INSPQ INSTITUT NATIONAL DE SANTÉ PUBLIQUE DU QUÉBEC

The Economic Consequences Associated With Obesity and Overweight in Québec: Costs Tied to Hospitalization and Medical Consultations

FARDEAU DU POIDS CORPOREL

Québec

AUTHORS

Chantal Blouin
Nathalie Vandal
Amadou Diogo Barry
Yun Jen
Denis Hamel
Ernest Lo
Sylvie Martel

COLLABORATOR

Patricia Lamontagne

ACKNOWLEDGMENTS

Franck Larouche and Gérard Ngeta, CIQSS
Alain Yao, ICIS
Gail Yuzichuk, RAMQ

TRANSLATION

Nina Alexakis Gilbert, Angloversion.ca
The translation of this publication was made possible with funding from the Public Health Agency of Canada.

The analysis presented in this paper was conducted at the Québec Interuniversity Centre for Social Statistics which is part of the Canadian Research Data Centre Network (CRDCN). The services and activities provided by the QICSS are made possible by the financial or in-kind support of the SSHRC, the CIHR, the CFI, Statistics Canada, the FRQSC and the Québec universities. The views expressed in this paper are those of the authors, and not necessarily those of the CRDCN or its partners.

This document is available in its entirety in electronic format (PDF) on the Institut national de santé publique du Québec Web site at: http://www.inspq.qc.ca.

LEGAL DEPOSIT – 1st QUARTER 2015
BIBLIOTHÈQUE ET ARCHIVES NATIONALES DU QUÉBEC
LIBRARY AND ARCHIVES CANADA
ISBN: 978-2-550-72044-7 (FRENCH PDF)
ISBN: 978-2-550-72322-6 (PDF)

Foreword

In 2003, the Ministère de la Santé et des Services sociaux (MSSS) produced the *Québec Public Health Program: 2003-2012* (the *Programme national de santé publique – 2003-2012* or PNSP). This program established several objectives, including reducing the proportion of the adult population that is overweight or obese (MSSS, 2003). The reiteration of these objectives in the 2008 PNSP update and the adoption of the *Plan d'action gouvernemental de promotion des saines habitudes de vie et de prévention des problèmes reliés au poids 2006-2012 – Investir pour l'avenir* (MSSS, 2006) (the government action plan for promoting healthy lifestyles and preventing weight-related problems) confirmed the importance of taking body weight into account in efforts to improve the health of the Québec population.

Following this initial planning phase, an interdisciplinary working group was established to produce an initial portrait of the current burden represented by health problems related to body weight in Québec and to project body weight calculations over a twenty-year horizon. This document is a product of the group's work. It constitutes one of a series of documents to be published examining the burden engendered by body weight in Québec. Two reports, entitled *Le fardeau économique de l'obésité et de l'embonpoint : revue de la littérature* (Blouin et al., 2013) and *Poids corporel et santé chez les adultes québécois* (Martel et al., 2014) were published previously.

This work results from a collaborative effort intended to support upcoming planning activities related to the promotion of healthy lifestyles and the prevention of weight-related problems, and to provide information that can help improve the quality of life of individuals, regardless of their weight.

Table of contents

List of tables

Summary

Over the past 40 years, industrialized countries have undergone social and economic changes that have increased the risk of developing chronic diseases within the population. The increasingly sedentary nature of work, a decrease in physical activity due to reliance on automobiles and to urban sprawl and more sedentary recreational activities have all contributed to an ongoing reduction in levels of physical activity.

To this can be added the major changes the food system has undergone during the same period. The food system is now characterized by the industrialization of agricultural production, increased caloric availability and lower prices for food with low nutritional value. In addition, food distribution and marketing practices have made food continually available in our environments. In this type of environment, which does little to promote healthy eating and the adoption of a physically active lifestyle, chronic diseases and obesity increased.

This report documents the economic impact of these social changes for Québec. It presents the initial results of an ongoing study at the INSPQ aimed at estimating the economic impact of overweight and obesity among adults in Québec. Two types of direct costs tied to the provision of health services are analyzed: medical consultations in outpatient clinics and nights in hospital. An analysis is made of the impact of those classified as overweight or obese, in terms of additional health services use, as compared to those of normal weight in the control group.

The main source of data for this project is the National Population Health Survey (NPHS). This is a longitudinal Canadian survey conducted by Statistics Canada. The survey was conducted from 1994 to 2011, every two years, among households in the ten Canadian provinces. The initial sample set for Québec used for our analysis includes 2,357 adults.

Our data indicates that adults in Québec who were obese in 1994 made greater use of health services between 1994 and 2011 than those of normal weight. The likelihood of use among obese people was 94% higher than for normal weight individuals for the number of nights in hospital and 13% higher for the number of medical consultations.

This excess use translates into an annual economic burden of $1.5 billion for Québec, if the monetary value is based on the expenses incurred for these health services in 2011. This amount represents 10 percent of total costs for medical consultations and hospitalization for adults in Québec in 2011.

To reduce the economic burden associated with obesity, importance should be placed on pursuing and intensifying current measures aimed at promoting healthy lifestyles and preventing weight-related problems by altering the environments in which we live, so that they become more conducive to healthy eating and physical activity. Indeed, international recommendations concerning obesity prevention stress the importance of working to change not only individual behaviour, but also, especially, the physical, economic, political and socio-cultural environments that shape our everyday habits. The social changes that produced an economic burden of this scale developed over the course of decades; long-term efforts will be required for the creation of living environments that make healthy choices the easiest ones.

1 Introduction

Over the past 40 years, industrialized countries have undergone social and economic changes that have increased the risk of developing chronic diseases within the population. Work has steadily become more sedentary; the number of people with a job that requires a moderate level of physical activity has decreased significantly (Church et al., 2011). Increased reliance on automobiles and urban sprawl have, in turn, reduced transportation-related physical activity. Recreational activities are also becoming increasingly sedentary, in particular, due to the rise of information technology and the amount of time spent in front of screens (Lear et al., 2014). In conjunction with this steady decrease in levels of physical activity, our food system has undergone major changes in recent decades. The food system is now characterized by the industrialization of agricultural production, increased caloric availability and lower prices for food with low nutritional value (Swinburn et al., 2011). In addition, changes in food distribution and marketing have made food continually available and ever present in our environments.

In this type of environment, which does little to promote healthy eating or the adoption of a physically active lifestyle, an increase in chronic diseases and obesity has been observed (Lamontagne & Hamel, 2013). In this report, we attempt to document the economic impact of these social changes for Québec, by focusing on the economic consequences of overweight and obesity. Recent studies have examined the impact of obesity on the health of the Québec population (Martel et al., 2014). Studies conducted abroad and in other Canadian provinces have revealed that overweight and obesity carry significant economic costs (Blouin et al., 2013). But there is hardly any information about the economic impact in Québec of environments that are not conducive to healthy lifestyles.

Thus, this report presents the initial results of a study being conducted by the INSPQ, which is aimed at estimating the economic burden of overweight and obesity among adults in Québec. In this report, we examine two types of direct costs, that is, costs directly associated with the provision of health services: medical consultations in outpatient clinics and nights in hospital. To this end, we consider the impact of those classified as overweight or obese, in terms of additional health services use, as compared to those of normal weight in the control group. In a second report, we will present our results for other types of costs: those related to medication use and to disability.

This first report is divided into four main sections. The first part provides an overview of the scientific literature on the economic burden of obesity and overweight. It summarizes the results of the studies reviewed and the main methodological choices made by researchers working in this area, in order to contextualize the approach adopted in this study. The second section discusses the methodology used in this study to quantify the economic costs examined. It includes an overview of the data sources used, of the variables and indicators selected and of the statistical analysis methods applied. The results of our study are presented in the third section. This is followed by a comparison between our results and those of studies of other populations and a discussion of the limitations of our research design.

2 Highlights of the literature on the economic burden of obesity and overweight

To prepare the research design for this study, we conducted a review of the literature published since 1990 that quantifies the economic burden of obesity (Blouin et al., 2013). We identified 129 studies quantifying the direct and indirect costs associated with obesity. Direct costs are costs related to the provision of health services. Indirect costs arise from lost productivity when individuals have to leave work because of health reasons, temporarily (absenteeism) or permanently (disability or premature death). These indirect costs are calculated on the basis of the contribution that these individuals would have made to the economy, if not for their health problems.

Of these 129 studies, 123 of them found that obesity engenders major costs. For example, for Canada, it is estimated that the additional health care costs associated with obesity and overweight represented 4.1% of the country's total health care spending in 2006 (Anis et al., 2010). A similar calculation performed for the province of Alberta totalled the costs resulting from excess weight at 2.8% of health care spending for 2005 (Moffat et al., 2010).

The vast majority of studies found that obesity had a significant impact on health care spending and on lost productivity, but study results varied significantly. For example, in comparing the annual cost of health care for an obese individual and for a normal weight individual, one U.S. study observed a difference of $620 per person-year (Goetzel et al., 2010) and another of more than $2,700 (Cawley, 2012).

The heterogeneity of research protocols can largely explain these variations and often makes it difficult to compare results (Bloom et al., 2001, Clabaugh, 2008). Researchers' choices respecting the costs included in the analysis (e.g., hospitalization, medication, absenteeism), the data sources used (e.g., longitudinal administrative data, transversal survey data) and the weight categories included (e.g., obesity only or overweight and obesity) can all have a significant impact on results. The estimation methods used can also explain much of the variation in results among studies.

In the literature on the economic burden of obesity, two main approaches to estimation were observed: modeling studies and studies based on databases.[1] Modeling studies begin by compiling a list of diseases associated with obesity and the estimated costs engendered by the treatment of these diseases. Next, the proportion of cases attributable to obesity is calculated for each disease, based on what is known about the risks associated with obesity. Accordingly, if 90% of cases of type II diabetes are known to be attributable to obesity, then 90% of the cost of treating diabetes in a given population is attributed to this factor. The sum of the costs for all the diseases identified is then tallied.

One of the major weaknesses of the approach adopted by modeling studies is that it produces results that vary widely depending on the diseases included in the estimates. The longer the list, the higher the costs. Moreover, the results of these studies do not take into account the fact that obese people are at risk for comorbidity, that is, of suffering from several conditions at once, such as cardiovascular disease, diabetes and hypertension. The costs engendered by such a person cannot be calculated by simply adding the average cost associated with each disease taken separately. This method of calculation would systematically lead to an overestimation of the actual cost associated with obesity. Another limitation of this approach is that it does not allow control for confounding factors, that is, other factors that may explain the association between excess weight and excess costs.

Studies based on databases make it possible to link the weight of individuals to the costs they engender. These costs may stem from their use of services, their level of absenteeism or their premature death. These studies compare obese or overweight individuals with those of normal weight. The objective is to establish whether they make greater use of health services, have a higher level of absenteeism or die earlier. This approach allows the excess costs of obesity and overweight to be calculated with statistical accuracy. The majority of studies use this approach, especially the most recent studies conducted in the United States.

Studies on this economic burden can also be classified according to the period of time covered. They are either transversal studies, conducted at a specific point in time, or longitudinal studies that monitor a population over a period of time or until an event is observed (e.g., death).

With respect to overweight, we identified 35 studies based on databases that analyze overweight individuals separately. They generally revealed a gap in health spending and lost productivity between these individuals and those of normal weight, but the gap was smaller than the one observed for obese individuals. Moreover, 8 of the 35 studies did not reveal a statistically significant difference between medical spending for overweight and normal weight individuals.

3 Approach chosen for this study

No estimation of the economic costs of obesity has been produced for Québec so far, apart from a study published by a group of consultants in 2000 (Coleman et al., 2000). This study, as well as nearly all those produced for Canada or for other Canadian provinces, is a modeling study.

[1] The second category also comprises simulation studies, which have the advantage of calculating the economic burden throughout the life cycle.

To avoid the limitations of modeling studies, our research design is based on a database. Studies using this approach do not face the problem of selecting diseases associated with obesity, since the analysis is carried out without regard to causative links. All the health problems of the individuals in the sample set are included in the calculation of the cost difference between normal weight and overweight individuals, not just the costs associated with a predetermined number of diseases linked to excess weight, such as diabetes or cardiovascular disease.

By adopting a more global view of health, our approach allows the additional use of health services engendered by all the health problems of overweight individuals to be measured.

In addition, we opted to use longitudinal data rather than transversal data, because the latter do not take into account health impacts that unfold over time and, since there may be significant delays between the onset of a condition (in this case, obesity and overweight) and the onset of diseases, the costs can take several years to materialize. As with several of the studies found in the literature, our project is to examine not only the impact of obesity, but also of overweight. Although the literature indicates that, at the individual level, the economic impact of overweight is smaller than that of obesity, it is important to include both weight categories. With an overweight prevalence of more than 34% in Québec in 2009-2010 (Lamontagne & Hamel, 2012), overweight can engender significantly higher costs, at the population level, for the health system.

3.1 Methodology

3.1.1 Data sources

The main source of data for this project is the National Population Health Survey (NPHS), Household Component. This is a longitudinal Canadian survey conducted by Statistics Canada. The survey, initiated in 1994, was carried out every two years among households in the ten Canadian provinces, excluding persons living on Indian reserves or Crown lands, residents of health care institutions, full-time residents of Canadian Forces bases and persons residing in certain remote areas of Ontario and Québec. The NPHS comprises 9 cycles and the last cycle of data collection took place in 2011. The sample was not renewed over time.

We used the longitudinal sample, square, of the NPHS, that is, the sample composed of all respondents, including those who gave partial responses to questionnaires or who did not respond to all cycles. The longitudinal sample (square) consists of 14,117 adults (18 years and older) for Canada and 2,417 adults for Québec. Of these, some subjects were excluded because their body mass index in cycle 1 was unknown (402 for Canada and 58 for Québec). Cycles for which subjects were missing data for at least one variable of the statistical model were excluded from the database. Thus, the final sample for Canada includes 13,684 subjects and 86,142 items of information from all cycles, while the Québec sample includes 2,357 subjects and 15,253 items of information from all cycles.

Our relative risk estimates were based on the model presented below, which includes five control variables. The latter were calculated based on weighted data from the Québec and Canadian samples, as recommended by Statistics Canada. The results for the Québec sample are presented in the body of the report and those for the Canadian sample are presented in Annex A.

To set a monetary value on weight-related excess service use, we drew on various sources of information. Firstly, the National Health Expenditure Database (NHEX) of the Canadian Institute for Health Information (CIHI) provided information about total expenditures on medical services and hospitalization costs in Québec. This database includes health expenses incurred by both the public and private sectors, including the expenses incurred by insurance companies and by patients themselves. It covers the period from 1975 to 2011. CIHI obtains its data from the public accounts of provincial, territorial and federal governments, and submits its estimates to the health departments for review (CIHI, 2013). The estimates of private expenditures are based on information collected from private insurers and on data collected by Statistics Canada's Survey of Household Spending (SHS).

We used the data for the 2011 calendar year for public and private funds allocated to hospitals and for physician fees, for the Québec population aged 18 and

older.[2] Section 5.2 of this report contains a discussion of the limitations of using this type of data source, as opposed to administrative data on health services use.

When the NHEX presents total expenditures for services provided by physicians, it includes fees paid to physicians for services provided in hospitals. Consequently, a portion of the costs listed in the CIHI database as "medical services" should be listed as hospital costs, if we want to accurately reflect each cost category. Using the official statistics of the Régie de l'assurance-maladie du Québec (RAMQ) on medical services expenditures by place of provision (Table SM.23), we recalculated the total expenditures associated with hospitalization and the expenditures for physician services in outpatient clinics. Spending on medical services provided in hospitals for general and specialized care are included in total expenditures associated with hospitalization, except for services provided in outpatient clinics and emergency departments. The medical services provided in nursing homes and long-term care facilities were also included in the total expenses linked to hospitalization.

To calculate the monetary value of excess service use linked to excess weight, as presented in Annex B, we also needed to know the estimated number of adults in Québec in each weight category in 2011. This information was drawn from Statistics Canada's Canadian Community Health Survey (CCHS) and processed by the INSPQ's Surveillance des maladies chroniques et traumatismes team.

3.1.2 Independent variable: Obesity and overweight

Obesity and overweight are defined as "abnormal or excessive fat accumulation that presents a risk to health."[3] Like the vast majority of recent studies, this report uses the classification system based on body mass index (BMI) to categorize individuals as normal weight, overweight or obese. BMI is defined as weight in kilograms divided by the square of height in meters (kg/m^2). An adult with a BMI between 25 and 29.9 kg/m^2 is classified as overweight, while an adult with a BMI of 30 kg/m^2 or greater is considered obese (Health Canada, 2003). Individuals with a BMI between 18.5 kg/m^2 and 24.9 kg/m^2 are classified as normal weight. Individuals with a BMI of less than 18.5 kg/m^2 are considered underweight. The latter were included in analyses, but these results are not presented in this report.

In the NPHS, each individual declared his or her height and weight for each cycle. Each individual's BMI was calculated based on these data. For the purposes of this report, the BMI for the survey's first cycle (1994-1995) is used in the model. The longitudinal studies identified in our literature review also used BMI at time 1 as the independent variable. We are trying to determine what use is made of health services following exposure to obesity or overweight. Since we do not know what the BMI of respondents was prior to 1994, time 1 serves as a kind of proxy for the level of exposure to this risk factor.

3.1.3 Dependant variables

The dependent variables used to measure health services use were the annual frequency of nights in hospital and of medical consultations. The NPHS provides self-reported information concerning these two variables.

Firstly, respondents were asked how many times they had consulted a physician in the last twelve months. Secondly, respondents were asked how many nights they had spent in a hospital, in a convalescent home or in a nursing home in the past twelve months. As with the questions relative to BMI, these questions were asked for each of the nine cycles. Our model uses the average number of consultations or nights in hospital for the entire period covered (1994-2011).

3.1.4 Control variables

Five control variables were introduced into our statistical model to ensure that the estimated relationship between weight and health services use would not be attributable to other variables that could be associated with weight or with service use (called confounding factors or confounders). On the basis of our literature review, we identified three socio-

[2] The NHEX provided information on the distribution of these expenditures by age group. In this way, we were able to calculate total expenditures in Québec in 2011 for services rendered by physicians and for hospital costs for persons aged 18 and older. The data provided by the CIHI are aggregated for the 15 to 19 year old age group. We therefore included 40% of expenditures for this age group within total expenditures, to account for expenses for 18 and 19 year olds. Note that information on the distribution by age group is available only for public spending, not for expenses incurred by households or insurers. We had to take the known distribution of provincial government expenditures and apply this to private spending.

[3] http://www.who.int/dietphysicalactivity/childhood_what/en/.

demographic variables: gender, age and socio-economic status; and two behavioural variables: smoking status and consumption of fruits and vegetables. We did not include level of physical activity as a confounding variable because, although a sedentary lifestyle can have an impact on weight, excess weight can also limit the practice of physical activity. A confounding variable must not also be influenced by the independent variable (Hernan et al., 2002). As the indicator of socio-economic status, we used the highest level of education obtained in the household, as reported by the respondent. For smoking status, we used an indicator that categorized respondents into four groups: regular smoker, occasional smoker, former smoker, someone who has never smoked. The indicator chosen for the final control variable was total daily frequency of fruit and vegetable consumption. The latter two indicators are derived variables from the survey results prepared by Statistics Canada (Statistics Canada, 2012).

3.2 Statistical analyses

The relationship between health services use and body mass index at time 1 was estimated using Poisson regression models adjusted for confounding factors, with results presented as relative risks. The correlation between data from the same individual was analyzed using GEE models (Generalized Estimating Equations). The choice of correlation matrix, between independent, exchangeable and autoregressive of order 1, was based on the quasi-likelihood information criterion (QIC) for each estimated model. Estimation of the variance of parameters, accounting for the survey design, was performed using the bootstrap method, as proposed by Statistics Canada. This method also allows overdispersion in the models to be taken into account. The 95% confidence intervals were calculated using the Wald method. The GENMOD procedure in SAS (Version 9.3) was used.

3.3 Calculation of excess cost

The excess cost resulting from obesity and overweight was defined as the difference between the observed cost and the cost expected if these conditions resulted in the same use of health services as for normal weight individuals. The total cost of health services use for a weight category can be estimated by multiplying the number of individuals in this category by the average cost per use. The total expected cost if individuals in this weight category were to make the same use of health services as normal weight individuals is estimated by dividing the observed costs by the relative risk for the number of health service uses for the weight category being examined, as compared with normal weight individuals (refer to the Formula in Annex B).

The average cost per health services use was estimated based on total health expenditures derived from NHEX data (for medical consultations and hospitalization, respectively). The unit cost was obtained by distributing the total cost according to the number of individuals and the average number of service uses observed for the population of Québec by weight category.

4 Results

4.1 Sample characteristics

A description of the Québec sample of NPHS participants, by body mass index (BMI) category at the time of the first survey cycle in 1994-1995, is presented in Table 1. As can be seen, 53.1% of adults in Québec fell into the normal body weight category, 32.6% were in the overweight category and 11.2% fell into the obese category.

Table 1 Sample characteristics, by weight category and by control variable, for Québec, NPHS 1994-1995

	BMI for cycle 1					
	Normal weight		Overweight		Obese	
	n	Weighted prop. (%)	n	Weighted prop. (%)	n	Weighted prop. (%)
Total	1 248	53,1	748	32,6	277	11,2
Age group						
18-24 years	173	15,9	44	4,8[a]	N.P.	N.P.[b]
25-44 years	604	47,8	315	41,6	99	36,8
45-64 years	303	23,8	257	36,2	121	43,6
65 years and over	168	12,4	132	17,4	45	15,5
Gender						
Male	528	45,4	454	61,0	123	48,0
Female	720	54,6	294	39,0	154	52,0
Household education level						
Some high school studies	243	15,8	198	22,3	88	25,8
High school diploma	150	11,3	78	10,0	27	11,5[a]
Some post secondary studies	304	24,2	184	23,2	69	29,4
Post secondary diploma	551	48,7	288	44,5	93	33,2
Smoking status						
Regular smoker	456	34,3	202	27,4	60	21,3
Occasional smoker	61	5,1	33	4,4[a]	N.P.	N.P.[b]
Former smoker	322	25,1	275	35,6	109	36,1
Never smoked	409	35,5	238	32,6	98	38,0
Fruit and vegetable consumption						
Less than 5 portions per day	547	43,6	348	46,1	122	44,9
At least 5 portions per day	382	31,2	233	32,7	95	33,8
Unknown	319	25,2	167	21,1	60	21,2

[a] The weighted proportion must be interpreted with caution. The coefficient of variation is between 16.6% and 33.3%.

[b] Value not shown. The weighted proportion does not meet the quality standards of Statistics Canada. The coefficient of variation is higher than 33.3%, or some categories include fewer than 10 subjects. Statistics Canada recommends that the data not be published.

Source: National Population Health Survey, Statistics Canada.

4.2 Medical consultations

Compared to normal weight adults in Québec, those in the obese category were found to consult physicians more frequently, and this difference was statistically significant. The excess use is calculated at 13% (95% CI: 2% - 26%) (Table 2). For overweight individuals, no statistically significant relative risk was observed. These estimates are based on the model presented above, which includes five control variables and examines health care use throughout the period monitored (1994 to 2011).

On average, normal weight adults in Québec consult a physician 3.6 (95% CI: 3.3 - 3.9) times per year, whereas those in the obese category consult 4.1 (95% CI: 3.6 - 4.5) times per year (Table 2). These are raw averages and, thus, are not adjusted for confounding variables.

Table 2 Medical consultations per year for adults, by body weight category at beginning of survey, for Québec, NPHS 1994-2011

	Number of medical consultations per year	
BMI for cycle 1	***Average[a] (95% CI)***	***Relative risk[b] (95% CI)***
Normal weight	3.6 (3.3-3.9)	1
Overweight	3.3 (3.1-3.5)	0.95 (0.85, 1.06)
Obese	4.1 (3.6-4.5)	1.13 (1.02, 1.26)[c]

[a] Average weighted to represent the Québec population, but not adjusted.

[b] Weighted and adjusted for potential confounders: age, gender, education, smoking status and fruit and vegetable consumption.

[c] Statistically significant difference between normal weight and obese individuals.

Source: National Population Health Survey, Statistics Canada.

4.3 Nights in hospital

As regards nights in hospital, excess use by obese individuals was calculated at 94% (95% CI: 24% - 201%) as compared to the reference group (Table 3). However, no statistically significant difference between overweight and normal weight individuals was observed.

The unadjusted average number of nights in hospital per year was 2.3 (95% CI: 1.2-3.4) nights for adults in Québec in the obese category and 1.0 (95% CI: 0.8-1.3) night per year for normal weight adults in Québec.

Table 3 Nights in hospital per year for adults, by body weight category at beginning of survey, for Québec, NPHS 1994-2011

	Number of nights in hospital per year	
BMI for cycle 1	***Average[a] (95% CI)***	***Relative risk (95% CI)***
Normal weight	1.0 (0.8-2.3)	1
Overweight	1.5[b] (1.0-2.0)	1.13 (0.76, 1.65)
Obese	2.3[b] (1.2-3.4)	1.94 (1.24, 3.01)[c]

[a] Average weighted to represent the Québec population, but not adjusted.

[b] Weighted and adjusted for potential confounders: age, gender, education, smoking status and fruit and vegetable consumption.

[c] Statistically significant difference between normal weight and obese individuals.

Source: National Population Health Survey, Statistics Canada.

4.4 What is the cost of this excess health services use for Québec?

In order to quantify the economic burden of obesity, we calculated the monetary value, for the year 2011, of excess services use by obese individuals. In 2011, the estimated expenditure for consultations with physicians attributable to adults in Québec was $4.7 billion. Spending on hospitalization, for its part, amounted to $10.5 billion, for the same year (Table 4).Using the estimated relative risks and information regarding the prevalence of obesity in Québec in 2011 (Table 5), we assessed the economic burden of obesity at approximately $1.5 billion (Table 6). This amount is composed of $110 million for excess physician consultations and $1.4 billion for excess nights in hospital. This total represents 10% of the combined cost for these two categories of health expenditures for adults in Québec in 2011.

Table 4 Total expenditures for medical consultations and hospitalization, for adults in Québec, 2011

Type of cost	*Expenditures (millions of dollars)*
Medical consultations	4,763.6
Hospitalization	10,536.5

Sources: the National Health Expenditure Database (NHEX) and the Régie de l'assurance-maladie du Québec (RAMQ).

Table 5 Estimated population in each body weight category, population aged 18 and over, Québec, 2011

Weight category	*Number of persons*	*Prevalence[a] (%)*
Underweight	173,550	2.8
Normal weight	2,919,730	47.1
Overweight	2,063,090	33.2
Obese	1,048,640	16.9
Total	**6,205,010**	**100**

[a] Prevalence based on self-reported measurements.

Source: Institut national de santé publique du Québec (INSPQ) (2014). Indicator derived from the master file of Statistics Canada's Canadian Community Health Survey, 2011 Cycle.

Table 6 Estimated economic burden of obesity in Québec for 2011, for medical consultations and hospitalization, in millions of dollars

Type of cost	*Excess expenditures (millions of dollars)*
Medical consultations	100
Hospitalization	1,420
Total	1,520

5 Discussion and limitations of study design

The results presented in this report confirm the presence of an economic burden tied to obesity, such as has been observed elsewhere in Canada and abroad (Blouin et al., 2013). It is important to recall that the results from non-experimental studies, like those having examined the economic burden of obesity, establish a correlation, and not necessarily a causal relationship, between obesity and health services use.

In addition to producing estimates for Québec, we have produced estimates of health services use for the Canadian NPHS sample. The excess use of medical consultations in Québec appears lower than that observed for the Canadian population. In fact, there is a difference of 30% (95% CI: 23% - 37%) associated with obese persons in Canada (see Table 8 in Annex 1). For Canada, a relative risk of 1.08 (95% CI: 1.03 - 1.13) for additional medical consultations was observed for overweight individuals, as compared with normal weight individuals. Given the larger sample size for Canada, the estimates have narrower confidence intervals than those observed for Québec. For this report, we did not perform statistical tests to examine the differences between the two samples and the estimates produced from these samples.

Compared with the Canadian results presented in Annex A, the excess use of hospital care by obese individuals, as compared with normal weight individuals, appears higher in Québec. In Canada, the risk of use appears to be 44% higher (95% CI: 16% - 78%) for obese persons than for those of normal weight (Table 9 in Annex 1). This difference between obese and normal weight Canadian adults is statistically significant. Note here that the estimate for Canada falls within the confidence interval of the estimate for Québec.

If the results of this study are compared with those that used a similar methodological approach,[4] the results generally converge. Thus, the study by Janssen et al. (2009) which examined the costs of medical consultations in Ontario in 2002-2003 observed excess costs of 14.7% for men and 18.1% for women. A U.S. study estimated at 26.9% the excess costs of outpatient visits associated with obesity in 2006 (Finkelstein et al., 2009). An Australian study based on a national survey that questioned participants about their use of health services in the two weeks prior to the interview observed a difference of 20% for men and 30% for women (Reidpath et al., 2002).

Regarding hospitalization, to our knowledge, no studies comparable to ours exist for Canada. The study by Finkelstein and colleagues estimated at 45.5% the additional cost of hospital care for obese Americans. In contrast, the Australian study mentioned above (Reidpath et al., 2002) found no significant difference for hospitalization.

Regarding overweight, this weight category was not observed to have a significant effect on health services use, as compared with normal weight adults, in Québec. In the literature review, we identified 35 studies using databases that compared the use of health services by overweight individuals and by those of normal weight. Eight of the 35 studies found no significant difference for overweight individuals. Those studies that observed a significant effect noted a smaller effect than that associated with obesity. It is possible that the smaller size of the Québec sample does not provide sufficient statistical power to detect this smaller effect. Moreover, as indicated below in the discussion of the design limitations related to our independent variable, the standard classification of weight categories, based on BMI, probably does not adequately reflect the health risks associated with abdominal adiposity. However, no other indicators, such as waist circumference, can be obtained from large-scale population-based surveys in Québec and Canada.

[4] Comparable designs are those of studies found in the literature that are based on databases (transversal or longitudinal data), that cover adults 18 years and older, that control for confounding variables and whose results are presented in a manner that allows the excess use to be calculated as a percentage and not only in additional dollars. These designs may differ from ours with regard to certain dimensions, such as the use of transversal data or of administrative data.

5.1 Limitations tied to the independent variable

Our study uses the BMI categories proposed by the WHO as its independent variable. Several authors have pointed out that using BMI as a measure of obesity has limitations, since it does not measure body fat distribution, and it is abdominal adiposity that is most clearly identified as a health risk (especially for those in the overweight and moderately obese categories) (Janssen et al., 2004). In addition, recent studies indicate that waist circumference has increased in each weight category (normal, overweight, and obese) in recent years (Shield et al., 2012). This implies that even normal weight persons are currently at greater risk for poor health than in the past. Also, the BMI thresholds for weight categories raise questions; for example, the health risks for normal weight individuals (our reference category) with a BMI of less than 22 kg/m^2 are much greater than for those with a BMI of between 22 and 25 (Eymsfield & Cefalu, 2013). At a later stage, it would be reasonable to compare obese individuals to those with a BMI of between 22 and 25, that is, to individuals whose weight is associated with the lowest health risk, because the current thresholds may underestimate the difference in health services use between the weight categories being examined. Nevertheless, the vast majority of studies use the BMI classification system proposed by the WHO in their research design. Indeed, very little data has been collected using other measurements, such as waist circumference.

Our study is also limited by the fact that it is based on self-reported, rather than measured, weight and height data. A systematic review of the subject demonstrated the existence of a BMI underestimation bias with self-reported data (Connor et al., 2007). In 2005, Statistics Canada compared self-reported weight and height with directly measured weight and height for 4,567 of the 132,947 respondents to the Canadian Community Health Survey (Shields et al., 2008).[5] Individuals whose BMI fell into the overweight or obese categories tended to overestimate their height and underestimate their weight. The differences were such that, for 2005, the prevalence of obesity in Canada would be estimated at 22.6% were it based on measured values, instead of at

[5] The self-reported weight of men with a normal BMI differed little from their measured weight, but a gap existed for overweight and obese men. For women, under-reporting of weight was observed for all weight categories (except for underweight women).

15.6%, the current estimated prevalence, as based on self-reported data. A similar exercise was carried out in Quebec in 2008, revealing that the prevalence of overweight among adults was underestimated by 4.1% and that of obesity by 8.8%, bringing them to 36.7% and 24.5% respectively in 2008 (Lamontagne & Hamel, 2012).

Given the scale of this reporting bias, we considered applying a correction factor to the NPHS data when calculating the BMI of respondents. Since we cannot compare our self-reported BMI data to measured BMI data for cycle 1 (1994-1995), we believe it would be dangerous to generalize the equations produced for the CCHS because "it is probable that the increase in obesity in recent years has been accompanied by a corresponding increase in reporting bias, which could indicate temporal instability in the equations" (Gorber et al., 2008). In Canada, an increase in the bias was confirmed for the period between 1986 and 2005 (Gorber & Tremblay, 2010). This bias toward underestimation of the prevalence may lead to conservative estimates of the economic burden.

In our study, as in all those identified in the literature review, body weight measurements were taken at the beginning of the period monitored (for studies using longitudinal data) and researchers then examined the evolution of the subsequent use of health services. With this approach, it is not possible to examine the impact of the duration of exposure to obesity or overweight on costs. Nor does this approach take into account the usual weight trajectories of people over the life course. In fact, adults generally gain weight with age (up to age 65) (Lamontagne & Hamel, 2012). Recent studies have examined the impact of duration and degree on the health burden of excess weight (Abdullah et al., 2012, Bouchard et al., 2013). They confirm that indicators that take into account the duration and degree of exposure to this risk factor are associated with a greater burden of chronic diseases, such as type 2 diabetes.

5.2 Limitations tied to the dependent variables

The NPHS provides self-reported data on the use of services, data which are subject to recall bias. In fact, several U.S. studies comparing self-reported data and medical administrative data on health services use found that patients tend to underestimate their services use (Ritter et al., 2001, Roberts et al., 1996). The gap is particularly significant for medical visits in outpatient clinics, and smaller or inexistent for emergency department visits or nights in hospital. In addition, the discrepancy between self-reported and administrative data increases with services use. This can result in an underestimation of the excess service use of obese individuals, given that they make greater use of health services. Consequently, our estimates of the associated economic burden are likely conservative. Nevertheless, it should be noted that the confidence intervals of our relative risk estimates for Québec are quite large, especially those for nights in hospital.

Also, the NPHS provides us with information as to the frequency with which individuals use health services, such as the number of visits to physicians or the number of nights in hospital. Consequently, the estimated costs associated with excess health services use cannot be based on actual expenditures, as is possible when administrative data, such as data from the Régie l'assurance-maladie du Québec (RAMQ), is used. The pairing of information from health surveys and from medical administrative databases is a promising means of producing more accurate estimates of economic burden. Moreover, this could make it possible to monitor effects over a longer period and to better measure costs that take a long time to materialize. Indeed, it is quite possible that the health problems of individuals who were obese and in their twenties in 1994, during cycle 1, did not materialize during the period monitored, but surfaced after 2011. Given the timeframe of our project, we did not have the option of pairing survey and administrative data. Consequently, our cost estimates do not take into account the fact that some hospitalizations or consultations are more costly than others, nor could we extend the monitoring period beyond the NPHS survey period.

Another important limitation of this initial report is that it only covers two types of direct costs associated with overweight and obesity. The total economic burden of excess weight comprises several other categories of direct and indirect costs. Some of these costs (such as the cost of medication) will be covered in the second report to be issued in the context of this project. Nonetheless, our study will not cover all the economic costs associated with excess weight. Thus, with respect to direct costs, our study does not examine

consultations with health care professionals other than physicians, the cost of home care or ambulance transportation costs. With respect to indirect costs, our project does not take into account costs related to absenteeism or to the reduced productivity of workers who are present at work but functioning at less than full capacity due to their illness. Finally, our study only examines the adult population, and not the excess use of services by children under 18 years old. Given the increase in obesity and overweight among young people, the economic burden calculated for Québec would probably have been higher if this population had been included in our study.

6 Conclusion

This report presents the first estimates quantifying the economic burden of obesity and overweight in Québec. They are based on survey data on the use of health services. Our results indicate that obesity is associated with significant overuse of health services and, consequently, engenders major additional costs that could be avoided.

We estimated an economic burden equivalent to $1.5 billion for 2011. Our estimates are likely conservative. Indeed, these estimates are based on self-reported data concerning the use of health services, which leads to underestimation of the number of medical consultations for more frequent users, in particular. Furthermore, the estimates rely on self-reported BMI data, which leads to an underestimation of the prevalence of overweight and obesity. In addition, this annual amount excludes other direct costs, such as the cost of prescription drugs or of services provided by health professionals other than physicians, and indirect costs, such as those linked to absenteeism and disability.

To reduce the economic burden associated with obesity, importance should be placed on pursuing and intensifying current measures aimed at promoting healthy lifestyles and at altering the environments in which we live, so that they become more conducive to healthy eating and physical activity. Indeed, international recommendations concerning obesity prevention stress the importance of working to change not only individual behaviour, but also, especially, the physical, economic, political and socio-cultural environments that shape our everyday habits (IOM, 2012). The social changes that produced an economic burden of this scale developed over the course of decades; long-term efforts will be required for the creation of living environments that make healthy choices the easiest ones.

References

Abdullah, Asnawi and al. (2012). Epidemiologic metric of obese-years, the combination of degree and duration of obesity, *American Journal of Epidemiology, 176*(2).

Anis, A. H., Zhang, W., Bansback, N., Guh, D. P., Amarsi, Z., & Birmingham, C. L. (2010). Obesity and overweight in Canada: an updated cost-of-illness study. *Obesity Reviews: An Official Journal Of The International Association For The Study Of Obesity*, *11*, 31-40.

Bloom, B. S., Bruno, D. J., Maman, D. Y., & Jayadevappa, R. (2001). Usefulness of US cost-of-illness studies in healthcare decision making. *Pharmacoeconomics*, *19*, 207-213.

Blouin, C., Barry, A.D., Jen, Y., Hamel, D., Lamontagne, P., Lo, E. & Martel, S. (2013). *Le fardeau économique de l'obésité et de l'embonpoint : revue de littérature,* Québec, Institut national de santé publique du Québec.

Bouchard, and al. (2013). Risk of type 2 diabetes and cumulative excess weight exposure in the Framingham offspring study, *Journal of Diabetes and its complications*.

Canadian Institute for Health Information (2013). *National Health Expenditure Trends, 1975-2013*, Ottawa. (Annex on health expenditure by use of funds, Québec, from 1975 to 2013).

Cawley, J. & Meyerhoefer, C. (2012). The medical care costs of obesity: An instrumental variables approach. *Journal of Health Economics*, *31*, 219-230.

Church, T.S., Thomas, D.M., Tudor-Locke, C., Katzmarzyk, P.T., Earnest, C.P., Rodarte, R.Q., and al. (2011). Trends over 5 decades in U.S. occupation-related physical activity and their associations with obesity. *PLoS One*, *6*(5): e19657.

Clabaugh, G. & Ward, M. M. (2008). Cost-of-illness studies in the United States: a systematic review of methodologies used for direct cost. *Value.Health*, *11*, 13-21.

Coleman, R. & Dodds, C. (2000). Cost of obesity in Quebec. *GPI Atlantic*.

Connor, S., Gorber, M., Tremblay, D. Hoher and al. (2007). A comparison of direct vs. self-report measures for assessing height, weight and body mass index: A systematic review. *Obesity Review*, *8*(4).

Eymsfield, S., & Cefalu, W. (2013). Does BMI adequately convey a patient's mortality risk? *JAMA*, *309*(1).

Finkelstein, E. A., Trogdon, J. G., Cohen, J. W. & Dietz, W. (2009). Annual medical spending attributable to obesity: payer- and service-specific estimates. *Health Aff (Millwood)*, *28*(5), w822-w831.

Goetzel, R. Z., Gibson, T. B., Short, M. E., Chu, B. C., Waddell, J., Bowen, J. and al. (2010). A multi-worksite analysis of the relationships among body mass index, medical utilization, and worker productivity. *J Occup Environ Med*., *52*(Suppl 1), S52-8.

Gorber, S.C. & M. Tremblay (2010). The Bias in Self-reported Obesity From 1976 to 2005: A Canada–US Comparison. *Obesity*, *18*, 354-361.

Gorber, S.C., Shields, M., Tremblay, M., & Mcdowell, I. (2008). The feasibility of establishing correction factors to adjust self-reported estimates of obesity. *Health Reports,* Statistics Canada, No. 82-003-X, page 80.

Health Canada (2003). *Canadian Guidelines for Body Weight Classification in Adults*, Ottawa.

Hernan, Miguel et al. (2002). Causal knowledge as a prerequisite for confounding evaluation, *American Journal of Epidemiology*, vo.155, no 2.

Institute of Medicine (2012), *Accelerating progress in obesity prevention: Solving the weight of the nation*, Washington, IOM.

Janssen, I., Lam M., & Katzmarzyk, P. T. (2009). Influence of overweight and obesity on physician costs in adolescents and adults in Ontario, Canada. *Obes Rev*, *10*(1), 51-57.

Janssen, I., Katzmarzyk, P.T., Ross, R. (2004), Waist circumference and not body mass index explains obesity related health risk. *Am J Clin Nutr*, *79*, 379–84.

Lamontagne, P. & Hamel, D. (2012). *Surveillance du statut pondéral chez les adultes québécois : portrait et évolution de 1987 à 2010*, Québec, Institut national de santé publique du Québec.

Lear, Scott and al. (2014). The association between ownership of common household devices and obesity and diabetes in high, middle and low income countries. *CMAJ*, February.

Martel, S. and al. (2014). *Portrait de la santé des adultes québécois selon le statut pondéral*. Québec, Institut national de santé publique du Québec.

Moffatt, E., Shack, L. G., Petz, G. J., Sauve, J. K., Hayward, K., & Colman, R. (2011). The cost of obesity and overweight in 2005: a case study of Alberta, Canada. *Can J Public Health*, *102*, 144-148.

Reidpath, D. D., Crawford, D., Tilgner, L. & Gibbons, C. (2002). Relationship between Body Mass Index and the Use of Healthcare Services in Australia. *Obesity*, *10*(6), 526-531.

Ritter, and al. (2001). Self-reports of health care utilization compared to provider records. *Journal of Clinical Epidemiology*, *54*, 2001, 136-141.

Roberts, and al. (1996). Comparison of self-reported and medical record health care utilization measures. *Journal of Clinical Epidemiology*, *49* (9), 989-995.

Shields, M., Gorber, S. & Tremblay, M. (2008). Estimates of obesity based on self-report versus direct measures. *Health Reports*, *19*(2), Statistics Canada.

Shields, M., Tremblay, M., Gorber, S. & Janssen, I. (2012). Measures of abdominal obesity within body mass index categories, 1981 and 2007-2009, *Health Reports, 23*(2), June 2012, Statistics Canada, Catalogue No. 82-003-XPE.

Statistics Canada, 2012. National Population Health Survey – Household Component, *Documentation for the Derived Variables and the Constant Longitudinal Variables* (Specifications) Cycles 1 to 9 (1994-1995 to 2010-2011).

Swinburn, Boyd and al. (2011). The global obesity pandemic: shaped by global drivers and local environnements. *The Lancet*, *27*, 804-14.

Annexes

Annex 1

Table 7 Sample characteristics, by weight category and by control variable, for Canada, NPHS 1994-1995

	BMI for cycle 1					
	Normal weight		Overweight		Obese	
	n	Weighted prop. (%)	n	Weighted prop. (%)	n	Weighted prop. (%)
Total	6,456	48.6	4,936	35.9	1,937	12.9
Age group						
18-24 years	1,004	16.7	394	7.0	113	5.5
25-44 years	2,868	47.8	1,880	41.3	732	41.9
45-64 years	1,429	21.9	1,629	34.9	706	37.3
65 years and over	1,155	13.7	1,033	16.9	386	15.2
Gender						
Male	2,588	43.7	2,860	61.8	864	48.2
Female	3,868	56.3	2,076	38.2	1,073	51.8
Household education level						
Some high school studies	1,037	11.5	1,001	15.3	477	17.6
High school diploma	737	10.7	559	11.6	224	12.0
Some post secondary studies	1,718	26.1	1,327	27.0	547	30.6
Post secondary diploma	2,964	51.7	2,049	46.2	689	39.8
Smoking status						
Regular smoker	1,951	28.0	1,208	23.4	467	23.9
Occasional smoker	317	5.2	222	4.9	64	4.0
Former smoker	1,786	27.0	1,760	35.7	723	36.5
Never smoked	2,402	39.8	1,746	36.0	683	35.7
Fruit and vegetable consumption						
Less than 5 portions per day	3,113	48.5	2,633	53.1	994	51.1
At least 5 portions per day	1,557	25.1	1,075	23.4	442	25.7
Unknown	1,786	26.4	1,228	23.5	501	23.2

Source: National Population Health Survey, Statistics Canada.

Table 8 Medical consultations per year for adults, by body weight category at beginning of survey, for Canada, NPHS 1994-2011

BMI for cycle 1	*Average*[a] *(95% CI)*	*Relative risk*[b] *(95% CI)*
Normal weight	4.3 (4.2-4.5)	1
Overweight	4.6 (4.4-4.8)	1.08 (1.03-1.14)
Obese	5.7 (5.4-6.0)	1.30 (1.23-1.37)

[a] Average weighted to represent the Canadian population, but not adjusted.

[b] Weighted and adjusted for potential confounders: age, gender, education, smoking status and fruit and vegetable consumption.

Source: National Population Health Survey, Statistics Canada.

Table 9 Nights in hospital per year for adults, by body weight category at beginning of survey, for Canada, NPHS 1994-2011

	Number of nights in hospital per year	
BMI for cycle 1	*Average*[a] *(95% CI)*	*Relative risk*[b] *(95% CI)*
Normal weight	1.1	1
Overweight	1.2	1.06 (0.885 - 1.266)
Obese	1.6	1.44 (1.160 - 1.776)

[a] Average weighted to represent the Canadian population, but not adjusted.

[b] Weighted and adjusted for potential confounders: age, gender, education, smoking status and fruit and vegetable consumption.

Source: National Population Health Survey, Statistics Canada.

Annex 2

The average per use cost of health services (medical consultations and hospitalization, respectively) was estimated by distributing the total costs according to weight categories. This was done using the number of persons and the estimated average number of service uses for each weight category to represent the Québec population. Thus, the following formula was used

$$Average\ cost/use = [\![CostTotal]\!]_{\downarrow} / ([\![(N]\!]_{\downarrow}norm \times (NU)^{\hat{}}{}_{\downarrow}norm + N_{\downarrow}ovw \times (NU)^{\hat{}}{}_{\downarrow}ovw + [\![N_{\downarrow}ob \times (NU)^{\hat{}}{}]\!]_{\downarrow}ob + N_{\downarrow}undw \times (NU)^{\hat{}}{}_{\downarrow}undw)$$

Where N_{norm}, N_{ovw}, N_{ob}, N_{undw} represents the adult population in the normal weight, overweight, obese and underweight categories respectively and $\widehat{NU}_{norm}$, $\widehat{NU}_{ovw}$, $\widehat{NU}_{ob}$, $\widehat{NU}_{undw}$ represents the estimated number of service uses for the Québec population in the normal weight, overweight, obese and underweight categories respectively.

The observed cost for obese persons was obtained by multiplying the number of obese persons by the estimated number of service uses for obese adults in Québec and by the average per use cost.

$$Cost_{ob} = N_{ob} \times \widehat{NU}_{ob} \times Average\frac{cost}{use}$$

The expected cost if the services use of obese persons was equivalent to that of normal weight persons was estimated using the following formula

$$Cost_{ob=norm} = N_{ob} \times \widehat{NU}_{ob}\frac{\square}{\mathbf{RR_{ob}}} \times Average\frac{cost}{use}$$

Finally, the excess cost is obtained by subtracting from the observed cost the expected cost if the services use of obese persons was similar to that of normal weight persons.

Publication N°: 1943

Centre d'expertise
et de référence

www.inspq.qc.ca

Institut national
de santé publique
Québec