The Cost of Obesity and Overweight in 2005: A Case Study of Alberta, Canada

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ABSTRACT

Objective: The aim of this paper is to highlight the potential impact of costs associated with overweight and obesity for provincial policy and prevention initiatives.

Method: Prevalence-based cost-of-illness methodology was used to estimate the direct costs (hospital care, drugs, physician care, institutional care, additional costs) and indirect costs (short- and long-term disability, premature mortality) associated with excess weight for 22 health conditions. Total costs for each health condition were estimated using the Public Health Agency of Canada's Economic Burden of Illness database. Population attributable fractions (PAF) were also estimated using 2004 and 2005 CCHS data and current literature reviews.

Results: In 2005, the cost of excess weight in Alberta totaled \$1.27 billion. The direct cost of excess weight was \$630.1M (49.5%), the indirect cost \$643.8M (50.5%). Excluding costs associated with premature mortality and caregiving, obesity accounted for 69.5% (\$500.8M) of costs and overweight the remaining 30.5% (\$220.2M). Among the 22 health conditions, coronary heart disease had the highest costs attributable to excess weight (\$307.1M), followed by osteoarthritis (\$167.7M) and type 2 diabetes (\$161.5M). The total cost of excess weight equated to 5.6% of the province's annual health care expenditures for 2005.

Conclusion: While obesity costing research often focuses on the direct health care costs, this study reveals that the indirect costs of excess weight are also significant and can account for over half of the total costs. Interventions to reduce excess weight among Canadians have the potential to improve the health of the population while reducing provincial and national health care costs.

Key words: Obesity; overweight; Canada; cost; cost of illness

La traduction du résumé se trouve à la fin de l'article.

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Obesity is a well-established risk factor for many chronic health conditions, including cardiovascular disease, several types of cancer and type 2 diabetes.¹ The treatment and consequences of obesity-related health conditions impose an increased economic burden on health care systems, employers, families and individuals. Obesity has been estimated to account for 2% to 7% of health care costs in developed countries:¹ in Canada, the cost of obesity has been estimated to account for 2.2-4.1% of health care costs.²⁻⁴ However, the true costs are likely to be higher because often only a limited number of obesity-related conditions are considered,¹ while conditions like osteoarthritis, respiratory diseases and certain types of cancer are excluded.

The purpose of this study was to estimate the direct and indirect costs associated with overweight and obesity and to inform, using economic rationale, the provincial planning of obesity control initiatives. Overweight- and obesity-attributable direct and indirect costs of 22 health conditions were estimated among men and women aged 15 to 99 years for Alberta in 2005. While most earlier costing studies relied on self-reported height and weight to assess excess weight,^{3,4} this study uses directly-measured height and weight data or adjusted self-reported data, resulting in an improvement in the accuracy of obesity prevalence and attributable cost estimates.

METHOD

This study used cost-of-illness methodology to estimate the direct and indirect costs of obesity. Direct costs and indirect short- and

long-term disability costs were estimated using a prevalence-based approach, which is commonly used in cost-of-illness studies.^{2,3} Mortality costs were estimated using an incidence-based, human capital approach, which is used by Health Canada to estimate the costs of premature mortality.⁵

Data sources

The prevalence of excess weight was estimated using directly-measured BMI data from the 2004 Canadian Community Health Survey (CCHS)⁶ and adjusted self-reported BMI data

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Table 1. Overweight and Obesity-attributable Health Conditions

Type 2 Diabetes
Hypertension*
Coronary Heart Disease*
Cerebrovascular Disease†
Osteoarthritis†
Gallbladder Disease‡
Asthma‡
Depression‡
Cancer
Colorectal cancer§
Postmenopausal breast cancer (diagnosed after age 50)§
Endometrial cancer§
Kidney cancer§
Esophageal cancer‡
Ovarian cancer§
Prostate cancer§
Pancreatic cancer§
Non-Hodgkin's lymphoma§
Multiple myeloma§
Leukemia§
Liver cancer‡
Bladder cancer‡
Stomach cancer

* RRs estimated using self-reported disease prevalence and directly measured BMI data from the 2004 CCHS.

† RRs estimated using self-reported disease prevalence and adjusted self-reported BMI data from the 2005 CCHS.

‡ RRs taken from the literature.⁹⁻¹²

§ RRs not determined and Canadian PAFs estimated from the literature.^{13,14}

|| Neither an RR nor a PAF could be found, and consequently an odds ratio (OR) from the literature was used.¹⁴ An OR may approximate an RR if the incidence of the disease is relatively rare (e.g., less than 10%) and if the OR is between 0.9 and 2.5,¹⁵ which was true for stomach cancer.¹⁴

from the 2005 CCHS.⁷ The Body Mass Index (BMI) reference cut-off values for overweight and obesity are from the *Canadian Guidelines for Body Weight Classification in Adults*.⁸ Relative Risks (RRs) were calculated using self-reported disease prevalence and directly-measured or adjusted self-reported national BMI data from the 2004 and 2005 national CCHS datasets. National rather than provincial CCHS datasets provided more stable estimates due to small numbers at the provincial level. RRs (or, as necessary, population attributable fractions) from the literature were also used for conditions that were not included in the 2004 or 2005 CCHS (Table 1). For cancer (14 types combined), prevalence estimates for obesity class 1, 2 and 3 by age group and obesity category were not available due to small numbers, and therefore they could not be calculated for all health conditions.

The direct and indirect costs of the 22 health conditions were obtained from the Public Health Agency of Canada's (PHAC) *Economic Burden of Illness in Canada, 2000* (EBIC) unpublished report.¹⁶ Direct costs included expenditures for hospital care, drugs, physician care, institutional care, and additional direct costs such as capital investments, public health, and research. The direct cost of informal caregiving among adults aged 65 and older was estimated using the average weekly hours of work for an Albertan caregiver,¹⁷ and the out-of-pocket and hourly costs of caregiving in Alberta.^{18,19} Caregiving costs could not be allocated to diagnostic categories because they were not reported to this detail²⁰ but aggregate costs attributable to obesity were estimated using data from other studies.²¹ Indirect costs included the value time lost due to both short- and long-term disability, and years of life lost due to premature mortality.⁵ Premature mortality estimates in this study included only deaths occurring between the ages of 15 and 74 years because this range corresponded to the age-specific costs provided by EBIC.

Figure 1. Proportion of weight-related costs of each health condition attributable to BMI categories

Costs of premature mortality were not included because separate PAFs for overweight and obesity were not available. For cancer (all 14 sites), due to small sample sizes in cancer type, age group and sex strata, it was not possible to obtain PAFs specific to obesity class 1, 2 or 3. Therefore, estimates by obesity category for all health conditions (males, females, both genders) could not be estimated.

Analysis

Population Attributable Fractions (PAFs)

The population attributable fractions (PAF) determined in this analysis represent the proportion of each health condition that was attributable to excess weight. PAFs were estimated for all BMI categories in each age group (18-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75 and over) and sex group. The obesity-attributable proportion of caregiving costs among seniors (aged 65 years and older) was estimated from the literature to be 15.5%.²¹ The proportion of premature mortality caused by overweight and obesity for each health condition was taken from the WHO *Global Burden of Disease* (GBD) report,²² due to a lack of recent Canadian longitudinal data needed to determine RRs for premature mortality by BMI category and cause of death.

Costs of Excess Weight and Economic Adjustment

The costs of obesity and overweight were derived by multiplying the PAFs for disease prevalence and premature mortality by the Alberta-specific cost of each health condition in 2000. Economic inflation was accounted for by applying the Alberta government's current expenditure implicit price index (IPI); between 2000 and 2005, the IPI increased 28.7%.²³ Indirect costs were adjusted using the more general consumer price index (CPI) for Alberta, which rose by 14.4% between 2000 and 2005.²⁴

RESULTS

In 2005, the cost of excess weight in Alberta totaled \$1.27 billion, representing 5.6% of the total cost of all health conditions in Alberta. Among the 22 health conditions attributable to excess weight, coronary heart disease (CHD) accounted for the greatest proportion of the \$1.27 billion cost, contributing 28.3% (\$307.1 million) of the total costs. Each exceeding \$100 million, osteoarthritis, type 2 diabetes, hypertension and cancer had the next highest costs. Taken together, these five conditions accounted for 80.5% of the overall costs of excess weight associated with the 22 health conditions evaluated (Table 2). Direct costs contributed the highest pro-

Table 2. Total and Disease-specific Direct and Indirect Costs Attributable to Overweight and Obesity Among Albertan Men and Women in 2005

	Total Costs Attributable to Overweight and Obesity		Direct and Indirect Costs (proportion of total obesity-attributable costs for each health condition)			
	2005\$, millions	Proportion of Total Cost Overall and Among Males, and Females (%)	Direct Costs (%)	Indirect Long-term Disability (%)	Indirect Short-term Disability (%)	Indirect Premature Mortality (%)
Type 2 diabetes	161.5	14.8	47.6	17.9	1.4	33.0
Male	86.3	14.2	45.1	16.8	1.4	36.7
Female	75.2	15.4	50.5	19.2	1.5	28.9
Hypertension	125.5	11.5	80.9	7.4	2.8	8.8
Male	64.6	10.6	75.4	9.5	3.9	11.2
Female	63.0	12.9	83.9	5.6	4.4	6.1
Coronary heart disease	307.1	28.1	27.7	4.4	1.7	66.2
Male	242.8	40.0	29.4	4.5	1.8	64.3
Female	63.9	13.1	21.2	3.7	1.3	73.8
Cerebrovascular disease	46.8	4.3	21.5	10.9	4.0	63.5
Male	20.4	3.4	7.7	4.9	1.9	85.4
Female	25.3	5.2	33.6	13.3	4.4	48.7
Cancers (14 sites combined)	117.8	10.8	26.3	9.2	3.0	61.6
Male	61.2	10.1	34.0	9.0	2.90	54.0
Female	58.9	12.0	18.2	11.2	3.60	67.0
Osteoarthritis	167.7	15.4	15.1	70.2	14.6	0.0
Male	81.6	13.4	12.2	73.5	14.3	0.0
Female	86.1	17.6	17.9	67.1	15.0	0.0
Gallbladder disease	91.5	8.4	83.6	4.9	11.3	0.2
Male	34.1	5.6	74.1	7.7	17.8	0.3
Female	58.6	12.0	87.3	3.8	8.7	0.1
Asthma	25.3	2.3	34.3	36.2	26.9	2.6
Male	3.9	0.6	34.1	38.3	24.2	3.4
Female	20.9	4.3	35.1	34.2	28.1	2.5
Depression	48.9	4.5	68.1	20.9	10.3	0.6
Male	12.2	2.0	68.9	21.9	8.4	0.8
Female	36.8	7.5	67.6	20.3	11.6	0.6
All health conditions, total cost of excess weight (excluding caregiving)	1092.0		41.1	19.2	5.8	34.0
Male	607.2	55.4	37.3	17.3	4.9	40.5
Female	488.7	44.6	45.5	21.5	7.4	25.6
Cost of Caregiving (direct cost, not allocated by sex or diagnostic category)	181.8					
Total Cost of Obesity and Overweight	1,273.8					

portional costs for hypertension, type 2 diabetes, gallbladder disease and depression (Table 2).

The cost of excess weight was split between direct costs (49.5% or \$630.1 million) and indirect costs (50.5% or \$643.8 million). Men contributed a greater proportion of the cost of excess weight than women (55.4% or \$607.2 million versus 44.6% or \$488.7 million), a difference that was largely explained by the higher obesity-attributable cost of CHD among men (Table 2). With the exception of CHD and type 2 diabetes, women had higher costs attributable to excess weight for most of the other health conditions. However, the obesity-attributable costs of all cancer sites combined and hypertension were similar among men and women.

When examined by BMI classes, including all cost components except premature mortality and caregiving, 30.5% of the total cost of all health conditions in Alberta was attributed to overweight (\$220.2 million) and 69.5% was attributed to obesity (\$500.8 million) (Figure 1). Overweight also accounted for the greatest proportion of costs attributed to excess weight for all cancers combined (44.0%) and CHD (41.0%), while obesity class 1 contributed the greatest proportion of costs for type 2 diabetes (44.6%), hypertension (37.6%), osteoarthritis (40.3%) and asthma (44.3%). Although the prevalence of class 2 and 3 obesity (combined) was only 16.2% in Alberta, these BMI categories accounted for the greatest proportion of the weight-related costs for cerebrovascular disease (42.6%), gallbladder disease (44.9%) and depression (43.9%) (Figure 1).

DISCUSSION

In 2004, the prevalence of overweight and obesity in Alberta was 60.9%,⁷ which, in 2005, translated into costs for the provincial health care system of \$1.27 billion. The cost of obesity (all classes) represented approximately 70% of the total cost of excess weight, despite the prevalence of overweight among Albertans being 10% higher than the prevalence of obesity (35.7% versus 25.2%).⁷ Therefore a shift from obese to overweight status within the provincial population could have substantial economic effects.

The estimated costs of excess weight accounted for 5.6% of the province's total health care costs, with direct and indirect costs contributing nearly equally to this total. Earlier estimates of the cost of obesity in Canada indicated that 2.2-4.1% of health care expenditures in Canada can be attributed to excess weight.^{3,4} These estimates are lower than the 5.6% of total health care expenditures that was attributed to excess weight in this study, and the 4.1% of total health care costs that was attributed to the direct costs of excess weight in another recent Canadian study.² These differences may be explained by several factors, such as the inclusion of more obesity-related co-morbidities, cost estimates for both overweight and obesity, inclusion of caregiving costs, inclusion of indirect costs, and the use of objectively-measured BMI status instead of more readily available self-reported BMI status.

Obesity costing research often focuses on direct rather than indirect costs of obesity.^{3,25} The failure of these studies to include indi-

rect costs due to limitations in data availability, likely results in significant underestimates of the true costs of obesity. We found the indirect costs of obesity were significant and account for approximately half of the costs; a finding that is consistent with studies that have assessed the indirect costs of excess weight.^{2,26,27}

There are necessary limitations in this study due to its use of previously-collected data and a prevalence-based methodology. The cross-sectional costs of excess weight over a one-year period did not account for the time lag between the onset of overweight/obesity and the subsequent development of negative health outcomes.²⁸ This time-based process is an important consideration for assessing both the lifetime costs of excess weight and the cost-effectiveness of obesity reduction interventions over the long term. Few incidence-based cost-of-illness studies have been completed due to insufficient time-based data on the development of weight-related health conditions and costs incurred. Conflicting results from modeling studies suggest that further research is required in this area.^{29,30}

Thompson et al. developed a dynamic model to estimate the lifetime risks of five obesity-related diseases and their associated medical costs, and life expectancy for adults aged 35-54 years.²⁹ Lifetime medical costs of the five diseases increased incrementally with increases in BMI, and were similar to the medical costs attributable to cigarette smoking. Compared to normal weight status (BMI of 22.5), a BMI of 27.5 kg/m² increased lifetime medical expenditures for the five diseases by 20%, a BMI of 32.5 kg/m² increased expenditures by 50%, and a BMI of 37.5 kg/m² nearly doubled expenditures.²⁹ Van Baal et al. also modeled the lifetime health care costs of obese and normal weight people and found that annual health expenditures were higher among obese individuals than normal weight individuals, but the lifetime medical expenditures for these two weight classes were not significantly different because of differences in life expectancy.³⁰ Lifetime health expenditure was highest among normal weight people who developed diseases unrelated to obesity in their years of life gained. Van Baal et al. concluded that while obesity prevention is important for improving public health, it may not decrease health care expenditures, as is suggested by most prevalence-based studies.³⁰ An important consideration is that their study did not include the indirect costs of obesity, which, as our study reveals, can bear a substantial economic burden on society.

In determining PAFs and calculating costs attributable to overweight and obesity, several assumptions were necessary due to limitations in data availability. Areas for improvement in data availability and quality include: improved allocation of costs by diagnostic category (including caregiving), more recent costing data, PAF estimates for premature mortality for a broader range of health conditions and information on the variability of costs that are specific to Canada and the provinces. Controlling for the co-existence of multiple weight-related co-morbidities in the same individuals may have decreased PAFs and direct cost estimates; however, these could not be accounted for in this analysis because of data limitations both for co-morbidity and costing information. For example, a proportion of CHD can be attributed to both type 2 diabetes and hypertension. Controlling for the inclusion of type 2 diabetes and hypertension in the necessary calculations could result in lower PAFs for the relationship between excess weight and CHD, and lower costs attributable to excess weight.

PAFs were mostly calculated using cross-sectional data from the Canadian Community Health Survey (CCHS), creating the poten-

tial for confounding and the assumption of the temporality of body weight and subsequent disease risk. Several dietary factors and physical inactivity, independent of body weight, have been associated with an increased risk of numerous co-morbidities, including coronary heart disease, type 2 diabetes, several types of cancer, musculoskeletal disorders and numerous others.³¹ Conversely, an illness may lead to sedentary lifestyle and obesity. Popkin et al. found that the combined effects of diet and physical activity, both through their direct effects on health and via their effects on obesity, have a much larger total effect than any separate pathway, such as obesity on its own.³¹ As a result, if the independent costs of certain dietary factors and low levels of physical activity were available and included here, the total cost would likely be higher.

Information on other obesity-related costs could not be included in this study, such as private out-of-pocket costs not reimbursed by governmental agencies, cost of reduced productivity during work hours (presenteeism), and some of the intangible costs of pain and suffering experienced by individuals and families. Improving the quality of available data would increase the accuracy of cost estimates, however it would also require substantial resources; therefore, it must be clear that the accuracy gained is worth the expense. While assumptions were necessary to overcome some of these limitations and these choices represent a source of uncertainty, the final analysis erred on the side of conservatism.

Cost-of-illness studies reconfirm that obesity is a serious societal problem with substantial costs but they have been criticized for failing to quantify potential solutions and being insufficient to inform government priority setting. While this limitation is acknowledged, this study provides some evidence of where interventions are most needed and have the greatest potential for cost savings. The breakdown of costs by sex and BMI status are more detailed than prior obesity costing studies in Canada,²⁻⁴ and may be particularly useful for targeting interventions where the disease burden and costs attributable to excess weight are highest. A necessary and critical next step will be evaluating the efficacy and cost-effectiveness of potential solutions, with careful consideration of the needs and characteristics of target populations.

CONCLUSION

Currently, the majority of Albertan adults are overweight or obese. The direct and indirect costs of this excess weight were equivalent to 5.6% of Alberta's annual health care expenditures in 2005 (\$1.27 billion). Among the 22 health conditions attributable to excess weight, coronary heart disease (CHD) followed by osteoarthritis, type 2 diabetes, hypertension and cancer had the next highest costs. Taken together, these five conditions accounted for 80.5% of the costs of excess weight in this study. The cost of excess weight represents a considerable economic and social burden to the health care system and provides further rationale for the development and implementation of comprehensive programs and policies to prevent and reduce obesity.

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RÉSUMÉ

Objectif : Souligner l'impact possible des coûts associés au surpoids et à l'obésité sur les politiques et les initiatives de prévention de la province de l'Alberta.

Méthode : Par une méthode de calcul du coût de la maladie basé sur la prévalence, nous avons estimé les coûts directs (soins hospitaliers, médicaments, soins médicaux, soins en établissement, coûts supplémentaires) et indirects (incapacité de courte et de longue durée, mortalité prématurée) associés à l'excès de poids pour 22 affections médicales. Les coûts totaux de chaque affection ont été estimés à l'aide de la base de données de l'Agence de la santé publique du Canada sur le fardeau économique de la maladie au Canada. Nous avons aussi estimé les fractions attribuables dans la population (FAP) à l'aide des données de 2004 et de 2005 de l'Enquête sur la santé dans les collectivités canadiennes et d'analyses documentaires récentes.

Résultats : En 2005, le coût de l'excès de poids en Alberta s'est élevé à 1,27 milliard de dollars. Son coût direct était de 630,1 M\$ (49,5 %) et son coût indirect, de 643,8 M\$ (50,5 %). Exception faite des coûts associés à la mortalité prématurée et à la prestation des soins, l'obésité représentait 69,5 % des coûts (500,8 M\$), et le surpoids, les 30,5 % restants (220,2 M\$). Sur les 22 affections médicales, la maladie coronarienne présentait les coûts imputables à l'excès de poids les plus élevés (307,1 M\$), suivie de l'arthrose (167,7 M\$) et du diabète de type II (161,5 M\$). Le coût total de l'excès de poids correspondait à 5,6 % des dépenses annuelles en soins de santé de la province pour 2005.

Conclusion : Les recherches sur le calcul des coûts de l'obésité s'attachent souvent aux coûts directs des soins de santé, mais notre étude montre que les coûts indirects de l'excès de poids sont tout aussi considérables et peuvent représenter plus de la moitié des coûts totaux. Les interventions visant à réduire l'excès de poids chez les Canadiens pourraient donc améliorer la santé de la population tout en réduisant les coûts provinciaux et nationaux des soins de santé.

Mots clés : obésité; surpoids; le Canada; coûts; coût de la maladie