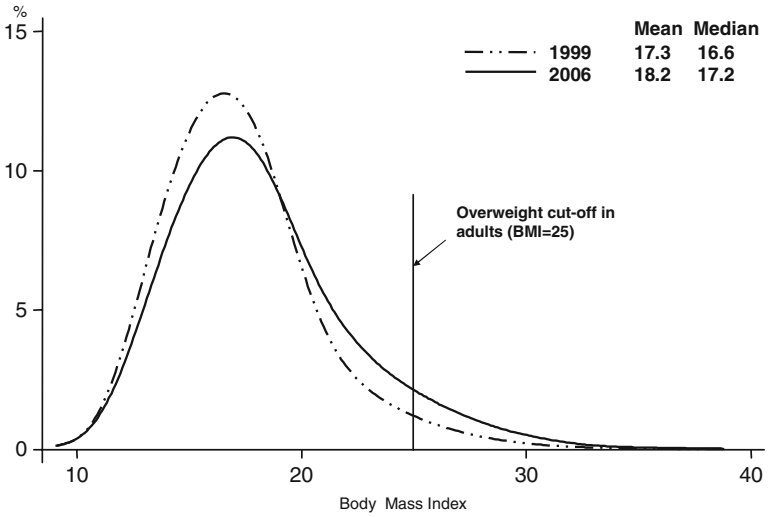
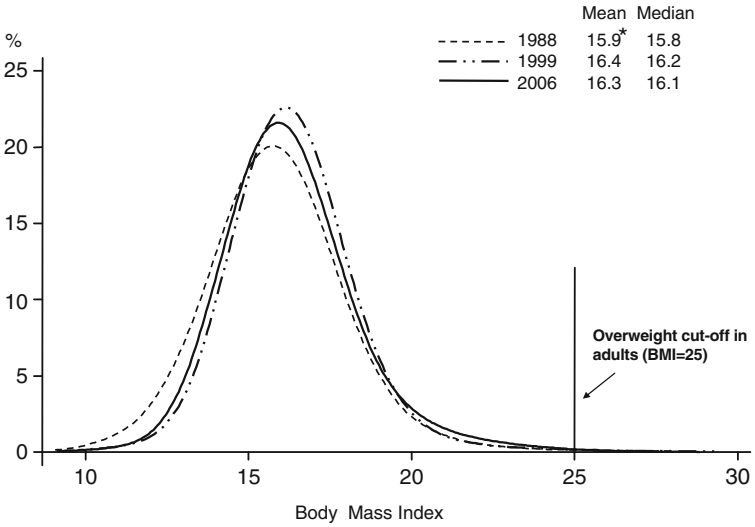


Fig. 5.4 Percentage distribution of children aged 6–11 years, by body mass index (BMI), Mexico, 1999 and 2006. *Sources*: 1999 Mexican National Nutrition Survey; 2006 Mexican National Health and Nutrition Survey

Race/Ethnicity

In the Canadian data, race and ethnicity were classified into four groups including: Whites, Blacks, Off-reserve Aboriginal children (North American Indian, Métis or Inuit), and Southeast/East Asians, with an "Other" category to capture the remainder of the population. Off-reserve Aboriginal children and youth were the most likely to have high BMI, with 25% being at or above the 95th percentile of BMI-for-age (Table 5.4). These numbers were significantly higher than the overall prevalence estimates for the total population (12% at or above the 95th percentile). The CCHS does not sample Aboriginal children living on reserves so no estimates are available for this group.



* Two to four age group only

Fig. 5.5 Percentage distribution of children aged 2–5 years, by body mass index (BMI), Mexico, 1988, 1999 and 2006. *Sources*: 1988 Mexican National Nutrition Survey; 1999 Mexican National Nutrition Survey; 2006 Mexican National Health and Nutrition Survey

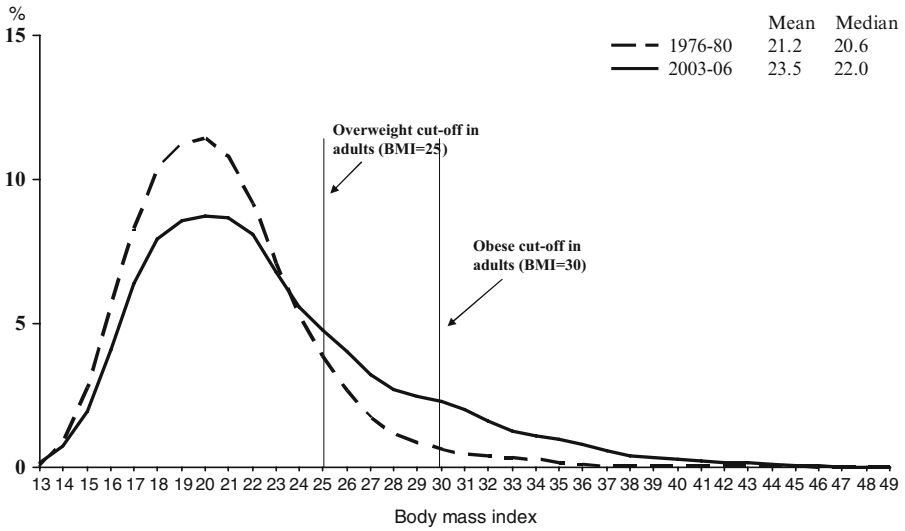


Fig. 5.6 Percentage distribution of adolescents ages 12–19 years, by body mass index (BMI), US, 1976–1980 and 2003–2006. *Sources*: US National Health and Nutrition Examination Survey II 1976–1980; US National Health and Nutrition Examination Survey 2003–2006

For Mexico, ethnic differences based on non-indigenous and indigenous classifications are shown in Table 5.5. Indigenous is defined as anyone living in a household where at least one person speaks an indigenous language. The prevalence is significantly higher among the non-indigenous children compared to the indigenous children. More than 13% of non-indigenous children and teens 2–19 years of age were at or above the 95th percentile of BMI-for-age in 2006 compared to 7.2% of indigenous children and teens.

Table 5.4 Prevalence of high body mass index (BMI)-for-age[a] among children aged 2–19 years by race/ethnicity, Canada excluding territories, 2004[b]

		BMI ≥ 85th		85th ≤ BMI <95th		BMI ≥ 95th	
Race/ethnicity	*n*	Percent	SE	Percent	SE	Percent	SE
Total	9,539	28	0.8	15.7	0.7	12.3	0.5
White	8,108	28.6	0.9	16.1	0.7	12.5	0.6
Black	135	33.8[c]	0.6	16.4[c]	4.4	17.4[c]	4.9
Southeast/East Asian	359	16.7*[,c]	2.7	7.8*[,c]	1.8	8.9[c]	0.2
Off-reserve Aboriginal	290	42.8*	5.5	17.5[c]	3.9	25.3*[,c]	4.6
Other	646	26.5	2.6	17.1	2.2	9.4	1.5

* Significantly different from estimate for total ($P < 0.05$)

[a] BMI-for-age ≥85th percentile; 85th percentile ≤ BMI-for-age <95th percentile; BMI-for-age ≥95th percentile. BMI (body mass index) is weight in kilogram divided by height and meters squared. The 85th and 95th percentiles are based on the 2000 CDC growth charts and represent the revised version of the 1977 NCHS growth charts

[b] 2004 Canadian Community Health Survey: Nutrition

[c] Use with caution (coefficient of variation between 16.6 and 33.3%)

In 2003–2006, there were large disparities by race-ethnicity in the US (Table 5.6). Among girls, non-Hispanic Blacks were significantly more likely to have high BMI compared to non-Hispanic Whites and the prevalence of high BMI was significantly higher in Mexican American girls 6–11 years than in non-Hispanic White girls of the same age group. Among boys, Mexican Americans were more likely to have high BMI compared to non-Hispanic White boys.

A comparison between the majority populations (White) in Canada and the US shows an insignificant difference in prevalence of high BMI among children and teens 2–19 years of age. In Canada, 12.5% (SE = 0.6) had high BMI compared to 14.7% (SE = 1.3) in the US. A comparison between the prevalence of high BMI in Mexico among the non-indigenous majority group with that among Mexican Americans (a minority group) in the US, however, shows a significant difference ($P < 0.05$). In Mexico 13.1% (SE = 0.4) of 2–19 years old had a high BMI while 20.9% (SE = 1.3) of Mexican American children in the US were above the same cut-point.

Sex and Age

Demographic differences in prevalence of high BMI can be seen in the most recent data from Mexico and the US. In Mexico in 2006, the prevalence of high BMI was significantly higher among boys than girls 2–19 years of age ($P < 0.0001$) (Table 5.5). This was true for 2–5 year old children, 6–11 year old children and 12–19 year old teens. In the US in 2003–2006, the prevalence of high BMI increased with age (Table 5.6). The highest prevalence was among school-age children and adolescents; 12.5% of pre-school age children 2–5 years, 17.0% of school-age children 6–11 years and 17.6% of adolescents 12–19 years were at or above the 95th percentile of BMI-for-age in 2003–2006. Unlike in the US, in Canada in 2004 (Table 5.1) and in Mexico (Table 5.5) the differences across age groups for either sex were not significant.

Socio-Economic Status

Body size is often associated with socio-economic status. However, the magnitude and the direction of the association tend to differ by level of economic development, sex and race/ethnicity

Table 5.5 Prevalence of high body mass index (BMI)-for-age[a] among children age 2–19 years by age and ethnicity, Mexico, 2006[b]

					Ethnicity					
		Total			Non-Indigenous			Indigenous		
Sex	Age (years)	*n*	Percent	SE	*n*	Percent	SE	*n*	Percent	SE
All	2–19	34,832	12.4	0.4	30,809	13.1*	0.4	4,023	7.2	0.7
	2–5	7,126	11.0	0.6	6,321	11.0	0.6	805	10.6[c]	2.4
	6–11	13,132	14.6	0.5	11,503	15.6*	0.6	1,629	7.5	1.1
	12–19	14,574	11.5	0.5	12,985	12.3*	0.6	1,589	5.3	0.7
Boys	2–19	17,290	14.0	0.5	15,331	14.7*	0.6	1,959	8.3	1.0
	2–5	3,621	12.3	0.9	3,224	12.4	0.9	397	11.8[c]	2.7
	6–11	6,575	16.6	0.7	5,768	17.6*	0.8	807	9.3[c]	1.8
	12–19	7,094	12.9	0.9	6,339	13.8*	1.0	755	5.8[c]	1.1
Girls	2–19	17,542	10.9	0.4	15,478	11.5*	0.5	2,064	6.1[c]	1.0
	2–5	3,505	9.6	0.8	3,097	9.7	0.7	408	[d]	
	6–11	6,557	12.7	0.8	5,735	13.7*	0.9	822	5.9[c]	1.0
	2–19	7,480	10.1	0.6	6,646	10.8*	0.7	834	4.7[c]	0.9

*Significantly different from estimate for Non-Indigenous versus Indigenous groups

[a] BMI-for-age ≥95th percentile. BMI (body mass index) is weight in kilogram divided by height and meters squared. The 95th percentile is based on the 2000 CDC growth charts and represent the revised version of the 1977 NCHS growth charts

[b] Mexican National Health and Nutrition Survey 2006

[c] Use with caution (coefficient of variation between 16.6 and 33.3%)

[d] Too unreliable to be published (coefficient of variation greater than 33.3%)

Table 5.6 Prevalence of high body mass index (BMI)-for-age[a] among children age 2–19 years by age and race/ethnicity, US, 2003–2006[b]

					Race-ethnicity								
		Total			Non-Hispanic White			Non-Hispanic Black			Mexican American		
Sex	Age (years)	*n*	Percent	SE	*n*	Percent	SE	*n*	Percent	SE	*n*	Percent	SE
All	2–19	8,168	16.3	0.9	2,195	14.7	1.3	2,696	20.7	1.0	2,583	20.9	1.3
	2–5	1,771	12.5	1.0	498	10.8	1.6	517	14.9	1.3	558	16.7	2.3
	6–11	2,096	17.0	1.3	558	15.0	1.9	673	21.3	1.8	671	23.7	2.0
	12–19	4,301	17.6	1.2	1,139	16.0	1.7	1,506	22.9	1.1	1,354	21.1	1.4
Boys	2–19	4,118	17.0	1.1	1,113	15.6	1.5	1,397	17.4	1.0	1,279	23.2	1.6
	2–5	875	12.8	1.2	260	11.1	2.2	254	13.3	2.5	269	18.8	2.8
	6–11	1,013	18.0	1.7	265	15.5	2.8	335	18.6	2.6	321	27.5*	2.1
	12–19	2,230	18.2	1.5	588	17.3	2.0	808	18.4	1.3	689	22.1	2.2
Girls	2–19	4,050	15.5	1.1	1,082	13.7	1.4	1,299	24.1	1.3	1,304	18.4	1.5
	2–5	896	12.2	1.4	238	10.4	2.0	263	16.6	2.3	289	14.5	2.7
	6–11	1,083	15.8	1.4	293	14.4	2.1	338	24.0*	2.0	350	19.7	2.6
	12–19	2,071	16.8	1.5	551	14.5	2.0	698	27.7*	1.9	665	19.9*	1.4

* Significantly different from estimate for non-Hispanic Whites ($P < 0.05$) with Bonferroni correction

[a] BMI-for-age ≥95th percentile. BMI (body mass index) is weight in kilogram divided by height and meters squared. The 95th percentile is based on the 2000 CDC growth charts and represent the revised version of the 1977 NCHS growth charts

[b] National Health and Nutrition Examination Survey 2003–2006

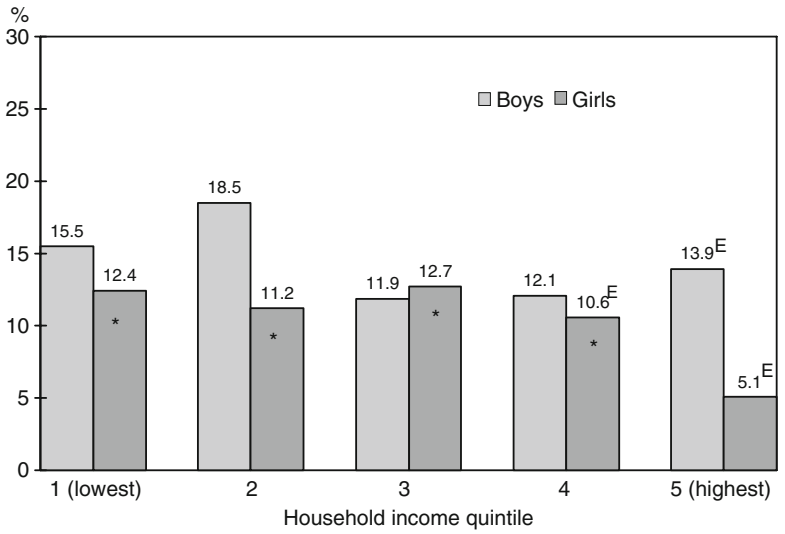
(Cassidy 1991; Chang and Lauderdale 2005; Sobal and Stunkard 1989). In less developed countries, higher weight may be associated with wealth and prosperity, and there may be a positive association between socio-economic status and body size for both men and women. Historically in many contexts, greater body size, including tallness, increased muscularity and increased fatness, has symbolized power, dominance, wealth or high social standing. For men in developed countries, height is positively associated with socio-economic status but weight and BMI tend to be weakly, if at all, associated with socio-economic status. For women in developed countries, however, weight and BMI have a strong inverse association with socio-economic status. The slender body that in the past might have reflected economic deprivation, limited access to food, or the necessity for hard physical labor now may require expenditures of time, money and effort to achieve. The finding in several studies that obesity is negatively predictive of subsequent education and earnings for women but not for men may reflect the stronger association between obesity and low socio-economic status at baseline for women than for men (Gortmaker et al. 1993; Sargent and Blanchflower 1994). The relationship between socio-economic status and weight in children is less well studied and less consistent.

The prevalence of high BMI according to household income quintiles for Canadian children and youth 2–19 years of age is provided in Fig. 5.7. Household income quintiles were derived by dividing total household income from all sources in the previous 12 months by Statistics Canada's Low Income Cut-Off (LICO) specific to the number of people in the household and the size of the community. This provides, for each respondent, a relative measure of their household income to the household incomes of all other respondents. There is no significant relationship between household income and high BMI for Canadian boys, but for girls the prevalence of high BMI was significantly lower in the highest income quintile compared to all other quintiles.

In Mexico, the prevalence of high BMI is significantly higher among boys 2–19 years of age in the highest household living conditions quintile compared to the first, second and third quintiles (Fig. 5.8). Among girls, those in the lowest quintile had a significantly lower prevalence of high BMI compared to those in the highest quintile. The living conditions score was computed using household characteristics and possession of goods through principal components analysis (PCA). We used the first component of the PCA which explained 46% of the variance. The variables in the model were floor material, ceiling material, total number of rooms in the household, possession of refrigerator, washing machine and stove as well as the number of electric appliances in the household (radio, TV, video player, telephone, and computer). The living conditions score was divided into quintiles to categorize the wellbeing condition; thus, subjects in quintile 1 had the lowest living condition and quintile 5 the highest condition.

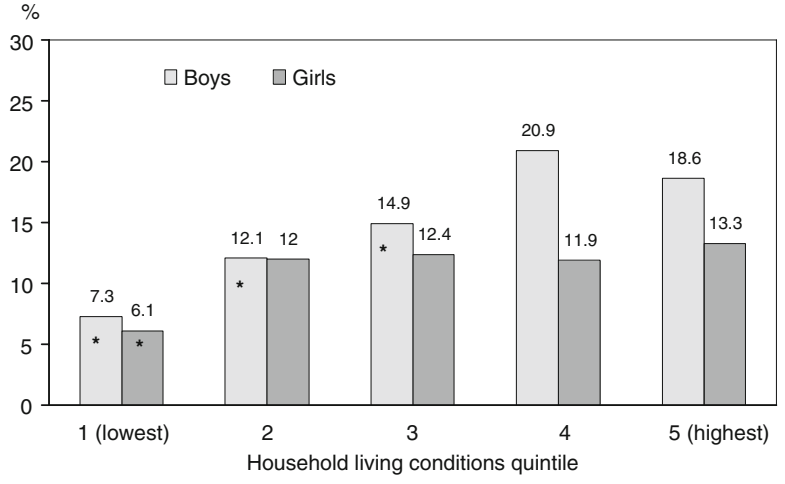
Figures 5.9 and 5.10 contain estimates of the prevalence of high BMI among US children 2–19 years of age by poverty income ratio (PIR) quintile. Results are shown for total boys and total girls to be comparable to results from Canada and Mexico. Results are also shown by race/ethnic group because differences in the relationship between PIR and high BMI prevalence have been reported (Ogden et al. 2007). PIR is the ratio of household income to the poverty threshold, as defined by the US Census Bureau appropriate for family size. Poverty thresholds are updated for changes in prices but do not take into account differences in cost of living around the country. In the US, the prevalence of high BMI was significantly higher among all boys and non-Hispanic Black boys in the lowest PIR quintile (first) compared to the highest (fifth) quintile. Among all boys and non-Hispanic White boys in the second quintile the prevalence of high BMI was higher compared to the highest (fifth) PIR quintile. Among girls only one significant difference was found, all girls in the lowest PIR quintile had a higher prevalence than all girls in the highest PIR quintile. Nonetheless, there are no significant trends (quadratic or linear) in the prevalence of high BMI by PIR quintile.

Socio-economic status can also be assessed by education level. Table 5.7 depicts the prevalence estimates of high BMI according to the highest level of education in the household in Canada. Although there was a trend of decreasing BMI with increasing education, the only significant association was found for those with BMIs ≥ the 85th percentile. At this lower cut-point, the prevalence



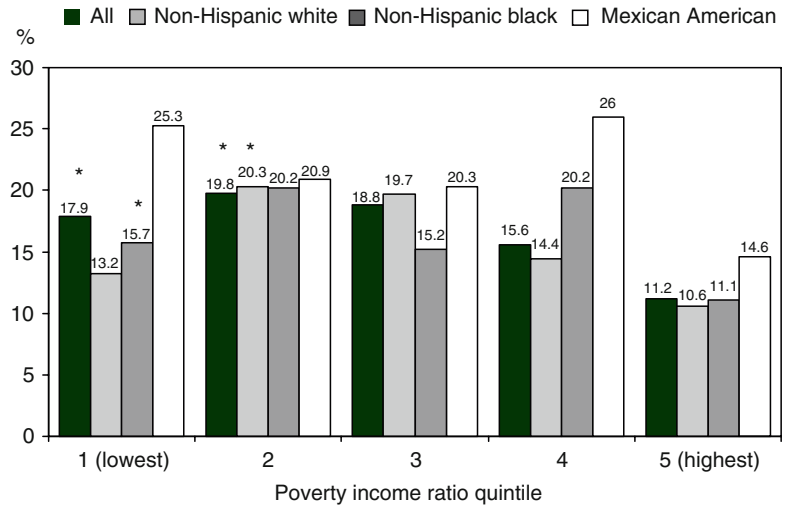
* Significantly different from estimate for quintile 5 ($P < 0.05$)

Fig. 5.7 Prevalence of high body mass index (BMI)-for-age (BMI ≥ 95th percentile) among children aged 2–19 years, by household income (total household income from all sources in previous 12 months divided by Statistics Canada's Low Income Cut-Off specific to number of people in household and size of community), Canada excluding territories, 2004. *E* use with caution (coefficient of variation between 16.6 and 33.3%). *Source*: 2004 Canadian Community Health Survey: Nutrition



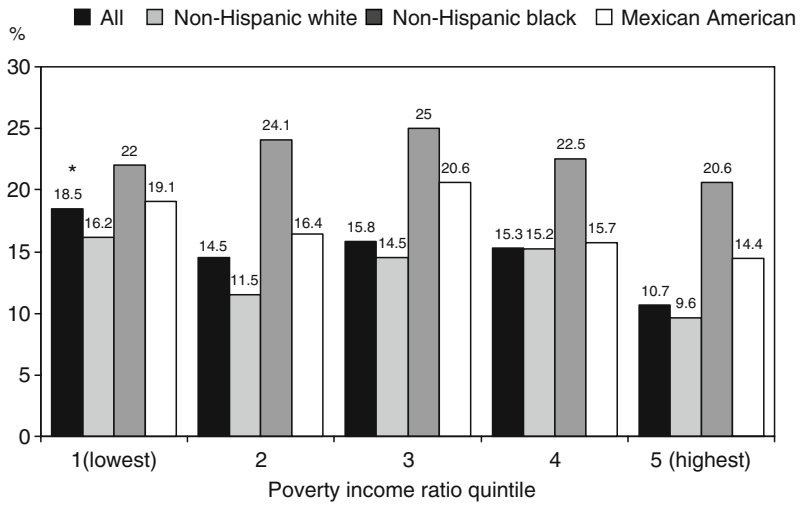
* Significantly different from estimate for quintile 5 ($P < 0.05$)

Fig. 5.8 Prevalence of high body mass index (BMI)-for-age (BMI ≥ 95th percentile) among children aged 2–19 years, by household living conditions (household living conditions derived using Principal Components Analysis which included housing characteristics and possession of goods) in Mexico, 2006. *Source*: Mexican National Health and Nutrition Survey 2006



* Significantly different from estimate for quintile 5 ($P < 0.05$) with Bonferroni correction

Fig. 5.9 Prevalence of high body mass index (BMI)-for-age (≥ 95th percentile) among boys aged 2–19 years, by poverty income ratio (ratio of household income to the poverty threshold accounts for family size and inflation) and race/ethnicity, United States, 2001–2006. *Source*: US National Health and Nutrition Examination Survey, 2001–2006



* Significantly different from estimate for quintile 5 ($P < 0.05$) with Bonferroni correction

Fig. 5.10 Prevalence of high body mass index (BMI)-for-age (BMI ≥ 95th percentile) among girls aged 2–19 years, by poverty income ratio (ratio of household income to the poverty threshold accounts for family size and inflation) and race/ethnicity, United States, 2001–2006. *Source*: US National Health and Nutrition Examination Survey, 2001–2006

Table 5.7 Prevalence of high body mass index (BMI)-for-age[a] among children aged 2–19 years by sex and highest level of education in household, Canada excluding territories, 2004[b]

		BMI ≥ 85th		85th ≤ BMI < 95th		BMI ≥ 95th	
	n	Percent	SE	Percent	SE	Percent	SE
All	9,539	28	0.8	15.7	0.7	12.3	0.5
Secondary graduation or less	1,813	32.5*	1.8	18.2	1.6	14.3	1.3
Some postsecondary	738	29	3.2	16.6	2.7	12.4	1.9
Postsecondary graduation	6,835	26.9	0.9	15	0.7	11.9	0.6
Boys	4,736	29.4	1.2	15.7	0.9	13.8	0.9
Secondary graduation or less	898	34.9*	2.7	20.4*	2.5	14.5	2.0
Some postsecondary	363	29.7[c]	5.0	15.3[c]	4.3	14.4[c]	3.1
Postsecondary graduation	3,398	28.3	1.4	14.8	1.0	13.5	1.0
Girls	4,803	26.6	1.1	15.8	0.9	10.8	0.7
Secondary graduation or less	915	29.9	2.4	15.9	2.1	14.0	1.9
Some postsecondary	375	28.2	3.8	17.9[c]	3.3	10.3[c]	2.1
Postsecondary graduation	3,437	25.5	1.3	15.3	1.0	10.2	0.9

*Significantly different from estimate for postsecondary graduation ($P < 0.05$)

[a] BMI-for-age ≥85th percentile; 85th percentile ≤ BMI-for-age <95th percentile; BMI-for-age ≥95th percentile. BMI (body mass index) is weight in kilogram divided by height and meters squared. The 85th and 95th percentiles are based on the 2000 CDC growth charts and represent the revised version of the 1977 NCHS growth charts

[b] 2004 Canadian Community Health Survey: Nutrition

[c] Use with caution (coefficient of variation between 16.6 and 33.3%)

of BMI ≥85th percentile for those living in a household where the highest level of education was a postsecondary degree (college or university) was significantly lower than for those where the highest educational attainment was secondary school or less.

In Mexico, there were significant differences in prevalence of high BMI (BMI ≥95th percentile) among boys (but not girls) by the education level of the household head. Boys in households where the head had more than a high school education were significantly more likely to have high BMI compared to those in households where the head of household had less than a high school education (Table 5.8).

Table 5.9 contains prevalence estimates of high BMI by categories of education of the household head by sex and race/ethnicity in the US. The prevalence of high BMI among non-Hispanic Black girls in households with greater than a high school education was significantly lower than the prevalence in households with only a high school education. This was the only significant difference found when comparing prevalence estimates between households with greater than a high school education to households with less education.

Although socio-economic status is measured differently in each country, the relationship between socio-economic status and high BMI among children and teens 2–19 years of age appears to be different in Mexico compared to Canada and the US. In Mexico, the relationship between household living conditions and high BMI is positive among both boys and girls while in Canada there is an inverse relationship between household income and high BMI only among girls. In the US, the relationship is not so clear. Among girls there was a significant difference between quintile groups only when analyzing the entire population but not when looking at race/ethnic groups separately. Among boys, non-Hispanic Whites and non-Hispanic Blacks in the lower PIR quintiles were significantly more likely to have high BMI compared to the highest PIR quintile. There were no significant trends within group. Analyses of high BMI based on education of household head show slight relationships that are not consistent across countries. In Canadian boys, a significant inverse relationship was found only at the BMI level between the 85th and 95th percentiles. In Mexican boys, there was a significant positive relationship between high BMI and education of household head while in the US, non-Hispanic Black girls in households with greater than a high school education were less likely to have high BMI compared to those in households with only a high school education.

Table 5.8 Prevalence of high body mass index (BMI)-for-age[a] among children age 2–19 years by sex, education level of household head and Ethnicity, Mexico, 2006[b]

					Ethnicity					
		Total			Non-Indigenous			Indigenous		
Sex	Education	*n*	Percent	SE	*n*	Percent	SE	*n*	Percent	SE
All	Total	34,633	12.4	0.4	30,637	13.1	0.4	3,996	7.1	0.8
	<High school	28,199	11.6	0.4	24,505	12.3	0.4	3,694	6.8	0.8
	High school	4,037	16.8	1.5	3,854	17.0	1.5	183	12.0[c]	2.9
	>High school	2,397	14.6	1.0	2,278	14.7	1.0	119	12.2[c]	3.6
Boys	Total	17,203	14.0	0.5	15,250	14.8	0.6	1,953	8.3	1.0
	<High school	13,935	12.6*	0.5	12,132	13.4*	0.5	1,803	7.6	1.0
	High school	2,080	20.0	2.5	1,991	20.1	2.6	89	17.5[c]	4.8
	>High school	1,188	19.0	1.7	1,127	19.1	1.8	61	[d]	
Girls	Total	17,430	10.9	0.4	15,387	11.5	0.5	2,043	6.1[c]	1.0
	<High school	14,264	10.6	0.5	12,373	11.3	0.5	1,891	6.0[c]	1.0
	High school	1,957	13.5	1.3	1,863	13.7	1.3	94	[d]	
	>High school	1,209	10.4	1.2	1,151	10.5	1.3	58	[d]	

*Significantly different from estimate for more than high school education ($P<0.05$)

[a] BMI-for-age ≥95th percentile (BMI: body mass index, weight in kilograms divided by height in meters squared)

[b] National Health and Nutrition Survey 2005–2006

[c] Use with caution (coefficient of variation between 16.6 and 33.3%)

[d] Too unreliable to be published (coefficient of variation greater than 33.3%)

Note: *SE* standard error

Table 5.9 Prevalence of high body mass index (BMI)-for-age[a] among children age 2–19 years by sex, education level of household head and race/ethnicity, US, 2003–2006[b]

			Total		Non-Hispanic White			Non-Hispanic Black			Mexican American		
Sex	Education	*n*[c]	Percent	SE	*n*[c]	Percent	SE	*n*[c]	Percent	SE	*n*[c]	Percent	SE
All	Total	8,168	16.3	0.9	2,195	14.7	1.3	2,696	20.7	1.0	2,583	20.9	1.3
	<High school	2,553	18.9	1.3	247	16.2	3.2	802	21.4	1.2	1,343	22.5	1.3
	High school	1,956	19.3	1.6	607	18.5	1.9	651	25.0	2.2	532	18.8	2.8
	>High school	3,321	13.9	1.0	1,280	12.8	1.3	1,148	17.9	1.2	564	18.5	2.5
Boys	Total	4,118	17.0	1.1	1,113	15.6	1.5	1,397	17.4	1.0	1,279	23.2	1.6
	<High school	1,250	18.6	1.5	120	15.3	4.0	405	17.2	1.5	652	24.7	2.0
	High school	990	19.3	1.9	315	19.0	2.4	324	20.2	2.0	261	21.4	3.8
	>High school	1,699	15.3	1.5	653	14.3	1.8	617	16.6	1.5	278	19.8	2.3
Girls	Total	4,050	15.5	1.1	1,082	13.7	1.4	1,299	24.1	1.3	1,304	18.4	1.5
	<High school	1,303	19.2	1.9	127	17.1	4.7	397	25.6	2.0	691	20.2	2.0
	High school	966	19.4	2.0	292	18.0	2.6	327	29.6*	3.2	271	15.9	2.2
	>High school	1,622	12.5	1.2	627	11.3	1.3	531	19.4	1.8	286	17.2	3.6

*Significantly different from estimate for >high school ($P<0.05$) with Bonferroni correction

[a] BMI-for-age ≥95th percentile (BMI: body mass index, weight in kilograms divided by height in meters squared)

[b] National Health and Nutrition Examination Survey 2003–2006

[c] Number of respondent with non-missing data for BMI. Pregnant girls were excluded

Note: *SE* standard error

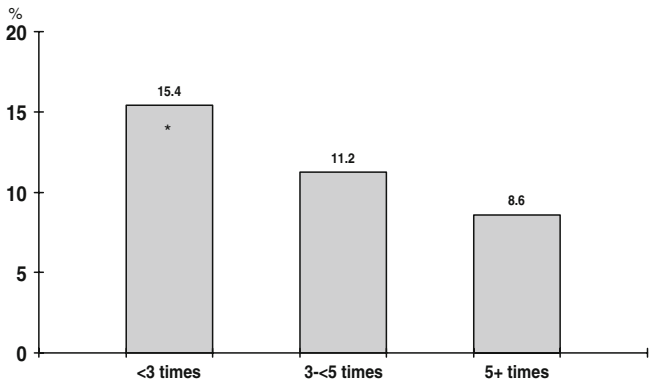
Behavioral Aspects of Obesity

Obesity is a complex condition determined ultimately by a balance of energy intake and energy expenditure. Clearly, individual behaviors, genetics, along with social, cultural and environmental factors must play important roles in the incidence and prevalence of obesity. Genetic factors, however, are unlikely to explain the current increases in the prevalence of overweight and obesity occurring around the world. It is likely that a gene-environment interaction, in which genetically susceptible individuals respond differentially to an environment with increased availability of palatable energy-dense foods and reduced opportunities for energy expenditure, contributes to our current high prevalence of obesity (Ogden et al. 2007).

Diet

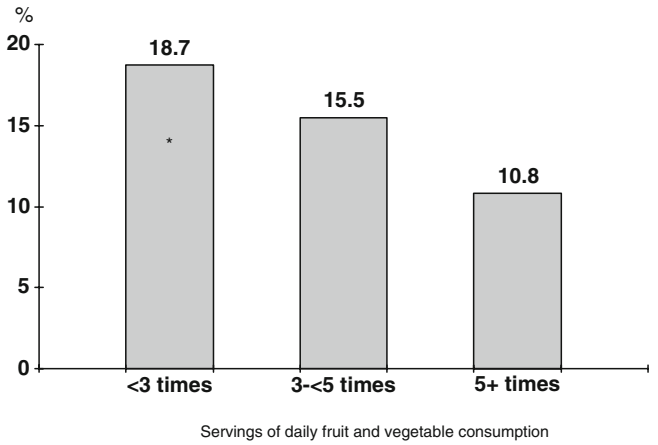
Poor eating habits are often established during childhood (Birch and Fisher 1998) and children often do not consume healthy diets (Eaton et al. 2008). Figure 5.11 depicts the prevalence of high BMI-for-age among Canadian children aged 12–19 years by daily fruit and vegetable consumption levels. Children and youth who consumed fruit and vegetables less than three times daily were significantly more likely to be overweight than those who consumed them five or more times daily (prevalence of 15 and 9% respectively). In the United States, in 2007 only 21.4% of high school students ate fruits and vegetables five or more times per day (Healthy People 2010 objective, http://www.healthypeople.gov/). Boys were more likely to consume the five or more fruits and vegetables per day compared to girls (Eaton et al. 2008). In the US, the prevalence of high BMI among teens 12–19 years of age was higher among those who consumed less than three servings of fruits and vegetables per day compared to those who consumed five or more servings per day (Fig. 5.12).

Changes in the composition of the diet have also been recorded. In Mexico, adolescents consume 20.1% of their energy from energy containing beverages. Total beverage consumption increased significantly between 1999 and 2006 among Mexican adolescents (Barquera et al. 2008). Moreover,



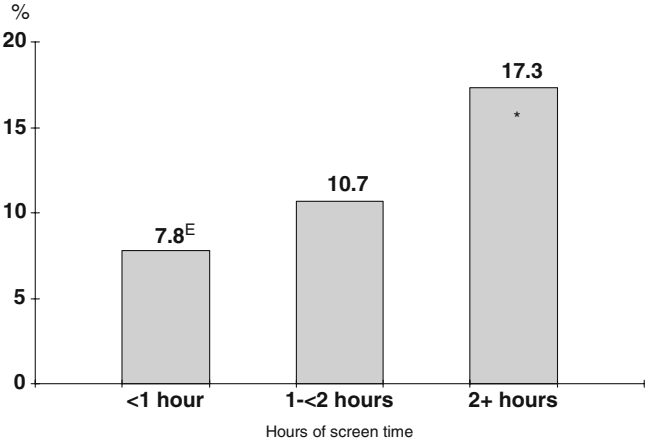
* Significantly different from estimate for five or more times ($P < 0.05$)

Fig. 5.11 Prevalence of high body mass index (BMI)-for-age (BMI ≥ 95th percentile) among children aged 12–19 years, by daily fruit and vegetable consumption, Canada excluding territories, 2004. *Source*: 2004 Canadian Community Health Survey: Nutrition



* Significantly different from estimate for five or more servings ($P < 0.01$)

Fig. 5.12 Prevalence of high body mass index (BMI)-for-age (BMI ≥ 95th percentile) among children aged 12–19 years, by daily fruit and vegetable consumption, US, 2003–2006. *Source*: 2003–2006 US National Health and Nutrition Examination Survey



* Significantly different from estimate for one or less ($P < 0.05$);
E use with caution (coefficient of variation between 16.6 and 33.3%)

Fig. 5.13 Prevalence of high body mass index (BMI)-for-age (BMI ≥ 95th percentile) among children aged 6–11 years, by daily hours of screen time, Canada excluding territories, 2004. *Source*: 2004 Canadian Community Health Survey: Nutrition

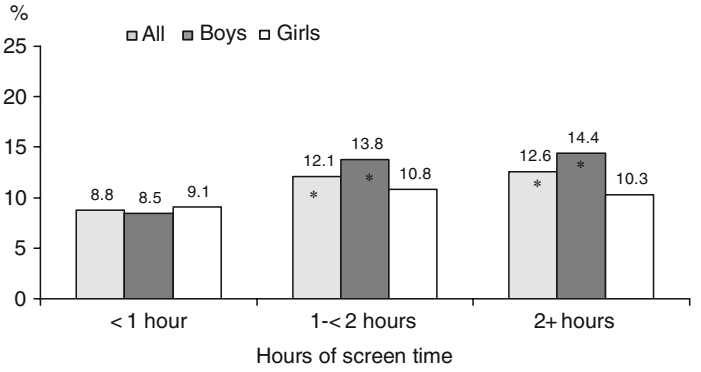
in the US, there has been an increase in soda consumption among 6–11 and 12–19 year olds and a decrease in milk consumption among 6–11 year olds between 1977–1978 and 2001–2002 (Sebastian et al. 2006). In the US, 33.8% of high school students drank soda in the previous 7 days (based on questionnaire data from the 2007 Youth Risk Behavior System) (Eaton et al. 2008).

Sedentary Behaviors

Many adolescents also participate in sedentary activities such as watching television or videos, playing video games or using a computer. Canadian data on screen time and high BMI for children aged

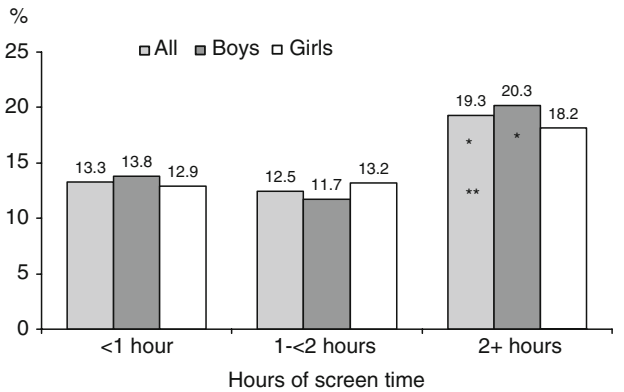
6–11 years are displayed in Fig. 5.13. There was a gradient between daily hours of screen time and prevalence of high BMI for this age group, with those who watched more than 2 h per day being significantly more likely to have high BMI than those who watched 1 or fewer hours daily.

In Mexico, teenage boys who spent 1–2 h or 2 or more hours involved in screen activities were more likely to have high BMI compared to those who spent less than 1 h per day involved in screen activities (Fig. 5.14). Similarly, in the US 12–19 year old teens were more likely to have high BMI if they spent 2 or more hours involved in screen activities compared to if they spent less than 1 h per day (Fig. 5.15). There was no difference in prevalence of high BMI by amount of screen time between boys and girls in the US.



* Significantly different from estimate for <1 h ($P < 0.05$)

Fig. 5.14 Prevalence of high body mass index (BMI)-for-age (BMI ≥ 95th percentile) among children aged 12–19 years, by daily hours of screen times, Mexico, 2006. *Source*: Mexican national Health and Nutrition Survey 2006



* Significantly different from estimate for 1-<2 ($P < 0.05$);
** Significantly different from estimate for <1 ($P < 0.05$)

Fig. 5.15 Prevalence of high body mass index (BMI)-for-age (≥ 95th percentile) among children aged 12–19 years, by daily hours of screen time, US, 2003–2006. *Source*: 2003–2006 US National Health and Nutrition Examination Survey

Conclusions

The prevalence of high BMI-for-age among children and teens in North America is a public health concern. The prevalence has increased in Canada, Mexico and the US over the past several decades, although it is not clear whether these increases will continue. Differences can be seen between sub-groups and between countries, however a shift in the entire distribution of BMI has occurred in each country. These increases are currently not well understood and further research is needed to identify the reasons for these changes, as well as their potential impact.

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