Dollars and Sense:

An economic costing of obesity, food insecurity, and chronic illness

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Acknowledgements

Angella MacEwan was contracted by the Atlantic Centre of Excellence for Women's Health to undertake this economic costing project. We are grateful for the care and attention she put into the research, including managing data acquisition, researching and identifying an appropriate methodology, executing the analysis, and writing up the results. Barbara Clow wrote the introduction and conclusion as well as portions of the paper describing the measurement and prevalence of food security and obesity. She also copy-edited the entire manuscript.

This project was made possible through financial support from the Women's Health Contribution Program, Health Canada. The views expressed here do not necessarily represent the opinion of Health Canada

ISBN 978-0-9810459-9-3

Introduction

In recent years, researchers, practitioners, policy makers, a host of non-governmental organizations as well as the media have raised an alarm about rising rates of overweight and obesity and the potential impact of these trends on health, both nationally and internationally (Gard and Wright, 2005). In 2010, for example, the World Health Organization estimated that there were more than 1 billion overweight adults and over 300 million obese adults worldwide (World Health Organization, 2010). Similarly, the Public Health Agency of Canada reported that approximately one in four Canadian adults was obese, according to measured height and weight data from 2007-2009 (Public Health Agency of Canada, 2010). At the root of these deep concerns about healthy weight is the association between obesity and specific chronic illnesses, including Type 2 diabetes, cardiovascular diseases, arthritis, some cancers, etc. (Starky, 2005; Shields and Tjepkema, 2006).

Efforts to reduce rates of obesity and related chronic diseases have tended, in large measure, to focus on individual 'lifestyle choices' related to diet and physical activity, on the assumption that individuals will be able to avoid overweight and obesity as well as the illnesses associated with unhealthy weights simply by eating less or better and exercising more (Clow, 2013). While diet and physical activity are undoubtedly important for health and well-being, they are not the only factors that affect weight and health. Social, economic, and political environments also contribute to rising rates of overweight, obesity, and chronic diseases. For example, healthy eating and physical activity become much more challenging for individuals if communities lack parks and affordable recreation facilities or if neighbourhoods lack shops that stock nutritious, high quality, and affordable foods. As Henwood, et al. have observed, health promotion policies and practices are "framed in a way ignores factors beyond individual control and presents the achievement of health goals as matters of individual choice, 'good behaviour,' and self-care" (Henwood, et al., 2011).

Food insecurity – worrying about or having insufficient food quantity and quality – represents one of many social and economic influences on body weight and chronic disease. On the surface, a connection between obesity and food insecurity might seem to be counter-intuitive because overweight and obesity are generally attributed to over-consumption while food insecurity is usually associated with inadequate caloric intake. But a growing body of research demonstrates that those living with food insecurity are at heightened risk of overweight and obesity as well as a variety of chronic diseases (Lyons, Park and Nelson, 2008; Martin and Ferris, 2007; Wilde and Peterman, 2006; Sarlio-

Lähteenkorvaz and Lahelma, 2001; Townsend at al., 2001). Interestingly, this association holds true for women experiencing moderate food insecurity, but does not apply to men.

Many explanations for this discrepancy have been posited by quantitative and qualitative researchers, including higher rates of poverty and lone parenthood among women as well as the gendered nature of caregiving and food planning and preparation (Papan and Clow, 2012; Lyons, Park and Nelson, 2008; Dinour, Bergen and Yeh, 2007; Hanson, Sobal and Fongillo, 2007; McIntyre et al., 2003; Sarlio-Lähteenkorvaz and Lahelma, 2001). In a recent study with women in Atlantic Canada, participants identified a variety of factors influencing their weight and health, including: lifelong experiences with overweight or obesity; childhood experiences of feast and famine affecting their relationship to food as adults; low income; lone parenting; chronic, disabling illnesses or conditions; stress, isolation and depression. For many of these women, healthy food choices were simply not an option. As one participant concluded, "*You have no control. You have to buy what is close to what you think is nutritional or do without. That's the truth"* (Papan and Clow, 2012).

For more than a decade, researchers have been exploring the economic costs of obesity and related chronic diseases and have amply demonstrated the fiscal imperative of addressing rising rates of unhealthy weights (Anis, et al., 2010; Hayward, 2009; Colman, 2000). For example, Birmingham, et al. (1999) estimated that in 1997 the direct cost of obesity was 2.4% of Canadian health-care spending on all diseases. Katzmarzyk and Janssen (2004) estimated that the direct cost of obesity in 2001 was 1.6 billion, 2.6% of the total health-care costs in Canada. A few studies have also examined the economic costs of food insecurity. According to Brown, et al. (2007), the cost of domestic hunger in the United States in 2005 was approximately $90 billion, related to charitable activities, care for hunger-related mental and physical health conditions, and lost productivity. To date, researchers have not joined these areas of investigation to explore the costs of obesity and chronic conditions related to food insecurity.

At the same time, a significant proportion of the work on economic health costing, including on obesity, does not address differences between and among women and men (Birmingham, et al., 1999; Colman, 2000, Mirolla, 2004, Anis, et al., 2010). A recent report by Colman and Hayward (2009), on the economic costs of obesity in Alberta is one of the few studies that explore such differences. They found that in 2005 the costs attributable to overweight and obesity were higher for males than for females over the age of 15 years, largely because of "the high obesity-attributable cost of coronary heart disease

in males relative to females ($242.8 million in males compared to $63.9 million in females, $2005)" (Colman and Hayward, 2009). These findings are significant in that they suggest the need for interventions aimed at adult males, at least in the province of Alberta. Given that the association between food insecurity and obesity has been established only for women experiencing moderate food insecurity, it is doubly important that research in this area pay attention to sex, gender, and diversity.

This study consequently represents the first attempt to estimate the direct costs associated with food insecurity, obesity, and chronic disease among women in Canada. In so doing, it serves to focus attention on those most in need – women experiencing moderate food insecurity – and it makes the case for more and more targeted investment in a variety of preventative health and social services as well as greater investment in a wide range of income support programs.

Overview

This report is divided into six sections. In the first part, we describe the data sources used for this study. The second section describes Body Mass Index, the most common measure of overweight, as well as its limitations. The third section provides an account of the prevalence of obesity in Canada and internationally, paying attention to the impact of sex and race/ethnicity. The fourth part examines the prevalence of food insecurity in Canada and the relationship between food insecurity, obesity and related health care conditions among women. The fifth section describes the methodology and estimates the direct costs associated with managing chronic conditions related to food security and obesity. The report concludes with a summary of findings and recommendations for further work.

Data Sources

The Canadian Community Health Survey (CCHS) is a cross-sectional national survey conducted by Statistics Canada, which collects information about health status, health care use and health determinants for the Canadian population each year (prior to 2007 every two years) with a wide-scale sample of Canadians 12 years of age and older, excluding First Nations Reserves, many communities in the territories, and a few other sub-populations. Most components of the CCHS are collected via telephone, and thus exclude potential respondents who do not have household telephones. The CCHS operates on a two-year collection cycle. The first year of the survey cycle ".1" is a large sample, general population health survey designed to provide reliable estimates at the health region level. The second year of the

survey cycle ".2" has a smaller sample and is designed to provide provincial level results on specific health topics. The comprehensive survey allows for analysis of health data at a regional level, across Canada.

Defining and Measuring Obesity

Overweight and obesity are overwhelmingly defined by body mass index (BMI) a ratio of weight to height. The value is determined by dividing a person's weight in kilograms by their height in metres squared: i.e. weight (kg)/height $(m)^2$. According to the World Health Organization, overweight begins at a BMI greater than 25, obesity begins at a BMI greater than 30 (World Health Organization, 2010). Obesity is further divided into three classes, "according to the increased health risks associated with increasing BMI levels: class I /BMI >30; class II BMI >35; class III BMI > 40" (Katzmarzyk and Mason, 2006).

Research demonstrates that BMI is far from an ideal measure of health or fitness, especially across ethnic groups. BMI was developed and tested primarily among people of European descent, with the result that it is often inaccurate for people of non-European descent Health Canada, 2003a; Razak et al., 2007). For example, Pacific Island women in New Zealand have a lower percentage of body fat (38.9 percent) at a BMI of 30 than do European women (42.5 percent) (Duncan, et al., 2004). Duncan et al. (2004) consequently advocated the development of BMI scales that are specific for ethnic populations and countries in order to more accurately gauge overweight and obesity prevalence rates and related health risks. Other researchers have criticized the use of BMI as an isolated indicator of obesity and have asserted the need to incorporate other, more reliable predictors of health risk measures, such as waist circumference (Duncan et al., 2004; Janssen, Katzmarzyk and Ross, 2004). The relationship between weight and health and/or fitness is more complex than analysis of BMI measures alone will allow. Despite the existence of more accurate models that account for multiple aspects of body composition, BMI continues to be the most prevalent method used in Canada and the developed world for defining obesity because it is considered the most cost-effective and practical method available (Duncan et al., 2004).

One factor affecting the consistency of data is that some surveys use participants' self-reports of weight and height to calculate BMI, while others undertake physical measurements of respondents. Self-reported measures of height and weight have been found to under-represent obesity as defined by BMI

across populations (Booth, et al., 2000; Elgar and Stewart, 2009; Roberts, 1995; Strauss, 1999). This is a serious issue, as under-reporting appears to be more common among individuals with higher BMIs (Katzmarzyk and Ardern, 2004). Both the 2004 Canadian Community Health Survey (CCHS) and the 2002/2003 First Nations Longitudinal Health Research Survey (RHS) used direct measurements to calculate BMI, to improve the accuracy of the results. While the survey data used in this project were based on direct measures of BMI, we recognize that BMI may not be an ideal measure for overweight and obesity and that this may affect understanding of the risk of adverse health effects for First Nations populations.

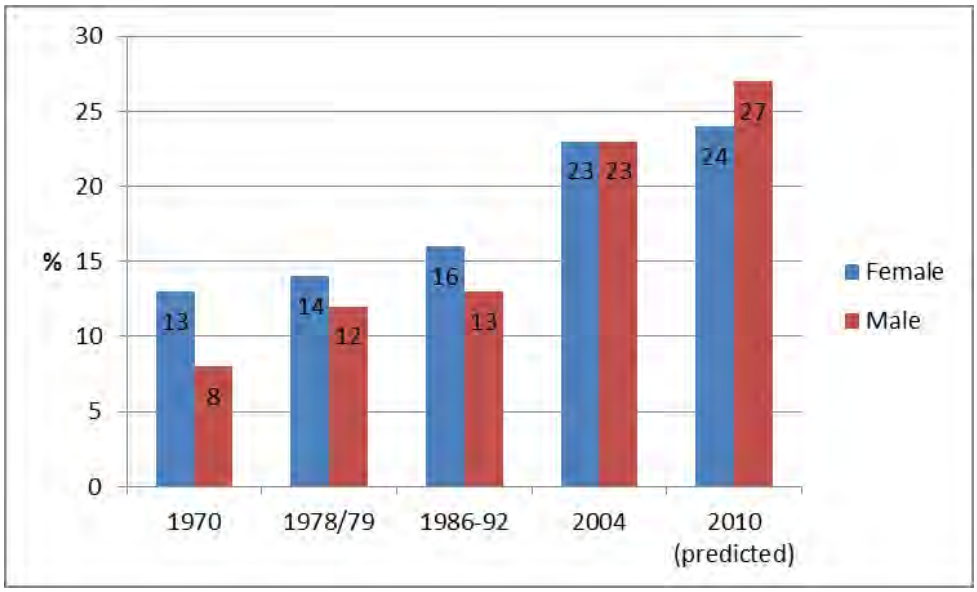
Trends in Overweight and Obesity

While rates of overweight and obesity appear to be rising globally, the prevalence of obesity varies from one country and region of the world to another. A study of obesity in OECD nations, for example, found little consistency in trends across member countries (Sassi et al., 2009). Some countries are seeing a rise in overweight, which the OECD calls "pre-obesity", while others report rising obesity but steady or lowering pre-obesity trends. The report notes that trends for men and women are also not consistent across countries. While the overall international and OECD trend has been that women have been more likely to be obese, and men more likely to be overweight, this is not the case for all countries. For example, Spain, Italy, and England all reported higher obesity rates for men in their most recent studies. Rates of overweight are rising faster for women than men in the U.S and England, but in Finland and Spain rates of overweight are rising faster for men than for women. Of particular note for this discussion, the OECD report concluded that sex has "significant interactions with other individual characteristics, such as socio-economic condition or ethnicity" in the likelihood of individuals becoming overweight or obese (Sassi, et al., 2009). Women with lower incomes, less education, and from traditionally disadvantaged ethnic groups are more likely to be overweight or obese in most OECD countries. There does not appear to be a similar interaction between obesity and socio-economic factors for men.

Canadian data support these findings. In 2004, nearly 60% of Canadians were considered overweight or obese using BMI (Figure 1). Moreover, the rates of obesity appear to be increasing – from 10% of the population in 1970 to 23% in 2004. Obesity has risen among all adult age groups but continues to peak in middle age. Patterns of obesity have also shifted by sex. In the past, men were more likely than

women to be overweight, but less likely to be obese. By 2004, the rates of obesity among female and

Figure 1. Trends in adult obesity rates by sex, Canada



Source: Luo, W., H. Morrison, M. de Groh, C. Waters, M. DesMeules, E. Jones-McLean, A. Ugnat, S. Desjardins, M. Lim, and Y.Mao. (2007)."The Burden of Adult Obesity in Canada," Chronic Diseases in Canada, 27(4): 135-144.

male adults were identical and Luo, et al. (2007) predicted that by 2010, obesity rates for men would outstrip those for women. At the same time, as with data from OECD countries in general, the 2004 CCHS data shows an inverse relationship between socio-economic factors and obesity for women in Canada, but not for men.

Defining and Measuring Food Insecurity

The 2007/2008 CCHS asked a series of 18 questions to determine if, during the previous year, households were uncertain of having, or unable to acquire, enough food to meet the needs of all their members because they had insufficient money for food. Based on their responses to these questions, households were coded into three categories:

1. **Food secure**: These households had access, at all times throughout the previous year, to enough food for an active, healthy life for all household members.
2. **Food insecure, moderate**: These households had indication of compromise in quality and/or quantity of food consumed.
3. **Food insecure, severe:** These households had indication of reduced food intake and disrupted eating patterns.

The questions posed in the CCHS are entirely income-related, measuring whether individuals and/or households have sufficient financial means to afford food. Other measures of food security have been

advanced and, in some cases, adopted. The World Health Organization, for example, includes having sufficient quantities of food available on a consistent basis and having knowledge of basic nutrition and food handling information as well as access to adequate clean water and sanitation as part of its definition of food security (World Health Organization, 2012). Some researchers have also suggested that food security involves "the inability to obtain sufficient nutritious, personally acceptable food through normal food channels ***or*** the uncertainty that one will be able to do so" (McIntyre, et al, 2002). CCHS data may consequently underestimate the full extent of food insecurity and our analysis has been constrained by the limitations of the data.

Prevalence of Food Insecurity

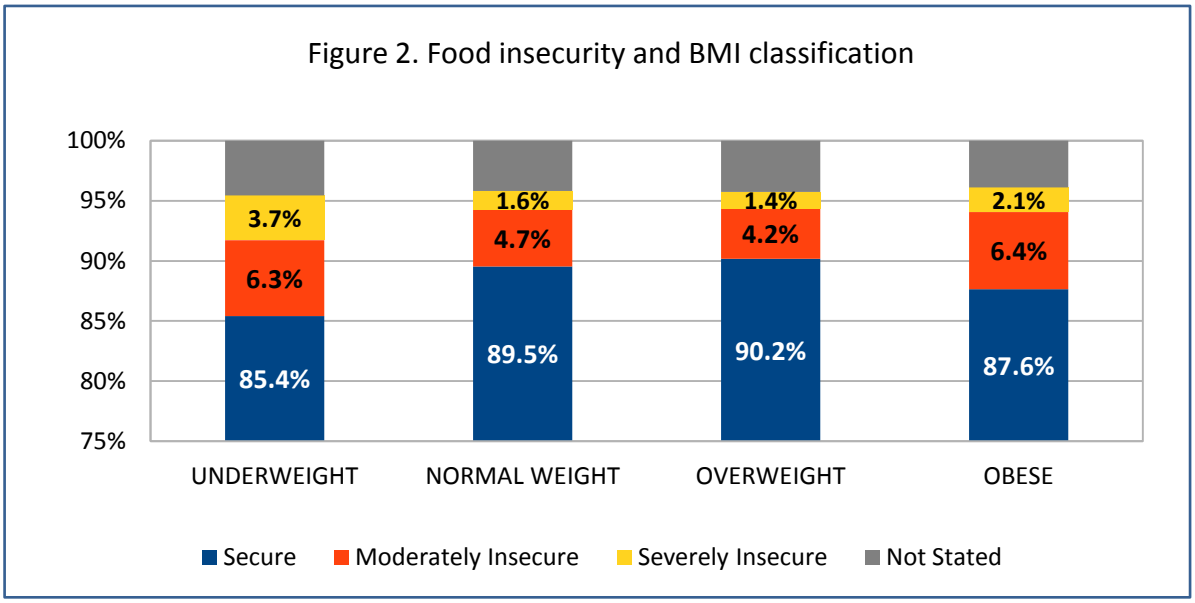
Millions of people around the world are food insecure. According to one report, in 2010-2012 food insecurity affected "12.5 percent of the global population, or one in eight people. The vast majority of these, 852 million, live in developing countries, where the prevalence of undernourishment is now estimated at 14.9 percent of the population" (FAO, 2012). The prevalence of food insecurity in Canada is much lower. In 2007-2008, 92.3% of Canadian households reported having enough food for active healthy living for all members during the previous year. But there are still a significant number of people living with food insecurity in Canada. The remaining 7.7 % of households experiencing moderate (5.1%) to severe (2.7%) food insecurity comprises nearly two million people (Health Canada, 2012).

Some populations are at much greater risk of food insecurity: Aboriginal people, lone mothers, recent immigrants, and those living in poverty. Among off-reserve Aboriginal households, for example, the rates of food insecurity in 2007-2008 were three times higher than among non-Aboriginal households (Health Canada, 2012). Similarly, lone parent households – most of which are headed by females – experienced food insecurity at nearly three times the national average for all households. Food insecurity was more prevalent in poorer parts of the country: Manitoba, the Atlantic Provinces and the three northern Territories. Differences between and among populations are often related to differences in socio-economic status (Dubois et al., 2006; Conley and Glauber, 2006), but other factors, such as geography, may also affect rates of food insecurity. Fresh, affordable foods are often scarce in many northern and remote communities in Canada. In 2007-2008, for example, Nunavut had the highest prevalence of food insecurity at more than four times the national average.

Food Insecurity and Obesity in Canada

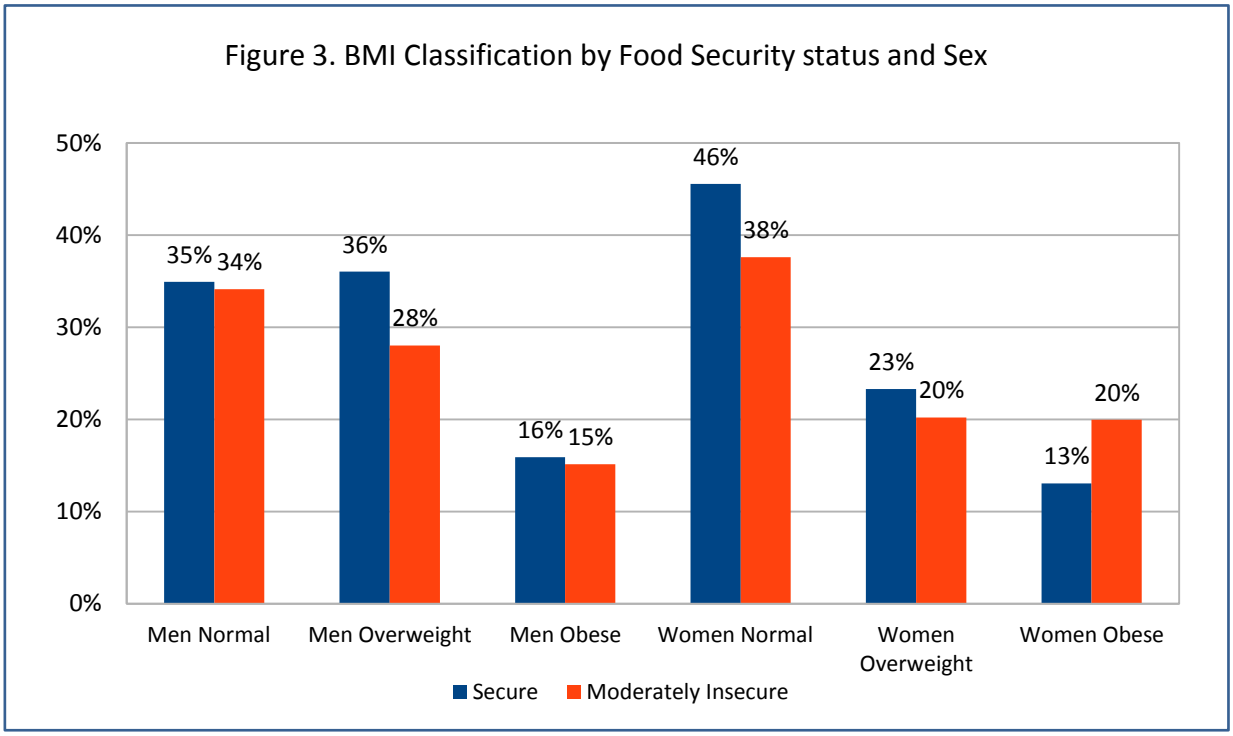
Much of the quantitative research on the relationship between food insecurity and obesity relies upon data from the United States (Eisenmann, et al. 2011; Mirza, Fitzpatrick-Lewis and Thomas, 2007; Adams, et al., 2005; Dietz, 1995;). However a 2008 study of CCHS data found a relationship between measured BMI and women who lived in households classified as food insecure with mild hunger (Lyons, et al., 2008). Researchers found that female respondents living in households classified as food insecure with mild hunger were almost three times more likely to be obese than were female respondents living in food-secure households.

Data from the 2007/2008 CCHS show that moderate food insecurity is more common among those who are underweight and those who are obese. These findings are in keeping with the dominant view that associated food insecurity with undernourishment as well as with research that suggests food insecurity may have a connection to obesity.



Source: Custom tabulation, CCHS 2007/2008 PUMF

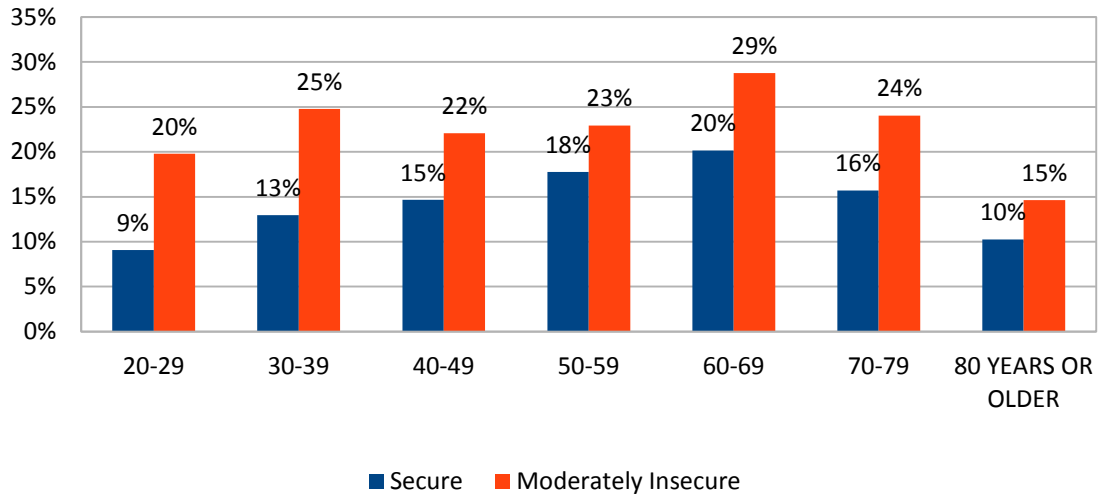
Moreover, the data support previous research linking obesity and food insecurity in women more than in men. In our analysis, 20% of moderately food-insecure women reported being obese, compared to only 13% of food-secure women. By comparison, 15% of moderately food-insecure men reported being obese, compared to 16% of food-secure men.



Source: Custom tabulation, CCHS 2007/2008, PUMF

The relationship between socio-economic factors and obesity for women in Canada appears to be similar to that for moderately food insecure women and obesity as well. Figure 4 shows the proportion of food secure and moderately food insecure women in each age group that are obese. For example, 25% of moderately food insecure 30-39 year old women are obese, compared to 13% of food secure 30-39 year old women. The higher proportion of obesity among moderately food insecure women in Canada is consistent across age groups.

Figure 4. Proportion of Obese Women by Food Security Status and Age

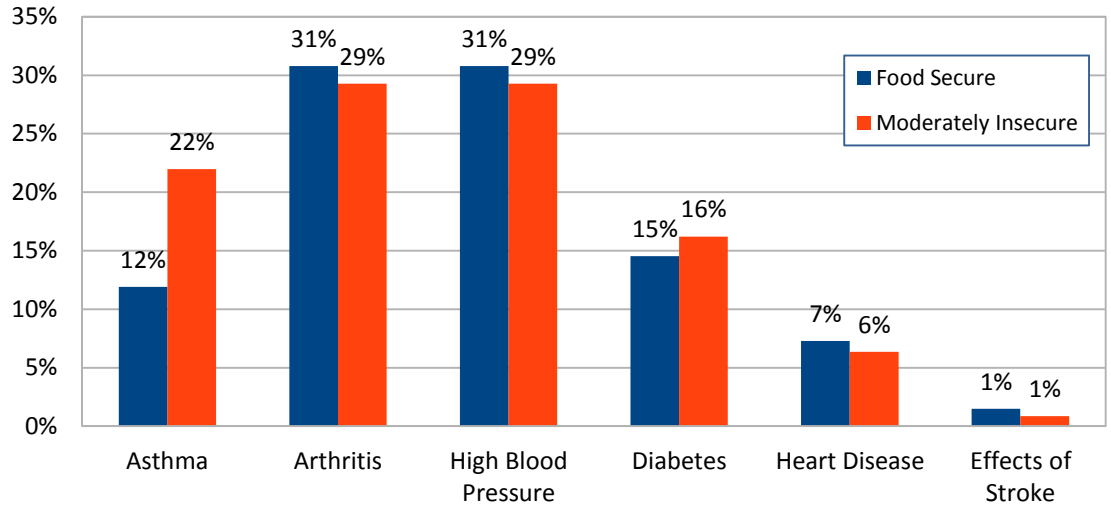


Source: Custom tabulation, CCHS 2007/2008, PUMF

Food Insecurity and Chronic Illness in Canada

As mentioned earlier, concerns about rising rates of overweight and obesity are founded on the association between weight and the prevalence and severity of many chronic illnesses, including Type 2 diabetes, cardiovascular diseases, musculoskeletal conditions, respiratory conditions, and several kinds of cancer. If being moderately food insecure influences a woman's healthy food intake and stress levels, and therefore her weight, it is possible that the resulting rise in obesity will also lead to higher rates of chronic illnesses generally associated with obesity. It is also possible that there are specific interactions between food security and chronic illness that influence rates of chronic illness among food insecure women. We assessed the association between food insecurity and six chronic conditions linked with overweight and obesity: asthma, arthritis, high blood pressure, diabetes, heart disease, and stroke.

Figure 5. Obese women with chronic disease by food security status



Source: Custom tabulation, CCHS 2007/2008, PUMF

In Figure 5, we can see that for five of the six illnesses there appear to be similar rates of chronic illness among obese food secure and moderately food insecure women. However, moderately food insecure obese women had a much higher rate of asthma than food secure obese women. It is not clear why this would be the case, but it could be due to the extra stress of being moderately food insecure. Seligman, et al. (2010), using data from NHANES, found an association between food insecurity and cardiovascular disease (specifically high blood pressure and heart disease), but not diabetes. They did not test a relationship for other chronic illness such as asthma.

Economic Costing Analysis

There are several possible approaches to economic costing. The three main ones are: prevalence-based financial accounting; incidence-based cost-of-illness approach; prevalence-based cost-of-illness approach. Each of these approaches has strengths and limitations. A prevalence-based financial accounting, such as Lavoie and Forget's (2008) "The Cost of Doing Nothing: Implications for the Manitoba Health Care System", is particularly relevant to the cost of food insecurity and obesity and might be useful if researchers wished to do prevalence-based economic costing at the community level. An analysis using prevalence-based financial accounting may be a useful 'next step' to follow the more general economic costing being outlined in this work.

An alternative approach, incidence-based analysis, estimates the lifetime cost of cases diagnosed in a given year. This can be combined with cost-effectiveness analysis (CEA), which compares the costs and outcomes of two or more courses of action. It is usually expressed as the cost per quality adjusted life year (QALY). This type of analysis also lends itself more readily to community level observations, as it requires more specific comparisons of inputs and outcomes. Given gaps in the data available to us, this type of analysis could not be completed at this time, but it may be a valuable future project.

In this analysis we used a prevalence-based cost-of-illness approach, which involves estimating the total cost of a disease for a given year, establishing rates of obesity, and determining what proportion of cases of each illness could be attributed to obesity. This type of analysis is useful for generalized larger scale evaluations, partly because a larger population is more likely to have individuals at all stages of the diseases under consideration. We wished to do a pan-Canadian analysis, for which prevalence based cost of illness was most appropriate. As well, the data available to us was best suited for this type of analysis.

In order to calculate the direct cost of obesity for moderately food insecure women in Canada for a given year, we required several pieces of information. We needed to know how many moderately food insecure women were medically obese, which diseases are linked to obesity among moderately food insecure women, what the relative risk of acquiring each of these diseases is for an obese person, and how much was spent in Canada on each of these diseases in that year.

Anis, et al. (2010) conducted a meta-analysis of medical literature to find the RR of 18 chronic illnesses that are co-morbid with obesity. The RR was then used along with the prevalence of obesity and individual chronic conditions to determine a PAF for each chronic condition. A PAF can be thought of as the excess fraction of chronic illness in the population under consideration (Hanley, 2001). This means it is the percentage of chronic illness (and the cost of treating it) that can be attributed to obesity. Say that 1/3 of the population is obese, but 50% of people with heart disease are obese. The excess fraction of obese people with heart disease can be attributed to obesity.

Below is an example calculation, using hypothetical numbers to illustrate the calculation of PAF. CF means fraction of cases.

The formula used was:

$$PAF_{total} = 1 - (CF_0 \times \frac{1}{RR_0} + CF_1 \times \frac{1}{RR_1} + CF_2 \times \frac{1}{RR_2})$$

where RR_0= 1, and:

$$CF_0 = \frac{\#of\_normal\_weight\_heart\_disease\_cases}{Total\_\#of\_heart\_disease\_cases} = \frac{20}{100} = 0.2,$$

RR_1= Relative risk of heart disease that can be attributed to overweight = 1.5,

$$CF_1 = \frac{\#of\_overweight\_heart\_disease\_cases}{Total\_\#of\_heart\_disease\_cases} = \frac{30}{100} = 0.3,$$

RR_2= Relative risk of heart disease that can be attributed to obesity = 2,

$$CF_2 = \frac{\#of\_obese\_heart\_disease\_cases}{Total\_\#of\_heart\_disease\_cases} = \frac{50}{100} = 0.5.$$

Then,

$$PAF_{total} = 1 - (0.2 \times 1 + 0.3 \times \frac{1}{1.5} + 0.5 \times \frac{1}{2}) = 0.35 = 35\%$$

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In our fictional example given above, 35% of the cost of treating heart disease can be attributed to overweight and obesity.

Anis, et al. (2010) used this method to estimate the direct and indirect costs of obesity for 2006. Since this survey was conducted in 2007 and 2008 and asked respondents about their health and food security status over the past year, we were able to use these figures to calculate the direct and indirect costs of obesity for women experiencing moderate food insecurity. We calculated the excess fraction of obesity that is due to moderate food insecurity among women, and then used that information to estimate the proportion of chronic illness due to obesity that is attributable to moderate food insecurity.
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Figure 6. Relative Risk of Obesity due to Moderate Food Insecurity

	Women		Men	
	Obese: Normal	Obese: Normal and Overweight	Obese: Normal	Obese: Normal and Overweight
RR	1.56	1.61	0.98	1.07

There is a marked difference between the relative risk of obesity due to food insecurity between women and men. This holds true when comparing the obese group to the normal weight group alone as well as when comparing the obese group to the combined normal and overweight groups. We compared the obese group to the normal weight group and to the combined group based on the possibility that with regard to the risk (moderate food insecurity) the impact on the overweight group was not significantly different than the impact on the normal weight group.

Figure 7. Population Attributable Fraction of Obesity due to Moderate Food Insecurity

	Women		Men	
	Obese: Normal	Obese: Normal and Overweight	Obese: Normal	Obese: Normal and Overweight
PAF	3.4%	3.6%	-0.08%	0.29%

There is virtually no PAF for men, but we can estimate that approximately 3.5% of women's obesity can be attributed to the risk factor of moderate food insecurity.

Anis, et al. (2010) calculated that the direct and indirect cost of obesity for all populations was $7.1 billion in 2006. Cost breakdowns for type 2 diabetes, cancer, and asthma were estimated based on prevalence rates by sex in 2006. Cost breakdowns for cardiovascular diseases were estimated based on hospitalization rates by sex for 2005. Cost breakdowns for gallbladder disease, osteoarthritis, and chronic back pain were estimated based on the proportion of obese women in the 2007 / 2008 CCHS. Calculations are shown in Figure 8 below.

Figure 8. Cost of Illness due to Obesity by Co-morbidity

Co-morbidity	ICD-9	Direct Cost due to Obesity ($ millions)	Indirect Cost due to Obesity ($ millions)	Estimated Cost for Women ($ millions) *Author's Calculations
Type 2 Diabetes	250 x 0, 250.x2	729.8	298.8	475.9
Cancer				
Breast, Postmenopausal	174,175	12.3	5.8	18.1
Colorectal	153,154	141.4	27.1	67.4
Endometrial	179,181,182	33.1	12.2	45.3
Esophageal	150	*NS*	*NS*	*NS*
Kidney	189	27.6	7.5	12.6
Ovarian	183	7.4	1.3	8.7
Pancreatic	157	32.9	5.7	18.3
CV Diseases				
Hypertension	401-405	455.7	120.9	229.6
Coronary Artery Disease	410-414	859.8	142.0	399
Congestive Heart Failure	428	263.9	43.0	122.2
Pulmonary Embolism	415.1	88.6	20.0	43.3
Stroke	430-438†	305.4	67.3	156.5
Other				
Asthma	493	171.3	134.7	191.3
Gallbladder Disease	574,575	135.9	40.2	82.8
Osteoarthritis	715	254.9	542.8	374.9
Chronic Back Pain	720-724	*N/A*	1,592.9	748.7
Total		3,519.9	3,062	2,995

Source: Anis, et al. (2010) Supplementary Information, Tables 4 and 6, Author's Calculations

If we consider that the Population Attributable Fraction of obesity due to moderate food insecurity is between 3.4% and 3.6% for women, this means that we can estimate the cost of obesity that is attributable to moderate food insecurity at 3.4% to 3.6% of $2.99 billion dollars in 2006. The estimated cost of obesity due to moderate food insecurity among women in Canada was between $102 million and $108 million in 2006.

Conclusion

Economic costing analysis can be a powerful tool for influencing public policy priorities and making the case for more preventative health spending and more targeted preventative health programs. For example, Colman and his colleagues at GPI Atlantic undertook a series of economic costing projects related to chronic disease, smoking, food security, and obesity in several provinces (GPI Atlantic). In the case of Nova Scotia, they found that the estimated direct costs were at least $120 million, or 6.8% of the province's 1999-2000 health care budget, well above estimates of national health-care spending (Colman, 2000). Moreover, by comparison only 2% of the provincial health care budget was devoted to health promotion and illness prevention. These findings prompted the Nova Scotia government to invest more in health promotion efforts, including the creation of a new Department of Health Promotion and Protection (*Chronicle Herald*, 2009). Although most economic costing research has not led to these kinds of pivotal shifts in policy and programming, it can establish as a baseline against which to measure changes in the economic impact of particular conditions as well as the value and efficacy of interventions. As Colman and Hayward have observed, "Economic costing studies can provide a crucial first step for future economic evaluations of the cost-effectiveness of interventions designed to reduce obesity levels in society" (Colman and Hawyard, 2010).

This analysis – the first to examine the costs of obesity related to food insecurity – demonstrates the importance of addressing the social, economic, and political conditions that give rise to poor diets and unhealthy weights, especially among women. Even though moderate food insecurity appears to contribute to obesity only among a small proportion of women, the costs of obesity are so large that there are significant cost savings possible through addressing food insecurity. At the same time, this analysis creates a baseline for assessing the impact of health, economic, and social policies and programs aimed at reducing rates of obesity and preventing obesity-related chronic conditions. Information gathered through this process could support the development of more, and more effective interventions. As Colman and Hayward have concluded, "By focusing attention on the economic burden of obesity, and on the associations of obesity with chronic disease and other health conditions, costing studies such as this one can mobilize societal and governmental interest and resources towards setting priorities for obesity prevention" (Colman and Hayward, 2010). Finally, as with Colman and Hayward's study of obesity in Alberta, this analysis has demonstrated the value of getting and using sex-disaggregated data as well as the importance of understanding the differential impact of obesity-

related chronic conditions on women and men (Colman and Hayward, 2010).

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