

## Excess Weight in Children 4 to 7 Years of Age – Targeting Risk Factors for Intervention

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### About the QLSCD (1998-2010)

This fascicle is based on data from the Qu ebec Longitudinal Study of Child Development (QLSCD 1998-2010) which is being conducted by the *Institut de la statistique du Qu ebec* (Qu ebec Institute of Statistics) in collaboration with various partners (listed on the back cover). The goal of this study is to gain a better understanding of the trajectories which, during early childhood, lead to children's success or failure in the education system.

The target population of the QLSCD comprises children (singleton births) born to mothers residing in Qu ebec in 1997-1998, with the exception of those whose mother, at the time of the child's birth, were living in certain administrative regions of the province (Nord-du-Qu ebec, Cree or Inuit lands) or on Indian reserves. Certain children were also excluded because of constraints related to the sample frame or major health problems. The initial sample eligible for longitudinal monitoring comprised 2,120 children. The children were followed annually from the age of 5 months to 8 years, and since then are being followed biannually to the age of 12. During the 2002 round, the data collection period was changed in order to visit all the children in the spring, namely during exam time in the education system. It should be noted that the QLSCD is the first large-scale study based on a sample of such magnitude, representative of Qu ebec newborns, who are being monitored in such an intensive manner throughout childhood.

The QLSCD employs a variety of data collection instruments to gather data on the child, the person most knowledgeable of the child (PMK), her or his spouse/partner (if applicable), and the biological parent(s) not residing in the household (if applicable). During each data collection round, the child is asked to participate in a variety of activities designed to assess development. As of the 2004 round, the child's teacher is also being asked to respond to a questionnaire covering various aspects of the child's development and adjustment to school.

Further information on the methodology of the survey and the sources of data can be accessed on the website of the QLSCD (also known as "I Am, I'll Be"), at: [www.jesuisjeserai.stat.gouv.qc.ca](http://www.jesuisjeserai.stat.gouv.qc.ca)



In Canada, as elsewhere in the world, overweight and obesity rates in children have significantly increased in recent decades. For example, among Canadian children 6 to 11 years of age, the prevalence of excess weight (overweight and obesity)<sup>3</sup> rose from 13% in 1978-1979 to 26% in 2004 (Shields, 2006). In 2004 in Qu ebec, 15% of children 2 to 17 years of age were overweight and approximately 7% were obese (Shields, 2005).<sup>4</sup> These rates are of great concern since obesity in youth increases the risk of adult obesity and associated health problems such as diabetes, sleep apnea or other respiratory disorders, as well as various forms of heart disease and certain cancers (Dietz, 1998; Steinberger & Daniels, 2003). Excess weight can also be a psychological and social burden – children with excess weight have a greater tendency to be rejected by their peers and experience social isolation (Fischler, 2001).

Although it is recognized that early and active intervention is needed to combat what some call the epidemic of obesity in children and youth, very little is known about the factors in early childhood associated with excess weight at school age and on the development of excess weight in young children in general.

The aim of this fascicle is to, in part, fill this gap. Based on data from the Qu ebec Longitudinal Study of Child Development (for a description of the study, see the box *About the QLSCD*), the first section presents trends in the weight status of Qu ebec children from the age of 4 to the age of 7 years. The next section covers the associations between excess weight and certain aspects of health and the psychosocial development of children at 7 years of age, namely in Grade 1 (first year of primary school). Following this, in order to inform prevention programs and benefit from the data collected since birth, we examine the links between excess weight at the age of 7 and various characteristics of children or the environment in which they are growing up. Therefore, associations between excess weight at school age and sociodemographic characteristics, lifestyle habits and perinatal factors are examined. These include sleep, diet, physical or sedentary activities, parent's weight status (when the child was 17 months) and certain diet-related behaviours in the children before they entered school.

It is important to note that the QLSCD has been conducted on a cohort of children born in Québec at the end of the 1990s. Therefore, children 7 years of age who came to Québec after their birth who are in the same age group as the initial sample have been excluded.<sup>5</sup> As a result, the data presented in this fascicle cannot provide an estimate of the prevalence of excess weight among all Québec children at the various ages examined. However, these data do provide, for the first time, a portrait of trends in the phenomenon of overweight and obesity in children based on direct physical measurements. The data collected since birth have also provided up-to-date information on certain characteristics of early childhood upon which interventions can be based to help prevent excess weight in school-aged children.

### *Estimating excess weight at 4, 6 and 7 years of age*

The data on body weight has been generated from the 2002, 2004 and 2005 rounds of the QLSCD, when the children were approximately 4, 6 and 7 years of age respectively.<sup>6</sup> The children's height and weight were measured by trained interviewers. During each round, body weight in kilograms was measured on scales set back to zero for each measurement. Children wore light clothes and no shoes. Height was measured in metres.<sup>7</sup>

The measurements of height and weight at these various ages were used to create an index to estimate total adiposity, namely the Body Mass Index (BMI). This was defined as the ratio of the child's body weight in kilograms to the square of his/her height in meters. To determine the prevalences of overweight and obesity at each age, reference values suggested by Cole et al. (2000) were used. Indeed, the goal being to define juvenile overweight and obesity in a uniform manner internationally, Cole and colleagues have established reference thresholds, based on BMI values, that take into account the child's age and sex. The BMI values in our study are presented in Table A.1 in the Appendix. For example, at 7 years of age, the values defining overweight and obesity are 17.92 kg/m<sup>2</sup> and 20.63 kg/m<sup>2</sup> in boys and 17.75 kg/m<sup>2</sup> and 20.51 kg/m<sup>2</sup> in girls respectively.

The BMI is the most used method for calculating excess weight in population surveys. Though it does not provide any information on the overall distribution of adipose tissue or on body composition, it does provide an excellent predictive value for future health risks associated with overweight and obesity, at least among adults (Douketis et al., 2005). Analyses conducted on data from the nutrition round of the QLSCD have revealed that the mean ratio of sub-scapular and triceptal skinfolds, an indicator of adipose tissue, was higher in overweight children, and even higher in obese ones (Desrosiers & Bédard, 2005). This finding suggests that excess weight can be accompanied by significant central adiposity in children, a condition associated with risk factors for heart disease (Freedman et al., 1999).

When the children were 4 and 6 years of age, the parents were asked about their perception of their child's weight compared to that of other children the same age. The results of this question were compared with those of the actual physical measurements taken of the children.

### *Characteristics related to excess weight at 7 years of age*

In order to document the possible impacts of excess weight on child development, the weight status of the children at 7 years of age was examined in relation to the parents' perception of the child's health status and physical condition. We were also interested in exploring the links between weight status and certain aspects of psychosocial development of the children as reported by the parents and teachers.

The analysis then examined factors in the perinatal period and childhood that may be associated with excess weight at the age of 7 years. Based on research conducted on the topic in Canada and elsewhere<sup>8</sup> and the availability and accuracy of QLSCD data, a multitude of variables were analyzed to see whether they were associated with excess weight. These are presented in detail in Tables A.2 and A.3 in the Appendix.<sup>9</sup>

It should be noted that although nutrient intake was not taken into account, eating too much or too fast at the age of 4 can be considered here to be a proxy measure for caloric intake at this age (McConahy et al., 2004). A previous analysis of QLSCD data indicated that children who ate too much or too quickly at the age of 2½, 3½ and 4 years as reported by their mother had a higher energy and macronutrient intake (carbohydrates, lipids, proteins) at the age of 4 compared to those who were reported not to have these behaviours at these ages. The children who ate too much or too fast consumed more cereal, meat and meat-substitute products daily compared to other children. It was also demonstrated that these behaviours were associated with excess weight at the age of 4, especially when they were reported by the mother at all three ages (Dubois et al., 2007a).

Although these behaviours were not re-assessed at 7 years of age, it has been demonstrated that eating when not hungry is a behaviour that tends to persist with age (Fisher & Birch, 2002). Eating too much or too quickly in childhood can be associated with hyperphagia in adolescence (Tanofsky-Kraff et al., 2005), and is a good predictor of excess weight in adulthood (Brunstrom et al., 2005; Hays et al., 2002).

However, food intake is only one of the parameters in the energy balance, since excess weight manifests when energy intake surpasses energy needs (Shields, 2006). Though the QLSCD does not provide precise data on the children's energy expenditure, it does provide data on the frequency of certain physical activities and time spent in front of a screen (see Table A.3 in the Appendix). A recent study indicated that Canadian children 6 to 11 years of age who spend two hours a day in front of a television or computer

screen are twice as likely to be overweight or obese than those who spend an hour or less (Shields, 2006).

The results presented in this fascicle are based in large part on bivariate analyses. To analyze the contribution of different variables to the risk of excess weight at the age of 7, a logistic regression was also conducted.

Because of the low numbers of obese children, without exception, analyses were conducted by comparing children with excess weight (overweight and obese) with other children.<sup>10</sup>

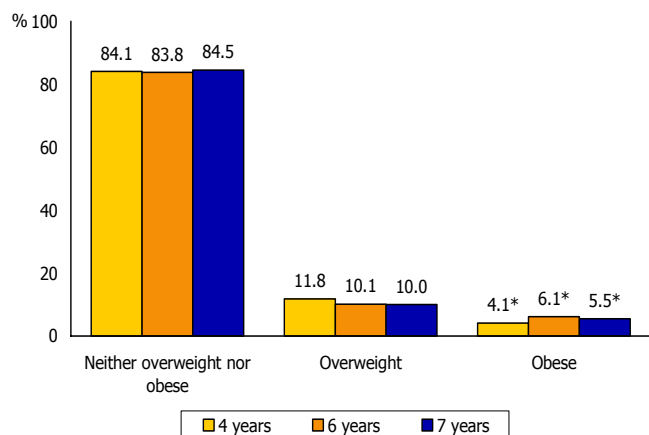
### Prevalence and persistence of excess weight in children between 4 and 7 years of age

Although a number of studies have shown the persistence of obesity over time, excess weight, particularly in childhood, may be a transient phenomenon related to the child's growth. A recent study, however, has underlined that major weight gain after the age of 2 may be significantly associated with the risk of obesity at the age of 7 (Reilly et al., 2005). Data from the National Longitudinal Survey of Children and Youth (NLSCY) revealed that over a period of four years, from 1994-1995 to 1998-1999, 56% of children in Canada initially aged from 2 to 11 years, had excess weight (i.e., were overweight or obese) for at least one year, while only 10% had persistent excess weight (Statistics Canada, 2002). However, it should be noted that the NLSCY collected data based on self-reported information by the parents or child as to height and weight. Physical measurements from the Canadian Community Health Survey (2004) indicated that 21% of children in Canada from 2 to 5 years of age and 26% of those from 6 to 11 years of age were overweight or obese (Shields, 2005). However, this cross-sectional survey could not provide data on trends in weight among children.

As the QLSCD data show in Figure 1, approximately 16% of Québec children had excess weight irrespective of whether they were 4, 6 or 7 years of age. At each age, 11% were overweight and 5% obese.

However, these snapshots camouflage changes from one category of weight to another in a fair number of children. Indeed, approximately 25% of the children had excess weight at one age or another, 8% of which was persistent, namely at all the three ages studied (see Figure 2).

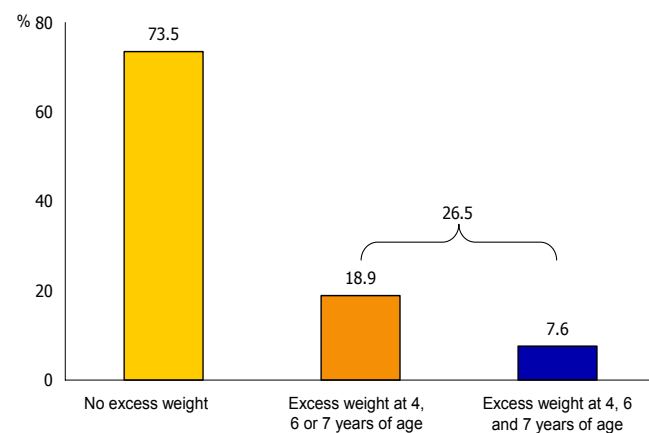
Figure 1  
Distribution of children by weight status<sup>1</sup> and age,  
Québec, 2002, 2004, 2005



1. Based on international criteria defined by Cole et al., 2000.
- \* Coefficient of variation between 15% and 25%; interpret with caution.

Source: Institut de la statistique du Québec, QLSCD 1998-2010.

Figure 2  
Distribution of 7-year-old children by presence of excess weight<sup>1</sup> or not at 4, 6 and 7 years of age,  
Québec, 2002, 2004, 2005

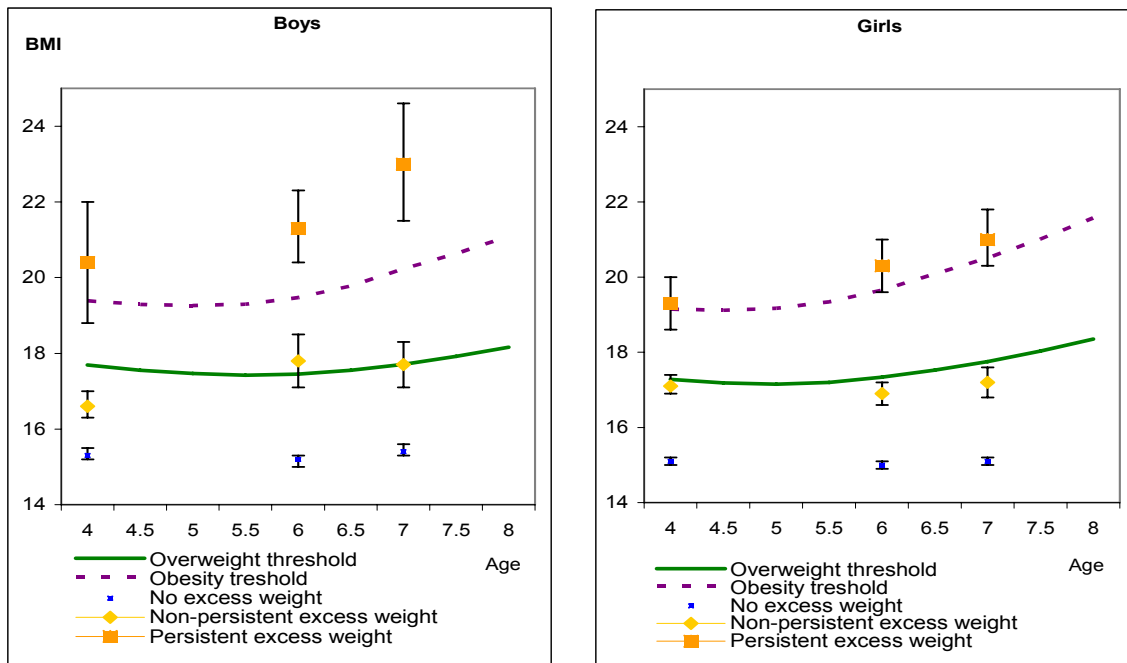


1. Overweight or obese according to international criteria defined by Cole et al., 2000.

Source: Institut de la statistique du Québec, QLSCD 1998-2010.

Figures 3a and 3b illustrate the BMI according to changes in weight status, separated by gender. Children whose excess weight was persistent had a BMI at the age of 4 years that was, on average, close to the threshold of obesity. In comparison, children with non-persistent excess weight presented a mean BMI close to the threshold of overweight.

Figures 3a and 3b  
**Trends in Body Mass Index (BMI) by weight status<sup>1</sup> and age, boys and girls, Québec, 2002, 2004 and 2005**



1. Based on international criteria defined by Cole et al., 2000.  
 Source: Institut de la statistique du Québec, *QLSCD 1998-2010*.

Overall, among children who were overweight or obese at the age of 4, slightly over half (53%) had excess weight at the age of 7. Conversely, only 8% of children who did not have excess weight at the age of 4 had excess weight three years later (data not shown). These data reveal that overweight or obesity in school-aged children was already present before entry into the education system. With regards to intervention in children with excess weight, some researchers recommend waiting until the age of 3 years (Barlow & Dietz, 1998; Basdevant et al., 1998) while the World Health Organization suggests waiting until the age of 6 (WHO, 2000). The American Academy of Pediatrics (AAP) issued guidelines in 1998 for children 2 to 7 years of age, focusing on weight maintenance; a weight management program would only be recommended for obese children with complications (Barlow & Dietz, 1998).

*Excess weight or not?  
 What do the parents think?*

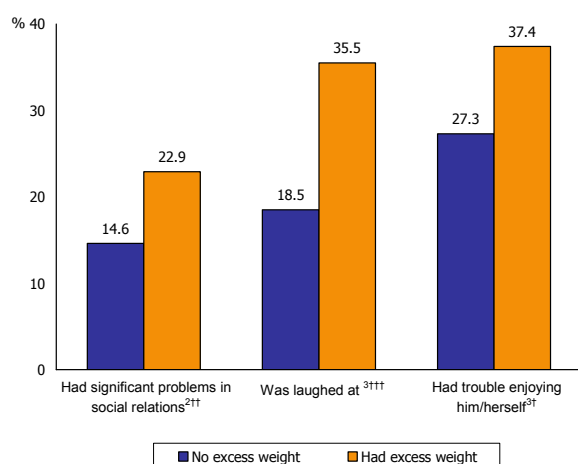
It does not always seem easy for a parent to recognize excess weight in a child in the full stages of growth. In accordance with what has been observed in the rest of Canada and other western countries (Baur, 2005), data from the *Enquête de nutrition auprès des enfants québécois de 4 ans* (Nutrition Survey of Four-Year-Old Québec Children) conducted as part of the QLSCD revealed a

considerable difference between objective measures of overweight and obesity and the parents' perception of their child's weight. Only 3.7% of 4-year-old children were perceived by their parents as having excess weight compared to other children the same age and sex (Desrosiers & Bédard, 2005). A similar finding emerged two years later, when the same question was asked of the parents. Only 5% of children 6 years of age were considered by their parents to have excess weight compared to other children the same age. Indeed, we can observe that among the children who were overweight or obese, approximately 75% were considered by their parents to have a normal weight and even in some cases as being thin or underweight (data not shown). These findings suggest that socially acceptable norms of weight in children tend to change – a higher weight in a child may be considered by some parents as normal. In the same vein, a recent analysis of data from the *Enquête sociale et de santé* (Québec Child and Adolescent Health and Social Survey) (*ESSEA*) conducted in 1999 on Quebecers 9, 13 and 16 years of age revealed that children with excess weight whose parents or classmates were overweight or obese, were more likely to consider their own excess weight as normal. The younger the children, the higher the percentage of those who misperceived their weight status (Maximova et al., 2008).

## Is having excess weight when we are a child a heavy burden to carry?

In addition to physical health problems often associated with excess weight, it can also have a significant negative impact both psychologically and socially. Indeed, a number of studies show that children who are overweight or obese experience a greater likelihood of being rejected by their peers, being subjected to bullying behaviours, and living in social isolation (Fischler, 2001; Janssen et al., 2004). The QLSCD data did not reveal any significant associations between excess weight at 7 years of age and the general health status or physical condition of the child compared to other children, as reported by the parent. However, children who had excess weight at this age were more likely to have problems in social relationships, as reported by both teachers and parents. For example, nearly a quarter of children (23%) with excess weight were considered by their parents to have special problems in their relationships at school compared to 15% of other children (Figure 4). Children with excess weight are also subjected, according to their teacher, to being laughed at more by other children (36% vs. 19%), and also had had more difficulty in enjoying themselves (37% vs. 27%) in the preceding six months at school.

Figure 4  
**Certain social aspects of child development by the presence of excess weight or not at 7 years of age,<sup>1</sup> Québec, 2005**



Note: <sup>†</sup>  $p < 0.05$ ; <sup>††</sup>  $p < 0.01$ ; <sup>†††</sup>  $p < 0.001$ .

- Overweight or obese according to international criteria defined by Cole et al., 2000.
- As reported by the Person Most Knowledgeable of the child (PMK).
- As reported by the teacher.

Source: Institut de la statistique du Québec, *QLSCD 1998-2010*.

## When emotions and certain eating behaviours go together

Certain studies suggest that there may be a circular relationship between excess weight and victimization problems. For example, children suffering from social rejection may have a greater tendency towards developing hyperphagic behaviours, namely overeating or binge eating (Karantzas, 2006; Mikami et al., 2008). These behaviours were covered by the QLSCD when the children were approximately 4 years of age. An indicator was constructed based on the data collected in order to identify children who eat too much or too fast, namely those who sometimes or often engage in one or another of these behaviours as reported by their parents.

It was revealed that at the age of 4, children who, according to their parents, had already been laughed at by other children in the three months preceding the survey, had a greater tendency than other children to eat too much or too quickly (32% vs. 23%; data not shown). Children who presented greater symptoms of general anxiety, separation anxiety (e.g. very negative reactions on the part of the child when separated from his/her parents) or attention deficit/hyperactivity were also more likely to manifest the aforementioned eating behaviours as reported by their parents.<sup>11</sup> This finding supports the associations identified in other studies between hyperactivity, particularly impulsivity, and certain eating pathologies (see for example Mikami et al., 2008). This can be explained by the fact that serotonin, the neurotransmitter thought to be at the origin of the deficit in attention deficit/hyperactivity disorder (ADHD), also plays a key role in the control of appetite (Vaissière, 2004), or by a problem in the regulation of emotions that leads to both eating pathology and ADHD. The association was maintained when rejection by peers was entered into the equation, which is found to be more frequent in children with ADHD (Mikami et al., 2008).

Overall, these findings suggest that more in-depth research should be conducted on the origins of certain eating behaviours in children.<sup>12</sup> It should be noted that the data from the nutrition part of the survey, conducted when the children were 4 years old, revealed that 23% ate too much or too fast, with boys exceeding girls in this regard (27% vs. 20%) (Bédard, Dubois & Girard, 2005).



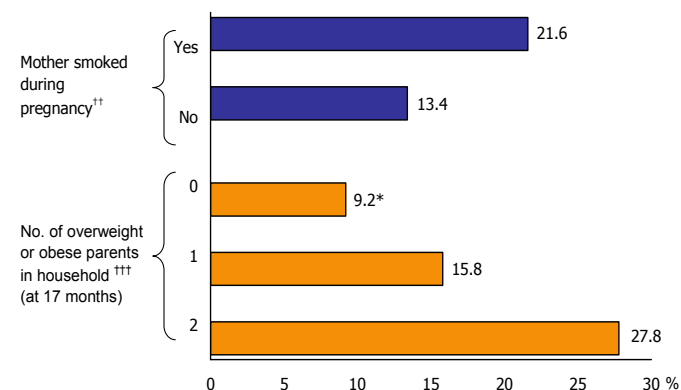
## Excess weight at 7 years of age by various characteristics of the child and the family

Developing effective interventions for overweight and obese children and youth should be based on in-depth knowledge of the factors at the origin of these health problems that often manifest early in life.

Figures 5 through 7 illustrate the characteristics revealed to be significantly associated with excess weight in Québec children 7 years of age among all the variables analyzed (Tables A.2 and A.3 in the Appendix). The characteristics proved to be quite diverse.

The first observation is that 7-year-old children whose mother smoked during pregnancy were more likely to have excess weight (Figure 5); the mechanism upon which this association is based could be related to altered metabolism induced by exposure to second-hand smoke in utero (von Kries et al., 2002). Children who at the age of 17 months were living with two parents who had excess weight, and to a lesser degree, one parent, who had excess weight, were more likely to be overweight or obese at the age of school entry.

Figure 5  
Proportion of 7-year-old children presenting excess weight,<sup>1</sup> by smoking status of mother during pregnancy and parents' weight status, Québec, 1998, 1999 and 2005



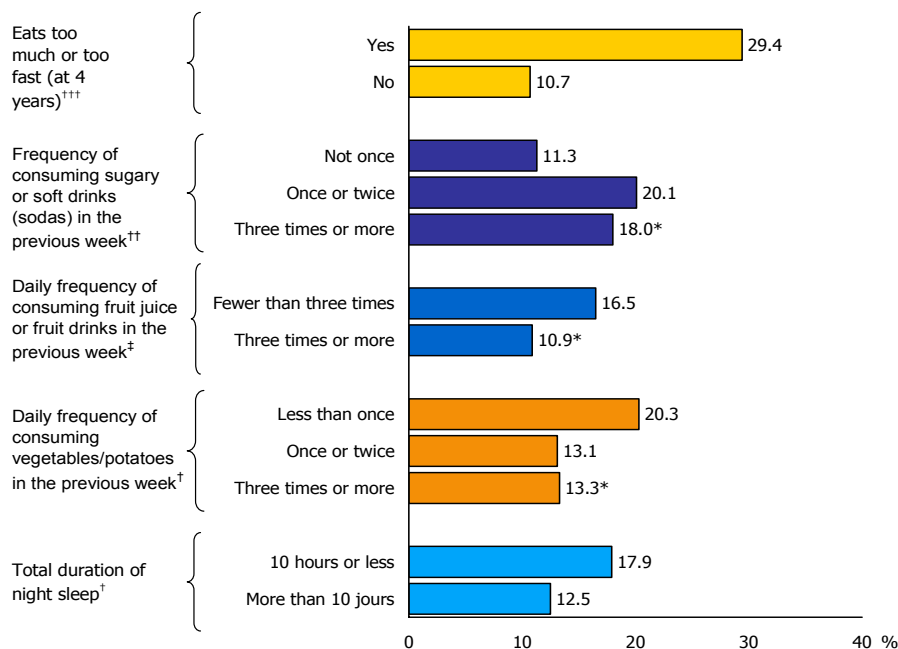
Note: <sup>††</sup> p < 0.01; <sup>†††</sup> p < 0.001.

1. Overweight or obese according to international criteria defined by Cole et al., 2000.

\* Coefficient of variation between 15% and 25%; interpret with caution.

Source: Institut de la statistique du Québec, QLSCD 1998-2010.

Figure 6  
Proportion of 7-year-old children with excess weight,<sup>1</sup> by certain lifestyle habits, Québec, 2002 and 2005



Note: <sup>†</sup> p < 0.10; <sup>†</sup> p < 0.05; <sup>††</sup> p < 0.01; <sup>†††</sup> p < 0.001.

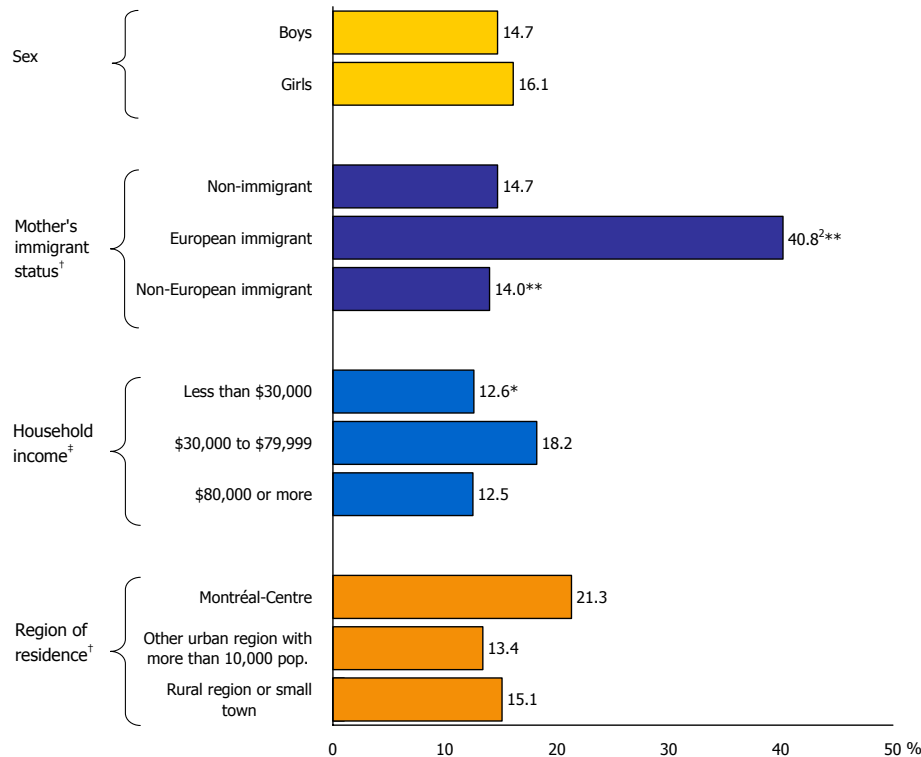
1. Overweight or obese according to international criteria defined by Cole et al., 2000.

2. Unless otherwise indicated, the characteristics apply to the children when they were 7 years of age.

\* Coefficient of variation between 15% and 25%; interpret with caution.

Source: Institut de la statistique du Québec, QLSCD 1998-2010.

Figure 7  
**Proportion of 7-year-old children with excess weight<sup>1</sup>, by various sociodemographic characteristics, Québec, 2005**



Note: <sup>‡</sup>  $p < 0.10$ ; <sup>†</sup>  $p < 0.05$ .

1. Overweight or obese according to international criteria defined by Cole et al., 2000.

2. This percentage should be interpreted with a certain level of caution, since the confidence interval was from 20.4% to 63.9%.

\* Coefficient of variation between 15% and 25%; interpret with caution.

\*\* Coefficient of variation higher than 25%; imprecise estimate provided for information purposes only.

Source: Institut de la statistique du Québec, *QLSCD 1998-2010*.

In accordance with recent studies (Snell, Adam & Duncan, 2007; Taheri, 2006; Touchette et al., 2008), an association was observed between sleep habits and body weight. At the age of 7 years, children who slept less (10 hours or fewer a night), were more likely than other children to have excess weight (Figure 6). In terms of eating behaviours, children who ate too much or too fast at the age of 4 showed a greater propensity to have excess weight at the age of 7. Children who had consumed sugary or soft drinks (sodas) in the week preceding the survey were also more likely to have excess weight, as were those who had not eaten vegetables on a daily basis in the same timeframe. Children who had drunk fruit juice or fruit drinks at least three times a day in the week preceding the survey were less likely ( $p < 0.10$ ) to be overweight or obese. Since the data could not distinguish between "pure" fruit juice and fruit drinks containing sugar and water as main ingredients, this finding is difficult to interpret. However, a recent study conducted on 3,618 U.S. children 2 to 11 years of age revealed that children who consumed one and a half cups (365 ml) or more of pure fruit juice daily, well above the amount recommended by the American Academy of Pediatrics, did not present a higher risk of being overweight or obese. In general, children who consume fruit juice seem to have a healthier diet and a higher intake of certain essential nutrients (O'Neil, Nicklas & Kleinman, 2007).

No significant association was discovered between weight status and other eating behaviours such as fussiness with food or eating at irregular hours at the age of 4, having daily breakfast or various physical and sedentary activities at the age of 7 (data not shown). However, it should be noted that the data collected on physical activity may not be precise enough to differentiate various levels of activity and their associated energy expenditure.

With regards to sociodemographic variables, the prevalence of excess weight tended to be higher among children in middle-income households compared to those with lower or higher incomes (Figure 7). These findings do not seem to support the thesis that children in financially disadvantaged families are more likely to have excess weight.<sup>13</sup> Though the children of European immigrant mothers were more likely to have excess weight compared to those of non-immigrant ones (see definition of "European" in Table A.3 in the Appendix), the QLSCD data did not reveal any links between excess weight in 7-year-old children and other characteristics of the family environment such as educational level or employment status of the mother, family size or the presence of one or two parents in the household (data not shown).

## Box 2

### What factors were associated with obesity in the children?

In spite of the low number of children involved ( $n = 69$ ), we were able to conduct descriptive analyses for information purposes only, in order to reveal characteristics associated with obesity at the age of 7.

These analyses revealed that children whose two parents had excess weight were more likely than other children, neither of whose parents had excess weight, to be obese at 7 years of age. However, compared to the latter group, children with only one parent who had excess weight were not more likely to be obese at this age. These findings may indicate that genetic factors are of primary importance in obesity. Other factors such as maternal smoking during pregnancy seemed to be more strongly associated with obesity than overweight. A significantly higher proportion of obese children were in families who had lacked money to buy food in the preceding year, which suggests that a diet imbalance engendered by poverty can perhaps be a greater contributing factor in the development of obesity than in overweight. The data also revealed that obese children were less likely to be perceived by their parents as having a higher level of physical condition than other children the same age.

However, with regards to certain lifestyle habits such as duration of nocturnal sleep or consumption of sugary or soft drinks (sodas), the analysis of the data suggests that these may be particularly associated with overweight, at least at the age of 7 years. In addition, there was a significantly higher proportion of overweight 7-year-olds in the Montréal-Centre region, whereas obese children seemed to be evenly distributed across the province. The numbers were too small to analyze the children's weight status as a function of the immigrant status of the mother.

Of all the variables studied, eating too much or too fast was the one that was most clearly associated with both overweight and obesity in children 7 years of age. Among children who ate too much or too fast at the age of 4, 18% were overweight and 11% were obese, while these figures were 9% and 2% respectively among children who did not have these behaviours (data not shown). These findings are based on bivariate analyses. More in-depth analyses would be needed to examine the respective contribution of these different factors to obesity in school-aged children.

In terms of geographic distribution, a greater proportion of children with excess weight were living in the region of Montréal-Centre compared to other urban regions with 10,000 or more inhabitants (Figure 7). This finding could be due to ethnocultural factors or other characteristics not measured here, such as food supply, or physical characteristics of neighbourhoods such as amenities or lack thereof conducive to a more or less active lifestyle. However, weight status at 7 years was not significantly associated with material deprivation in the local area of residence (data not shown).

### *When multiple factors are involved*

In order to identify the main factors associated with excess weight, it is necessary to use a method allowing them to be analyzed simultaneously. For example, it is possible that the link between the mother's immigrant status and excess weight in the child could be only related to certain diets and eating habits more common in families with a mother who is a European immigrant. To differentiate the various influences of these characteristics, a logistic regression analysis was conducted on the QLSCD data. All the variables that were significant at the threshold of 0.10 in the bivariate analyses were entered into the model. Moreover, even if the sex of the child had not been significantly associated with excess weight in the previous analyses, it was entered into the logistic regression model to verify whether there was any interaction between sex and the other variables under study.

The findings are presented in Table 1 in the form of odds ratios. A ratio of less than one indicates the children were less likely to have excess weight compared to the reference category, whereas a ratio higher than one indicates a higher probability of having excess weight.<sup>14</sup>

Among the variables presented in Figures 5, 6 and 7, neither household income nor consumption of vegetables, fruit juice or fruit drinks in the week preceding the survey proved to be significantly associated with weight status, when the set of risk factors were in the model. Indeed, the analysis conducted in stages revealed that the influence of income, already marginal, dissipated when maternal smoking during pregnancy or the frequency of consuming sugary or soft drinks were entered into the model, undoubtedly because of the significant association between income and these characteristics. In other words, the fact that children in higher-income families were less likely to have excess weight than those in middle-income families, could be attributed in part, for example, to their lower propensity to have been exposed to cigarette smoke during their mother's pregnancy or to consuming sugary or soft drinks at the age of 7 years, these two factors having a preponderant influence on excess weight (for an illustration of the link between income and consumption of sugary and soft drinks, see Figure 8). With regards to the link between consumption of vegetables and excess weight, it became non-significant when eating too much or too fast at 4 years of age was entered in the model, these two eating behaviours being strongly associated with each other (data not shown). This finding suggests that beyond the quantity of food consumed, children who eat too much or too fast may present eating habits less favourable to maintaining a healthy weight.

Table 1  
**Main characteristics associated with excess weight (overweight or obesity) in 7-year-old children, logistic regression model, Québec, 1998-2005<sup>1,2</sup>**

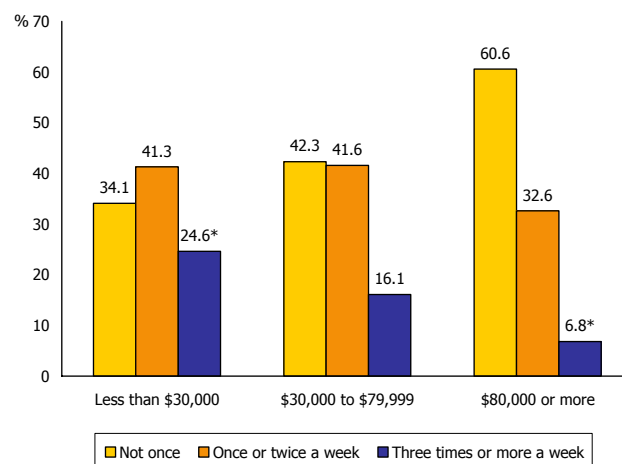
	Odds ratio	Confidence interval (95%)
<b>Sex of child</b>		
<i>Boy</i>	1.00	...
Girl	1.36	(0.95-1.95) <sup>‡</sup>
<b>Mother smoked during pregnancy</b>		
<i>No</i>	1.00	...
Yes	1.81	(1.22-2.71) <sup>††</sup>
<b>No. of parents in household who are overweight or obese (17 months)</b>		
<i>None</i>	1.00	...
One	2.00	(1.21-3.30) <sup>††</sup>
Two	4.62	(2.63-8.12) <sup>†††</sup>
<b>Eats too much or too fast (4 years)</b>		
<i>Yes</i>	3.49	(2.30-5.29) <sup>†††</sup>
<i>No</i>	1.00	...
<b>Frequency of consumption of sugary or soft drinks (sodas) (previous week)</b>		
<i>Not once</i>	1.00	...
Once or twice	1.77	(1.19-2.62) <sup>††</sup>
Three times or more	1.25	(0.71-2.18)
<b>Duration of night sleep</b>		
10 hours or less	1.43	(0.93-2.19) <sup>‡</sup>
<i>More than 10 hours</i>	1.00	...
<b>Mother's immigrant status</b>		
<i>Non immigrant</i>	1.00	...
European immigrant	3.48	(1.24-9.78) <sup>†</sup>
Non-European immigrant	0.44	(0.18-1.09) <sup>‡</sup>
<b>Region of residence</b>		
Montréal-Centre	2.29	(1.42-3.69) <sup>†††</sup>
<i>Other region with more than 10,000 inhabitants</i>	1.00	...
Rural region or small town	0.96	(0.61-1.50)

1. The reference category is presented in italics. The odds ratios are significantly different from 1 to a threshold of: <sup>‡</sup> 0.10; <sup>†</sup> 0.05; <sup>††</sup> 0.01; <sup>†††</sup> 0.001.
2. Except for mother smoking during pregnancy or as indicated otherwise, the characteristics apply to the children when they were 7 years old.

Note: The partial non-response rate of this model was between 5% and 10%. The risk of bias associated with this non-response rate is low. The relationship between mother's immigrant status and excess weight was attenuated because of non-response observed among immigrant mothers.

Source: Institut de la statistique du Québec, *QLSCD 1998-2010*.

Figure 8  
**Distribution of 7-year-old children by household income and frequency of consumption of sugary or soft drinks (sodas) during the week preceding the survey, Québec, 2005<sup>1</sup>**



1.  $p < 0.001$

\* Coefficient of variation between 15% and 25%; interpret with caution.

Source: Institut de la statistique du Québec, *QLSCD 1998-2010*.

The data in Table 1 indicate that even when the other characteristics were in the model, children whose mother had smoked during pregnancy were more likely to present excess weight at the age of 7 years. All characteristics being equal, the probability that a child would be overweight or obese was also significantly higher if at least one parent had excess weight. In terms of eating and lifestyle behaviours, children who ate too much or too fast at the age of 4 were more likely to have excess weight at the age of 7, even when other individual or family risk factors were in the model. Compared to children who had not consumed sugary or soft drinks in the week preceding the survey, those who had done so once or twice were also more likely to be overweight or obese. In terms of the duration of nocturnal sleep, its "effect" persisted but seems more marginal, when other factors were in the model.

Compared to children whose mother was born in Canada, children of European immigrant mothers were more likely to have excess weight (Health Canada, 2003). Since European immigrants, compared to non-European ones, have cultural backgrounds and lifestyle habits closer to those of the Canadian population, they perhaps have more easily adopted the lifestyle habits of their new country thereby contributing to excess weight. However, the differences observed with regards to the mother's immigrant status should be interpreted with caution, because the category thresholds of BMI may not be well adapted to certain ethnic or racial groups (Health Canada, 2003). Indeed, it has been observed that for an identical BMI, the rate of adipose mass, the distribution of adiposity and the health risk may differ among ethnic or racial populations (WHO, 2000). The sample numbers in the QLSCD in this regard did not allow for more in-depth analyses according to ethnocultural background.

Finally, residential location also emerged as a separate influence on excess weight status. Children living in the region of Montréal-Centre were more likely than those in other urban regions of Québec to be overweight or obese, even when other factors such as immigrant status of the mother were in the model. This finding suggests that characteristics proper to the geographic location of a child's residence, not measured here (e.g. food supply, sports and recreation facilities and parks) could play a role beyond individual and family factors.

It should be emphasized that when all characteristics were in the model, girls seemed to have a slightly greater propensity to present excess weight than boys. However, no significant interaction at the threshold of 0.5 was observed between the child's sex and the other characteristics associated with excess weight.

### *Summary and action plans*

Analyses conducted on the QLSCD data revealed that though 16% of children presented excess weight at the ages of 4, 6 or 7 years of age, more than 25% had excess weight at one of these ages, of whom 8% had this status in a persistent manner, namely at all three ages under study. At each of the aforementioned ages, approximately 5% of children were obese. Overall, approximately half of the children presenting excess weight at 4 years of age had excess weight three years later, and children with a higher BMI than their peers at the age of 4 were more likely than their peers to maintain this weight status. This portrait of body weight status and associated factors indicates that precursor factors in the children began at the beginning of life, and even at conception, given the association of excess weight and maternal smoking during pregnancy. Identifying risk factors that can be altered shows that it is possible to prevent overweight and obesity so that more children can grow up with a healthy weight status.

This is even of greater importance in that, as we have seen, excess weight is associated with difficult social relations in certain children, which can have a negative impact on their performance in school and future social adjustment. Although no significant association was observed between excess weight and perceived health status, the negative consequences of excess weight on health can manifest later in youth, particularly among those who are obese. Indeed, the QLSCD data have already shown that at the age of 7, obese children are less frequently perceived by their parents as being in good physical condition compared to other children the same age. Data from the Canadian Community Health Survey (2004) revealed that only half of obese boys and girls (52% and 45% respectively) 12 to 17 years of age considered themselves to be in excellent or very good health, compared to 75% of children in this age group who were neither overweight nor obese (Shields, 2006).

In accordance with other studies, this analysis clearly indicates that children whose parents have excess weight are at higher risk of this problem themselves (Agras et al., 2004; Danielzik et al., 2002; Dubois & Girard, 2006; Francis et al., 2007). Weight gain is partly genetic, but also partly cultural (Dubois et al., 2007b), resulting from family lifestyle habits related to diet and physical activity.

In this regard, it is clear that certain dietary habits of the children as observed by the mother merit further study, particularly eating too much or too quickly, which was significantly associated with excess weight at the age of 7 years. As we have seen, such eating behaviours can also be associated with certain psychosocial and affective development problems. Our results therefore underline the need for further in-depth research on eating pathologies at a young age and the need to address psychosocial factors through interventions designed to be counterweights to obesity (Brunet et al., 2007).

Communicating advice on nutrition recommendations, food choices and portion sizes for children related to their age and level of physical activity can help parents adapt their menus. Restaurant and grocery can also be called upon to change their practices. In the U.S., it has been shown that portion sizes served or sold in restaurants, grocery stores or vending machines, have considerably increased in the past two decades, the idea being to provide consumers more (in quantity, not necessarily quality) for their money (Division of Nutrition and Physical Activity, 2006). A certain number of studies suggest that children under the age of 3 or 4 years eat mainly in reaction to appetite or hunger signals, while older children may be influenced by a variety of environmental factors, such as portion size or availability (Rolls, Engell and Birch, 2000). A recent study, however, has shown that children 2 to 9 years of age will react to the portions served in quite similar fashion, by eating more food, irrespective of their age (Fisher, 2007). Although the need is there, interventions should be appropriately targeted, since it is increasingly recognized that restrictive behaviours of parents in terms of food can have the opposite effect on children, namely by contributing to a taste for fatty and sugary foods, overeating and weight gain (Faith et al., 2004). Thus, rather than imposing quantitative or qualitative constraints, it is being increasingly recommended that the diet of the whole family be reoriented (Barlow & Dietz, 1998). In this regard, the relationship between eating behaviours and the social context of meals (e.g. eating alone, in front of the television or not) merits further exploration.

The association between sleep duration and BMI underlines the importance of creating conditions favourable to sleeping in young children. According to the National Sleep Foundation in the U.S., in order to foster optimal development, children 5 to 12 years of age should sleep between 10 and 11 hours a night (Mindell, 2004). The data in our study reveal that, compared to children who sleep more than 10 hours a night, those who sleep 10 hours or fewer were more likely to have excess weight, even when all characteristics were taken into account in the model. Since our analysis here only examined the number of hours of sleep at the age of 7, it is difficult to establish a causal link between excess weight and duration of nocturnal sleep in the children. However, recent studies based on longitudinal data suggest that children under 3 years of age who had comparatively shorter sleep

duration presented a higher risk of overweight or obesity at school age (Snell, Adam & Duncan, 2007; Taheri, 2006; Touchette et al., 2008). A number of hypotheses have been put forward to explain this link. Lack of sleep can lead to a deregulation of certain hormones that influence metabolism. To compensate for altered metabolism linked to lack of sleep, children may tend to eat more and gain weight more easily (Taheri et al., 2004). In this regard, the QLSCD data revealed that 4-year-old children who slept 10 hours or fewer were more likely to overeat or eat too fast (data not shown). However, since the association between sleep duration and excess weight remains even when eating too much or too fast are taken into account, this suggests that indeed other factors may be in play here (see Touchette et al., 2008).

Though some of our findings on 7-year-old Québec children seem to support those of other studies, in contrast, the findings of other studies do not seem to match ours. The lack of consensus on the impact of a number of risk factors on excess weight in children and youth was underlined in a recent review of the literature on the topic (Johnson-Taylor & Everhart, 2006). In terms of breastfeeding, contradictory results may be due to how breastfeeding is measured, since some studies examine breastfeeding exclusively (without other liquids, water or solid food) rather than duration of total breastfeeding (see Table A.3 in the Appendix). In the QLSCD, only 6% of children were still being breastfed exclusively at the age of 4 months, which did not allow for conducting detailed analyses on a possible link with excess weight (Dubois et al., 2000). Other factors such as physical activity in young children are not always measured with a degree of precision, which was the case here. Furthermore, the means of measuring overweight and obesity are not always comparable from one study to another. In the QLSCD, among children 4 years of age, striking differences were observed between the height and weight reported by the mother, and those physically measured by an interviewer (Dubois & Girard, 2007). It is therefore important to compare studies in which height and weight are actually measured, since these measurements are more accurate than those reported by a parent.

### *In the guise of a conclusion*

Overall, our findings bear witness to the importance of intervening early to curb the problem of excess weight at school age. The fact that parents are not always able to recognize overweight and obesity in their children calls for improved sensitization to the factors that can contribute to the maintenance of a healthy weight. However, whether they address weight reduction or weight management, interventions conducted with children must do so with a great deal of tact (Bédard et al., 2005; Brunet et al., 2007; Mongeau, 2003; Paradis, 2008). Indeed, labeling a child "obese" may cause irreparable damage to his/her self-esteem (Barlow & Dietz, 1998).

Though parenting behaviours related to diet play a key role in prevention and treatment (Faith et al., 2004; Golan & Crow, 2004), it is now well recognized that behaviour modification interventions have greater success when they are multifaceted. Therefore, beyond sensitization campaigns and family intervention, it seems important to facilitate access to healthy foods at affordable prices and foster physical activity in the various contexts in which the children are developing and growing up such as daycares, school and the local neighbourhood.

Many directions for further research can be drawn from the findings presented here. In addition to ongoing analyses of trends in weight status using direct measurements of the children as they grow older, it would be productive to further identify factors associated with the persistence or lack thereof of excess weight at school age. Furthermore, the fact that children in the region of Montréal-Centre seem to be at higher risk of presenting excess weight than their peers living elsewhere in Québec demonstrates the need to further investigate the role of the built environment (proximity of green spaces, types of grocery stores and restaurants close to home) plays in excess weight in school-aged children.

## *Appendix*

Table A.1  
**BMI reference value based on international criteria used to determine overweight or obesity in the children, by age and sex**

Age (years)	Overweight (kg/m <sup>2</sup> )		Obesity (kg/m <sup>2</sup> )	
	Boys	Girls	Boys	Girls
3.5	17.69	17.40	19.39	19.23
4	17.55	17.28	19.29	19.15
4.5	17.47	17.19	19.26	19.12
5	17.42	17.15	19.30	19.17
5.5	17.45	17.20	19.47	19.34
6	17.55	17.34	19.78	19.65
6.5	17.71	17.53	20.23	20.08
7	17.92	17.75	20.63	20.51
7.5	18.16	18.03	21.09	21.01
8	18.44	18.35	21.60	21.57

Source: Cole et al., 2000.

Table A.2

**List of characteristics examined in the analysis of factors that may be associated with excess weight at 7 years of age<sup>1</sup>**

**Perinatal characteristics**

- Maternal smoking during pregnancy (yes; no)
- Birth weight (medical records: less than 2,500 g; 2,500 g to 4 kg; more than 4 kg)
- Premature status (medical records: <37 weeks)
- *Total breastfeeding duration* (not breastfed; breastfed less than 4 months; breastfed 4 months or more)

**Parents' weight status**

- *Number of parents in the household who were overweight or obese* (when the child was 17 months old)

**Sociodemographic characteristics at 7 years of age**

- Sex of the child (boy; girl)
- *Mother's immigrant status* (non-immigrant; European immigrant; non-European immigrant)
- Mother's educational level (no high school [secondary school] diploma; high school diploma; other)
- Mother's employment status (past 12 months) (full-time; part-time; had not worked)
- Household income level (less than \$30,000; \$30,000 to \$79,999; \$80,000 or more)
- *Income sufficiency* (yes; no)
- Type of household (two-parent; single-parent)
- Number of brothers or sisters (none; one; two; three or more)
- *Region of residence*
- *Level of material deprivation in the neighbourhood* (quintiles)

**Eating behaviours at 4 years of age** (reported by the mother)

- *Difficult with food*
- *Eats too much (overeats) or too fast*
- *Eats at irregular times*

**Eating habits and diet behaviours at 7 years of age** (reported by the mother)

- Eats breakfast every morning (yes; no)
- Frequency of daily consumption of fruit juice or fruit drinks (fewer than three times; three times or more)
- *Frequency of weekly consumption of sugary or soft drinks (sodas)*
- Frequency of daily consumption of sweets (cake, cookies, candies, etc.) (less than once; once; twice or more)
- *Frequency of daily consumption of vegetables / potatoes*

**Sleep habits at 7 years of age** (reported by the mother)

- Duration of nocturnal sleep (10 hours or less; more than 10 hours)

**Physical and sedentary activities at 7 years of age** (reported by the mother)

- *Participation in non-organized physical activities or sports outside of school hours*
- *Participation in sports with a coach or trainer outside of school hours*
- *Takes other lessons or organized physical activity classes outside of school hours*
- *Time spent in front of a television or computer screen*

**Other**

- *Low-income trajectories from birth to 4 years of age*
- Lack of money to buy food reported when child was 6 years of age

1. Characteristics in italics are described in detail in Table A.3.

Table A.3  
**Details of certain characteristics described in this fascicle**

Characteristic	Round	Description
<b>Perinatal characteristics</b>		
Duration of total breastfeeding	1999	Duration of maternal breastfeeding, whether or not the child was fed other liquids or solid foods: <ul style="list-style-type: none"> <li>▪ Not breastfed</li> <li>▪ Breastfed less than 4 months</li> <li>▪ Breastfed 4 months or more</li> </ul>
<b>Parents' weight status</b>		
Number of parents in household who were overweight or obese	1999	Based on data related to height and weight reported by the parents when the child was 17 months old. Overweight and obesity were established according to international criteria defined by Cole et al. (2000): <ul style="list-style-type: none"> <li>▪ Neither</li> <li>▪ One</li> <li>▪ Two</li> </ul>
<b>Health and psychosocial development of the child</b>		
Overall health	2005	Health of the child perceived by the Person Most Knowledgeable (PMK) of the child: <ul style="list-style-type: none"> <li>▪ Excellent or Very Good</li> <li>▪ Good, Fair or Poor</li> </ul>
Physical fitness	2005	Level of physical fitness of the child compared to other children the same age, as reported by the PMK: <ul style="list-style-type: none"> <li>▪ Higher</li> <li>▪ Equal to or lower</li> </ul>
Symptoms of general anxiety, separation anxiety, attention deficit / hyperactivity <sup>1</sup>	2002	Means and percentiles on a standardized scale (from 0 to 10) measuring one or another aspect of child development as reported by the PMK. A higher score indicates more symptoms or a higher degree of symptom(s).
<b>Sociodemographic characteristics</b>		
Mother's immigrant status	2005	<ul style="list-style-type: none"> <li>▪ Non-immigrant</li> <li>▪ European immigrant (born in Europe, the U.S., Australia, or New Zealand)</li> <li>▪ Non-European immigrant (born in any other country except those listed above and Canada) (Chen, Wilkins &amp; Ng, 1996)</li> </ul>
Income sufficiency status	2005	According to the low-income cutoff before taxes set by Statistics Canada as a function of the size of the household and region of residence in the reference year of 2004: <ul style="list-style-type: none"> <li>▪ Sufficient</li> <li>▪ Insufficient</li> </ul>
Low-income trajectories before the age of 4 years	1998 to 2001	Three categories: <ul style="list-style-type: none"> <li>▪ The category of "Not once" refers to children in a household the income of which had never been below the low-income cutoff between birth and the age of 4 years</li> <li>▪ The category of "Transitory" comprises children in a household having experienced one or two years below the low-income cutoff</li> <li>▪ The category of "Persistent" comprises children in a household having experienced at least three years below the low-income cutoff</li> </ul>

Table A.3 (cont'd)  
**Details of certain characteristics described in this fascicle**

<b>Eating habits and diet behaviours</b> (reported by the mother)		
Frequency of weekly consumption of sugary or soft drinks (sodas)	2005	Frequency of consumption at home or school during the week preceding the survey: <ul style="list-style-type: none"> <li>▪ Not once</li> <li>▪ Once or twice</li> <li>▪ Three or more times</li> </ul>
Frequency of daily consumption of vegetables / potatoes	2005	Frequency of consumption at home or school during the week preceding the survey: <ul style="list-style-type: none"> <li>▪ Less than once a day</li> <li>▪ Once or twice</li> <li>▪ Three or more times</li> </ul>
Eats too much or too fast	2002	Comprises children who engaged in one or the other of these behaviours sometimes or often.
Difficult with food	2002	Comprises children who are often fussy or picky, who always eat meals that differ from other family members, or who often refuse to eat.
Eats at irregular times	2002	Comprises children who rarely, sometimes or never eat meals at regular hours and those who often eat between meals and who are not hungry at mealtime.
<b>Physical or sedentary activities</b> (past 12 months) (reported by the mother)		
Participates in non-organized physical activities or sports outside of school hours	2005	<ul style="list-style-type: none"> <li>▪ Almost every day</li> <li>▪ A few times a week</li> <li>▪ About once a week</li> <li>▪ About once a month or less</li> </ul>
Participation in sports with a coach or trainer outside of school hours (except dance and gymnastics)	2005	<ul style="list-style-type: none"> <li>▪ More than once a week</li> <li>▪ About once a week</li> <li>▪ One or two sessions</li> <li>▪ About once a month or less</li> </ul>
Participation in other lessons or organized physical activity classes outside of school hours	2005	<ul style="list-style-type: none"> <li>▪ About once or more a week</li> <li>▪ One or two sessions</li> <li>▪ About once a month or less</li> </ul>
Time spent in front of a television or computer screen	2005	<p>The mother was asked how many hours a day, on average, her child spends: a) playing video games or being in front of a computer b) watching television or videos/DVDs during the week and on the weekend. Response categories were: "None," "Less than one," "From one to less than three," "From three to less than five," "From five to less than seven," "Seven or more." To calculate the amount of time spent in front of a screen, the mid-point value of each response category (namely 0, 0.5, 2, 4, 6 or 7) was taken for each of a and b, then added together. The resulting totals were then grouped into three categories:</p> <ul style="list-style-type: none"> <li>▪ One hour or less</li> <li>▪ More than one to less than three</li> <li>▪ Three or more</li> </ul>

Table A.3 (cont'd)  
**Details of certain characteristics described in this fascicle**

<b>Zone of residence</b>		
Region of residence	2005	<p>Combination of a variable describing the administrative region and a geographical variable distinguishing four categories: 1- the Montréal CMA (Census Metropolitan Area); 2- other CMAs with more than 100,000 inhabitants; 3- CAs (Census Agglomerations) with between 10,000 and 100,000 inhabitants; and 4- MIZs (Metropolitan Influenced Zones) called RSTs (Rural and Small Towns), comprising municipalities with a population lower than 10,000 habitants (Martinez et al., 2004). Based on these two variables, a variable comprising three categories was constructed:</p> <ul style="list-style-type: none"> <li>▪ Montréal-Centre;</li> <li>▪ Other urban region with more than 10,000 inhabitants</li> <li>▪ Rural or small town region</li> </ul>
Level of material deprivation of neighbourhood of residence	2005	<p>Quintile of the material deprivation index of the neighbourhood, developed by Pampalon, Philbert and Hamel (2004). The index comprises educational level, employment/population ratio, and mean income of people 15 years of age and over in the neighbourhood of residence.</p>

1. For further information on the contents of these indices or scales or on other derived variables, technical documentation (French only) can be accessed on the QLSCD website at: [www.jesuisjeserai.stat.gouv.qc.ca/pdf/doc\\_tech/volet\\_2006/E9Variables\\_deriveesE1\\_E9.pdf](http://www.jesuisjeserai.stat.gouv.qc.ca/pdf/doc_tech/volet_2006/E9Variables_deriveesE1_E9.pdf)

## Notes

1. *Direction des statistiques sociales, démographiques et de santé, Institut de la statistique du Québec (ISQ)* (Social, Demographic and Health Statistics Directorate, Québec Institute of Statistics).
2. Department of Epidemiology and Community Medicine, and the Institute of Population Health, University of Ottawa.
3. Contrary to what Health Canada and Statistics Canada's use of the term "excess weight" to designate overweight only, here and in the rest of the fascicle we use "excess weight" to cover both the category of overweight and that of obesity. Indeed, in light of the work of other authors (Éco-Santé Québec, 2007; Mongeau et al., 2005), this seems easier to retain as an all-encompassing term.
4. The Canada-wide percentages were 18% and 8% respectively for children 2 to 17 years of age. The prevalence of overweight was significantly higher among all Canadian children compared to Québec ones (18% vs. 15%) (Shields, 2005).
5. According to data compiled by the ISQ based on the *Fichier d'inscription des personnes assurées (FIPA)* (Register of Insured Persons) at the *Régie de l'assurance maladie du Québec* (Québec Health Insurance Board – i.e. Medicare), approximately 8% of 7-year-old children in 2005 had come to the province after being born elsewhere.
6. To be more precise, the children were between 3 years and 8 months and 4 years and 7 months of age in the 2002 round, between 5 years and 8 months and 6 years and 8 months of age in the 2004 round, and between 6 years and 8 months and 7 years and 7 months of age in the 2005 round. It should be noted that height and weight measurements reported by the parents were collected during other annual rounds of the QLSCD. These data are not included here because it has been demonstrated that measurements reported by parents are less precise, and can therefore produce over-estimates of the prevalence of excess weight in children (Dubois and Girard, 2007; Shields, 2005).
7. In the nutrition round conducted when the children were 4 years old, two measurements of height and weight were taken. The final figure used was the average of the two measurements. When the difference between the first and second measurement was more than 0.5 kg for the weight and at least 0.5 cm for the height, a third measurement was taken, and the average of the two closest measurements was used. At the ages of 6 and 7 years, only one measurement of height and weight was taken. For a more detailed description of the protocol used in the 2002 nutrition round, see Desrosiers and Bédard (2005). For the procedures involved in the 2004 round, see Brunet and Tremblay (2003-2004). The procedure used in the 2005 round can be accessed on the QLSCD website at: [www.jesuissjeserai.stat.gouv.qc.ca/pdf/questionnaires/E8POAC\\_7ans.pdf](http://www.jesuissjeserai.stat.gouv.qc.ca/pdf/questionnaires/E8POAC_7ans.pdf)
8. See for example: Armstrong et al., 2002; Dubois et al., 2000; Dubois & Girard, 2006; Gillman et al., 2001; Hediger et al., 2001; Ong et al., 2000; Parsons et al., 1999; Parsons et al., 2003; Power & Jefferies, 2002; Rasmussen, 2001; Reilly et al., 2005; Stettler et al., 2002; Touchette et al., 2008; von Kries et al., 1999.
9. Because of lower response rates in the 2003 and 2004 rounds of the QLSCD, the characteristics measured in these rounds, when the children were 5 and 6 years of age, were not retained in the analysis. However, an exception was the lack of money to buy food reported when the children were 6, since this could be the origin of an imbalance in nutrition and contribute to excess weight (see Box 2).
10. All the data presented in this fascicle have been weighted and therefore adjusted so that the results are representative of the target population of the QLSCD. In addition, the estimates were produced by taking into account the complex sample design of the survey.
11. These findings were based on mean comparison tests. Since the data in these behaviour scales did not follow a normal distribution, chi-square tests were conducted to confirm the associations obtained by categorizing the variables linked to the scales into two – upper quartile, quintile or decile, versus others, according to the distribution. These analyses confirmed the mean comparisons.
12. See the articles on this topic in the Encyclopedia on Early Childhood Development at: <http://www.child-encyclopedia.com/en-ca/child-eating-behaviour/how-important-is-it.html>
13. In the QLSCD, the income declared is that before taxes and deductions, in the 12 months preceding the survey, of all household members who usually live in the household in which the child lives. It should be noted that in order to further explore the possible link between poverty and excess weight in the children, other analyses were conducted on, for example, income sufficiency, based on the low-income cutoff set by Statistics Canada, and number of episodes of low income before the age of 4. In all cases, children living in lower-income households were not more likely than other children to have excess weight (overweight or obesity). However, this could differ if we were to specifically examine income and its possible link to obesity (see Box 2).
14. Similar to the bivariate analyses, all the variables significant at the threshold of 0.10 were retained in the final model. Since the phenomenon of excess weight is not rare, it is recommended to interpret the odds ratios in a correlation manner, namely by only considering that the probability of excess weight was increased or lowered by a given factor, without focusing on the specific magnitude of the "effect" observed.

## Bibliography

- AGRAS, W. S., L. D. HAMMER, F. McNICHOLAS and H. C. KRAEMER (2004). "Risk factors for childhood overweight: a prospective study from birth to 9.5 years," *Journal of Pediatrics*, Vol. 145, No. 1, p. 20-25.
- ARMSTRONG, J., J. J. REILLY and THE CHILD HEALTH INFORMATION TEAM (2002). "Breastfeeding and lowering the risk of childhood obesity," *Lancet*, Vol. 359, No. 9322, p. 2003-2004.
- BARLOW, S. E., and W. H. DIETZ (1998). "Obesity evaluation and treatment: Expert committee recommendations," *Pediatrics*, Vol. 102, No. 3, p. e29, [Online]: [www.pediatrics.org/cgi/content/full/102/3/e29](http://www.pediatrics.org/cgi/content/full/102/3/e29) (page accessed March 22, 2005).
- BASDEVANT, A., M. LAVILLE, O. ZIEGLER et al. (1998). "Guide pratique pour le diagnostic, la prévention, le traitement des obésités en France," *Diabète et métabolisme*, Vol. 24 (Suppl. 2), p. 10-42.
- BAUR, L. A. (2005). "Childhood obesity: practically invisible," *International Journal of Obesity*, Vol. 29, No. 4, p. 351-352.
- BÉDARD, B., H. DESROSIERS, B. LACHANCE and L. DUBOIS (2005). "Conclusion générale," in: H. DESROSIERS et al. (under the supervision of) (2005). *Enquête de nutrition auprès des enfants québécois de 4 ans*, Québec, Institut de la statistique du Québec, p. 127-139.
- BÉDARD, B., L. DUBOIS and M. GIRARD (2005). "Habitudes, comportements et contextes alimentaires," in: H. DESROSIERS et al. (under the supervision of) (2005). *Enquête de nutrition auprès des enfants québécois de 4 ans*, Québec, Institut de la statistique du Québec, p. 113-126.
- BRUNET, A., C. RISI, I. SAMSON and I. MICHAUD (2007). *Pour faire contrepoids à l'obésité en milieu scolaire, Les cahiers de la directrice – Complément au Rapport de la directrice de santé publique*, Longueuil, Agence de la santé et des services sociaux de la Montérégie, 28 p.
- BRUNET, M., and A. TREMBLAY (2003-2004). *Cahier des procédures. Évaluation de la condition physique – Maternelle 5 ans*, document produced in the context of Québec en forme (Québec in Shape), Québec, Université Laval, internal document, 14 p.
- BRUNSTROM, J. M., G. L. MITCHELL and T. S. BAGULEY (2005). "Potential early-life predictors of dietary behaviour in adulthood: a retrospective study," *International Journal of Obesity*, Vol. 29, No. 5, p. 463-474.
- CHEN, J., R. WILKINS and E. NG (1996). "Health Expectancy by Immigrant Status, 1986 and 1991," *Health Reports*, Vol. 8, No. 3, p. 29-38.
- COLE, T. J., M. C. BELLIZI, K. M. FLEGAL and W. H. DIETZ (2000). "Establishing a standard definition for child overweight and obesity worldwide: international survey," *British Medical Journal*, Vol. 320, p. 1-6.
- DANIELZIK, S., K. LANGNASE, M. MAST, C. SPETHMANN and M. J. MULLER (2002). "Impact of parental BMI on the manifestation of overweight 5-7 year old children," *European Journal of Nutrition*, Vol. 41, No. 3, p. 132-138.
- DESROSIERS, H., and B. BÉDARD (2005). "Caractéristiques des enfants et de leur famille," in: H. DESROSIERS, et al. (under the supervision of) (2005). *Enquête de nutrition auprès des enfants québécois de 4 ans*, Québec, Institut de la statistique du Québec, p. 47-65.
- DIETZ, W. H. (1998). "Health Consequences of Obesity in Youth: Childhood Predictors of Adult Disease," *Pediatrics*, Vol. 101, p. 518-525.
- DIVISION OF NUTRITION AND PHYSICAL ACTIVITY (2006). "Do Increased Portion Sizes Affect How Much We Eat?," *Research to Practice Series, No. 2: Portion Size*, Atlanta, Centers for Disease Control and Prevention, 5 p.
- DOUKETIS, J. D., G. PARADIS, H. KELLER and C. MARTINEAU, for the Expert Working Group on the Canadian Guidelines for Body Weight Classification (2005). "Canadian guidelines for body weight classification in adults: Application in clinical practice to screen for overweight and obesity and to assess health risk," *Canadian Medical Association Journal*, Vol. 172, No. 8, p. 995-998.
- DUBOIS, L., B. BÉDARD, M. GIRARD and É. BEAUCHESNE (2000). "Diet," in: *Longitudinal Study of Child Development in Québec (ÉLDEQ 1998-2002). 5-Month-Old Infants*, Québec, Institut de la statistique du Québec, Vol. 1, No. 5.
- DUBOIS, L., and M. GIRARD (2007). "Accuracy of maternal reports of pre-schoolers' weights and heights as estimates of BMI values," *International Journal of Epidemiology*, Vol. 36, No. 1, p. 132-138.
- DUBOIS, L., and M. GIRARD (2006). "Early determinants of overweight at 4.5 years in a population-based longitudinal study," *International Journal of Obesity*, Vol. 30, No. 4, p. 610-617.
- DUBOIS, L., A. P. FARMER, M. GIRARD and K. PETERSON (2007a). "Preschool children's eating behaviours are related to dietary adequacy and body weight," *European Journal of Clinical Nutrition*, Vol. 61, No. 7, p. 846-855.
- DUBOIS, L., M. GIRARD, A. GIRARD, R. E. TREMBLAY, M. BOIVIN and D. PÉRUSSE (2007b). "Genetic and environmental influences on body size in early childhood: a twin birth-cohort study," *Twin Research and Human Genetics*, Vol. 10, No. 3, p. 479-485.
- ÉCO-SANTÉ QUÉBEC (2007). *9.1.1 Proportion de la population présentant un surplus de poids*, [Online]: [www.ecosante.fr/QUEBFRA/901010.html](http://www.ecosante.fr/QUEBFRA/901010.html) (page accessed November 26, 2008).
- FAITH, M. S., K. S. SCANLON, L. L. BIRCH, L. A. FRANCIS and B. SHERRY (2004). "Parent-child feeding strategies and their relationships to child eating and weight status," *Obesity Research*, Vol. 12, No. 11, p. 1711-1722.
- FISCHLER, C. (2001). *L'honnivore*, Paris, Éditions Odile Jacob, 440 p.
- FISHER, J. O. (2007). "Effects of age on children's intake of large and self-selected food portions," *Obesity*, Vol. 15, No. 2, p. 403-412.
- FISHER, J. O., and L. L. BIRCH (2002). "Eating in the absence of hunger and overweight in girls from 5 to 7 years of age," *American Journal of Clinical Nutrition*, Vol. 76, No. 1, p. 226-231.
- FRANCIS, L. A., A. K. VENTURA, M. MARINI and L. L. BIRCH (2007). "Parent overweight predicts daughters' increase in BMI and disinhibited overeating from 5 to 13 years," *Obesity*, Vol. 15, No. 6, p. 1544-1553.

- FREEDMAN, D. S., M. K. SERDULA, S. R. SRINIVASAN and G. S. BERENSON (1999). "Relation of circumferences and skinfold thicknesses to lipid and insulin concentrations in children and adolescents: the Bogalusa Heart Study," *American Journal of Clinical Nutrition*, Vol. 69, No. 2, p. 308-317.
- GILLMAN, M. W., S. L. RIFAS-SHIMAN, C. A. CAMARGO, C. S. BERKEY, A. L. FRAZIER, H. R. ROCKETT, A. E. FIELD and C. A. COLDITZ (2001). "Risk of overweight among adolescents who were breastfed as infants," *Journal of the American Medical Association*, Vol. 285, No. 19, p. 2461-2467.
- GOLAN, M., and S. CROW (2004). "Parents are key players in the prevention and treatment of weight-related problems," *Nutrition Reviews*, Vol. 62, No. 1, p. 39-50.
- HAYS, N. P., G. P. BATHALON, M. A. MCCRORY, R. ROUBENOFF, R. LIPMAN and S. B. ROBERTS (2002). "Eating behaviour correlates of adult weight gain and obesity in healthy women aged 55-65 y," *American Journal of Clinical Nutrition*, Vol. 75, No. 3, p. 476-483.
- HEDIGER, M. L., M. D. OVERPECK, R. J. KUEZMARSKI and W. J. RUAN (2001). "Association between infant breastfeeding and overweight in young children," *Journal of the American Medical Association*, Vol. 285, No. 19, p. 2453-2460.
- JANSSEN, I., W. M. CRAIG, W. F. BOYCE and W. PICKETT (2004). "Associations Between Overweight and Obesity With Bullying Behaviors in School-Aged Children," *Pediatrics*, Vol. 113, No. 5, p. 1187-1194.
- JOHNSON-TAYLOR, W. L., and J. E. EVERHART (2006). "Modifiable Environmental and Behavioral Determinants of Overweight among Children and Adolescents: Report of a workshop," *Obesity*, Vol. 4, No. 6 (Special Report), p. 929-966.
- KARANTZAS, K. (2006). *An investigation of obesity and binge eating behaviour in preadolescent Australian school children*, Doctoral thesis, Swinburne University of Technology, Faculty of Life and Social Sciences, Parkville (Australia), 186 p.
- MARTINEZ, J., R. PAMPALON, D. HAMEL and G. RAYMOND (2004). *Does Living in Rural Communities Rather Than Cities Really Make a Difference in People's Health and Wellness*, Québec, Institut national de santé publique, Direction Planification, recherche et innovation, 74 p.
- MAXIMOVA, K., J. J. MCGRATH, T. BARNETT, J. O'LOUGHLIN, G. PARADIS and M. LAMBERT (2008). "Do you see what I see? Weight status misperception and exposure to obesity among children and adolescents," *International Journal of Obesity*, Vol. 32, p. 1008-1015.
- MCCONAHY, K. L., H. SMICKLAS-WRIGHT, D. C. MITCHELL and M. F. PICCIANO (2004). "Portion size of common foods predicts energy intake among preschool-aged children," *Journal of American Dietetic Association*, Vol. 104, No. 6, p. 975-979.
- MIKAMI, A., S. HINSHAW, K. A. PATTERSON and J. CHANG LEE (2008). "Eating Pathology Among Adolescent Girls With Attention-Deficit/Hyperactivity Disorder," *Journal of Abnormal Psychology*, Vol. 117, No. 1, p. 225-235.
- MINDELL, J. A. (2004). "Sleep in America," *Sleep Research Society Bulletin*, Vol. 10, p. 14-15.
- MONGEAU, L. (2003). "Être jeune et gros: Le rôle délicat du clinicien. Comment intervenir sans nuire?," *Le Clinicien*, Vol. 18, No. 5, p. 45-49.
- MONGEAU, L., N. AUDET, J. AUBIN and R. BARALDI (2005). *L'excès de poids dans la population québécoise de 1987 à 2003*, Québec, Institut national de santé publique and Institut de la statistique du Québec, 23 p.
- O'NEIL, C. E., T. A. NICKLAS and R. E. KLEINMAN (2007). *The relationship among 100% juice consumption, nutrient intake, and weight of children 2-11 years*, presentation at the Pediatric Academic Societies' Annual Meeting, Toronto, May 5-8, abstract No. 8406.4, 1 p.
- ONG, K. K. L., M. L. AHMED, P. M. EMMETT, M. A. PREECE, D. B. DUNGER and ALSPAC STUDY TEAM (2000). "Association between postnatal catch-up growth and obesity in childhood: prospective cohort study," *British Medical Journal*, Vol. 320, No. 7290, p. 967-971.
- PAMPALON, R., M. PHILIBERT and D. HAMEL (2004). *Développement d'un système d'évaluation de la défavorisation des communautés locales et des clientèles de CLSC*, Final research report, Québec, Institut national de santé publique du Québec, 38 p.
- PARADIS, G. (2008). "Le traitement de l'obésité chez l'enfant et l'adolescent," *Le bulletin de l'Alliance québécoise pour la santé du cœur*, Special insert, Vol. 11, No. 1, p. 1- 8.
- PARSONS, T. J., C. POWER, S. LOGAN and C. D. SUMMERBELL (1999). "Childhood predictors of adult obesity: a systematic review," *International Journal of Obesity*, Vol. 23, No. 8, p. S1-S107.
- PARSONS, T. J., C. POWER and O. MANOR (2003). "Infant feeding and obesity through the lifecourse," *Archives of Disease in Childhood*, Vol. 88, No. 9, p. 793-794.
- POWER, C., and J. M. H. JEFFERIES (2002). "Fetal environment and subsequent obesity: a study of maternal smoking," *International Journal of Epidemiology*, Vol. 31, No. 2, p. 413-419.
- RASMUSSEN, K. M. (2001). "The 'Fetal Origins' Hypothesis: challenges and opportunities for maternal and child nutrition," *Annual Review of Nutrition*, Vol. 21, p. 73-95.
- REILLY, J. J., J. ARMSTRONG, A. R. DOROSTY, P. M. EMMETT, A. NESS, I. ROGERS, C. L. STEER and A. SHERIFF, for the Avon Longitudinal Study of Parents and Children Study Team (2005). "Early life risk factors for obesity in childhood: Cohort study," *British Medical Journal*, [Online]: <http://www.bmi.com/cgi/rapidpdf/bmi.38470.670903.E0v1> (page accessed June 12, 2008).
- ROLLS, B. J., D. ENGELL and L. L. BIRCH (2000). "Serving portion size influences 5-year-old but not 3-year-old children's food intakes," *Journal of the American Dietetic Association*, Vol. 100, No. 2, p. 232-234.
- HEALTH CANADA (2003). *Canadian Guidelines for Body Weight Classification in Adults*, Ottawa, Health Canada, 41 p.
- SHIELDS, M. (2006). "Overweight and obesity among children and youth," *Health Reports*, Vol. 17, No. 3, p. 27-42.
- SHIELDS, M. (2005). "Overweight Canadian children and adolescents," *Nutrition: Findings from the Canadian Community Health Survey*, Ottawa, Statistics Canada, No. 1, Catalogue No. 82-620-MWE2005001, 34 p.
- SNELL, E. K., E. K. ADAM and G. J. DUNCAN (2007). "Sleep and the Body Mass Index and Overweight Status of Children and Adolescents," *Child Development*, Vol. 78, No. 1, p. 309-323.

- STATISTICS CANADA (2002). "National Longitudinal Survey of Children and Youth: Childhood obesity," *The Daily*, October 18. [Online]: <http://www.statcan.gc.ca/daily-quotidien/021018/dq021018b-eng.htm> (page accessed September 4, 2008).
- STEINBERGER, J., and S. R. DANIELS (2003). "Obesity, Insulin Resistance, Diabetes and Cardiovascular Risk in Children," *Circulation*, Vol. 102, p. 1448-1453.
- STETTLER, N., B. S. ZEMEL, S. KUMANYIKA and V.A. STALLINGS (2002). "Infant weight gain and childhood overweight status in a multicentre cohort study," *Pediatrics*, Vol. 109, No. 2, p. 194-199.
- TAHERI, S. (2006). "The link between short sleep duration and obesity: we should recommend more sleep to prevent obesity," *Archives of Disease in Childhood*, Vol. 91, p. 881-884.
- TAHERI, S., L. LIN, D. AUSTIN, T. YOUNG and E. MIGNOT (2004). "Short sleep duration is associated with reduced leptin, elevated ghrelin, and increased body mass index," *PLoS Medicine*, Vol. 1, No. 3, e62, p. 210-217.
- TANOFKY-KRAFF, M., D. FADEN, S. Z. YANOVSKI, D. E. WILFLEY and J. A. YANOVSKI (2005). "The perceived onset of dieting and loss of control eating behaviors in overweight children," *International Journal of Eating Behaviour*, Vol. 38, No. 2, p. 112-122.
- TOUCHETTE, É., D. PETIT, R. E. TREMBLAY, M. BOIVIN, B. FALISSARD, C. GENOLINI and J. MONTPLAISIR (2008). "Associations Between Sleep Duration Patterns and Overweight/Obesity at Age 6," *Sleep*, Vol. 31, No. 11, p. 1507-1514.
- VAISSIÈRE, M. (2004). *Troubles du comportement alimentaire et médecine générale*. Thesis presented for the Diplôme d'État, doctorate in medicine, Université Paul Sabatier, Toulouse, 328 p.
- VON KRIES, R., B. KOLETZKO, T. SAUERWALD, E. VON MUTIUS, D. BARNERT, V. GRUNERT and H. VON VOSS (1999). "Breast feeding and obesity: cross-sectional study," *British Medical Journal*, Vol. 319, No. 7203, p. 147-150.
- VON KRIES, R., A. M. TOSCHKE, B. KOLETZKO and W. SLIKKER (1999). "Maternal Smoking during Pregnancy and Childhood Obesity," *American Journal of Epidemiology*, Vol. 156, No. 10, p. 954-961.
- WORLD HEALTH ORGANIZATION (WHO) (2000). *Obesity: Preventing and Managing the Global Epidemic. Report of a WHO Consultation on Obesity*, Geneva, World Health Organization, WHO Technical Report Series, No. 894, 252 p.

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