ECONOMIC DETERMINANTS OF OBESITY IN CANADIAN ADULTS

by

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Abstract

This paper examines how socioeconomic status and economic insecurity relate to obesity in working-age Canadians between 2000 and 2010. First, I attempt to explain the gender specific gradients in body mass. Second, I test the theory that higher levels of economic insecurity are associated with higher rates of obesity. Data from the Canadian Community Health Survey is used to determine how BMI relates to various measures of income, food insecurity, and stress. My results indicate that low income is associated with higher rates of female obesity and lower rates of male obesity. Economic insecurity measured at the provincial level, such as the employment rate seems to have no significant impact on obesity, which may be due to limitations in the data. Food insecurity is predictive of excess body weight in women, especially mothers.

List of Abbreviations Used

BMI	Body Mass Index
CCHS	Canadian Community Health Survey
CPI	Consumer Price Index
EI	Employment Insurance
MET	Metabolic Energy Cost
OECD	Organisation for Economic Co-operation and Development
OR	Odds Ratio
PUMF	Public Use Micro-data File
SES	Socioeconomic Status
WHO	World Health Organization

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Chapter 1

Introduction

The prevalence of obesity in Canadian adults has roughly doubled in the period from 1981 to 2007 [Shields et al., 2010]. Obesity is associated with a higher risk of health conditions such as type II diabetes, stroke, heart attacks and many more [Cawley and Meyerhoefer, 2011]. As a result, the treatment of conditions which are caused or associated with obesity are a direct cost to the health care system. The indirect costs of obesity capture the loss of economic productivity resulting from poorer health and absenteeism [Starky, 2005]. The Canadian Institute for Health Information [2011] estimates that the direct and indirect costs of obesity have risen from $3.9 billion in 2000 to $4.6 billion in 2008. These estimates depend on the costs associated with conditions that are comorbid to overweight or obesity. A study by Anis *et al.* [2010] that accounted for the comorbidity of 18 conditions found the costs of overweight and obesity to be as high as $11 billion.

While genetics account for approximately half of the cross-sectional variation in obesity [Comuzzie and Allison, 1998], patterns in diet and exercise vary significantly throughout Canada. As such, the distribution of body weight varies across age, sex, income, education, geography, environment and economic conditions. Understanding these patterns provides valuable insight into the regulation of weight-related behaviour and the possibility for public policy to encourage a healthy lifestyle. Explaining the trend of increasing obesity and the timing of the trend has led scholars to consider the impact of economic factors.

There are two general patterns of excess body-weight that will be discussed here. The first is the relationship between BMI and Socioeconomic Status (SES), as measured by, both relative and absolute income. Families with low SES are less able to afford nutritional food and have fewer opportunities for physical activity. This complex relationship will be examined primarily by observing how patterns of BMI, diet and exercise vary according to household income, relative income, education and gender. Several theories explaining these patterns will be discussed. Then, different measures of absolute and relative income will be tested to compare which statistical relationship is more predictive and significant. Because income is associated with a multitude of personal characteristics, educational attainment is included as a control for this endogeneity.

The other variable of interest is economic insecurity, defined by Osberg [1998] as "the anxiety produced by a lack of economic safety – i.e. by an inability to obtain protection against subjectively significant potential economic losses". Considerable stress is associated with the possibility of job loss and the extent to which the resulting financial consequences

are insured. This study attempts to test if higher levels of psychological stress due to economic insecurity in Canada have an influence on obesity. The probability of unemployment is captured using the provincial unemployment rate specific to age and gender. In Canada the consequences of unemployment are mitigated by the employment insurance system. There is some variation in the portion of earnings that are reimbursed by EI and the portion of unemployed who are covered by EI. This regional variation in economic insecurity is used to test if these economic conditions have any role in explaining the prevalence of overweight and obesity. While there are similarities in the conditions faced by low income families and economically insecure families, the distinction is the uncertainty associated with the latter. The risk of a dramatic *reduction* of resources is a source of considerable stress, and the purpose of this research is to detect the possible health consequences of this stress. There is some evidence, discussed below, that weight related behaviour is affected by stress.

Economic insecurity is measured indirectly by observing the probability of unemployment and the potential consequences. Food insecurity, is a measure of an individual's concern that food will run out before they are able to afford more. This uncertainty of sustenance can be thought of as an individual expression of extreme economic insecurity. The risk associated with a negative income shock is conceptually similar to the risk associated with negative shock to nutrition. Food insecurity is an individual's forward-looking concern of their subjective ability to provide consistent nourishment in their household. The ability to choose and prepare food on a limited budget substantially affects the subjective experience of lost income. The inclusion of food insecurity represents a novel contribution to the economic insecurity hypothesis of obesity. The association between these risks and excess body weight are tested along with the role of stress as a possible mechanism.

This paper relies primarily on survey data from the Canadian Community Health Survey [2010b], and additional data capturing economic conditions at the provincial level. The purpose of this analysis is to determine the influence of economic conditions by observing patterns within the population while attempting to hold all else constant. Once these patterns are established, additional explanatory variables measuring diet, exercise and stress are included to determine what best explains the given disparities.

Motivation

My interest is to understand the relationship between economic conditions and health. The reason for using obesity as the primary outcome measure is that it is determined in part by our behaviour. At the individual level, biology and medicine have identified some of the causes and consequences of obesity, but they cannot explain the epidemiological trend of increasing rates of obesity. Human decisions about diet and exercise are undoubtedly complex and vary from one individual to the next. Psychology can provide some insight

into those decisions, such as our ability to delay gratification and sustain effort. Again, even with an exceptional understanding of these individual capacities, we cannot explain aggregate trends of increasing obesity. If human physiology has remained relatively static for the last 30 (or 3000) years, then some external conditions must play a role in influencing our behaviour. Economics is uniquely suited to provide insight into how external factors such as income, inequality and security may influence weight-related health decisions. While such influences are likely too subtle to be felt by an individual experiencing weight gain, they can be detected by analyzing trends in survey data.

The purpose of this research is to gain a better understanding how obesity is related to income and the certainty of that income. There are five strands of literature that are relevant to this topic, beginning with the well documented relationship between SES and obesity. The paradoxical relationship between food insecurity and obesity is then discussed, followed by the observed relationship between macroeconomic conditions and health. With regard to economic insecurity, I review the evidence for its influence on health, and obesity in particular.

Chapter 2

Literature Review

2.1 Socioeconomic Status and Obesity

The complex relationship between relative socioeconomic status and obesity is studied in a number of ways, including cross-country comparisons and individual level studies using micro-data. In a review of 333 published worldwide studies examining the relationship between SES and obesity, McLaren [2007] find that for countries that are higher on the United Nation's Human Development Index [2011], the association between obesity and income is negative. That is, relative to countries with low and medium levels of development, higher incomes are associated with lower levels of obesity in countries like Canada.

There is an extensive literature examining the relationship between wage and obesity in the United States. The correlation between obesity and wage was first discovered by Register and Williams [1990] by incorporating BMI into an classical equation estimating the determinants of wage. Even after controlling for individual characteristics such as age, sex, education and experience, they find that the mean wage of obese women (men) was 16% (7%) lower than their normal weight counterparts. Results are dependent on sex. Wada and Tekin [2007], use precise measures of body fat to separate the influence of fat-free mass and adipose tissue. Their results indicate that the amount of fat tissue depresses wages for both sexes, while fat-free mass has a positive influence on male wages. Hildebrand and Van Kerm [2010], estimate the impact of height and weight separately on wages in Europe. For men, higher incomes are associated with a higher BMI, while the opposite is true for women. The same general pattern emerges in Canada [Tjepkema, 2005]. There are three possible explanations for this correlation : obesity may decreases wages through employer discrimination (BMI $\Rightarrow$ Income), additional income may improve living conditions related to body weight (Income $\Rightarrow$ BMI), or some unobserved factor could be influencing both simultaneously [Conley and Glauber, 2005].

Increased income could allow for an improved diet, increased opportunities for physical activity or even the pressure for thinness [McLaren, 2007] and thereby be associated with less obesity. This could explain the pattern between countries, but it cannot explain the gender specific patterns found in wealthy countries. Gregory and Ruhm [2009] provides the most comprehensive evidence that BMI partially determines wage, rather than the other way around. To test reverse causality, the authors used long (13-19 years) lags of BMI because there is no plausible reason to suggest that current wages might have some influence on an individual's weight 13 years prior. They found that the relationship between BMI and wage

was fairly similar when using the lagged body weight (after correcting for age), suggesting that for obese women, lower wages are partially caused by employer discrimination. Given that wages peak for women well below the overweight cutoff, and above the overweight threshold in men, the authors conclude that the wage penalty for overweight and obese women is due to discrimination based on physical attractiveness. Similar findings are found by Conley *et al.* [2005].

Negative correlations between educational attainment and numerous health outcomes, including BMI have also been established [Grossman, 2006]. Education may reduce excess body weight through access to better health information, because it fosters stronger self control, and/or because education may lead people to value future health more. For a detailed discussion of the influence of education, see Von Hipple and Lynch [2012]. This study will examine the extent to which the BMI varies across income and education by testing which variables are better predictors of excess weight.

As discussed above, the beauty hypothesis argues that weight determines wage, at least for women. This beauty based selection present in the labour market is less likely to influence an individual's level of education. In this study, I compare the statistical relationships between BMI and personal income vs. education to test which explanation best fits the Canadian data.

Several different measures of SES are used, including household income, personal income, equivalent income (adjusted for differing needs of families of different size) and income distribution. The relationship between BMI and each of these has slightly different interpretations: Personal income is most relevant to testing the beauty hypothesis, while household income is a more accurate measure of socioeconomic status if income is mostly shared within the family. Relative SES, compares household income to those within the same region. This measure is a better indication of prestige and status than absolute income. It should be noted that these measures only capture a income at the time of the survey, and cannot provide an accurate reflection of an individual's lifetime income.

Brunner *et al.* [1997] find that stress associated with low occupational status is associated with higher coronary risk and metabolic syndrome. With regard to body weight, social status may be influence body weight rather than the other way around. There is evidence from within Canada suggesting higher *relative* SES is associated with increased social pressure for women to be thin [McLaren and Gauvin, 2002].

2.1.1 Macroeconomic Conditions and Health Status

A strand of economic literature examines the relationship between macroeconomic conditions and health. The seminal paper by Christopher Ruhm [1996], asking "Are Recessions Good for Your Health?" shows that rates of mortality in the United States actually decreases when the unemployment rate increases. In a subsequent paper, Ruhm [2005] attempts to

find the underlying cause for this relationship and suggests that the health gain during recessions is due to decreased smoking and increased exercise. If such behaviours are sensitive to fluctuations in the business cycle, it is plausible that the prevalence of overweight and obese might also be correlated with macroeconomic conditions.

Filipski [2009] cautions that the pro-cyclical nature of mortality is not due to changes in stress levels or health behaviour, but from fewer vehicular accidents as a result of fewer commuters. He also claims that Ruhm's findings are largely driven by the elderly, who have less of a direct relationship with the labour market. Ruhm's response is that even if traffic fatalities are taken into account, there are decreases in heart attacks and other medical conditions which are not fully explained. He suggests that reductions in pollution and decreases in smoking are important, but do not explain all of the effect [2006].

This direction of the relationship seems to be consistent from one country to another, but the magnitude varies. Bezruchka [2009] argues that countries with strong social safety nets see smaller changes in response to the business cycle. Using data from the OECD countries, Gerdtham and Ruhm [2006] find the largest effect in the United States. Considered all together, a 1% decrease in unemployment caused a 0.4% increase in mortality due to cardiovascular disease, flu and pneumonia.

Ariizume and Schirle [2011] have recently tested the pro-cyclicality of mortality in Canada. They attempt to replicate the estimation techniques in Ruhm [1996] and find that if their sample is not separated by age groups, the effect disappears. When different age groups are considered individually, they do find a procyclical relationship, but only for those in their 30s. This is an interesting result because in the United States, the largest impact was on seniors. Ariizume and Schirle suggest that universal health care is a mitigating factor; reducing the impact of the business cycle on health outcomes for those not in the labour force.

2.1.2 Economic Insecurity and Health Status

While the only measure of health status being tested is overweight and obesity, the broader discussion of how health status relates to economic insecurity is conceptually relevant. The risk associated with unemployment is determined by the probability of unemployment, and the economic consequences of unemployment. The Index of Economic Wellbeing [Osberg, 2010, p. 42], captures four measurements of economic insecurity: the unemployment rate, the financial risk associated with illness, the risk of single parent poverty and the risk of poverty in old age.

This analysis will focus on the risk imposed by unemployment, which is measured by the unemployment rate, the proportion of unemployed persons covered by EI and the amount of weekly EI benefits. The last two measures represent the insurance against drastic losses of income resulting from unemployment. Measures of the Canadian EI system will be discussed further in the Data section.

Existing literature establishes a relationship between economic security and health outcomes [Catalano, 1991], with stronger evidence for symptoms of psychological distress [De Witte, 2007] and subjective well-being [Helliwell and Huang, 2011]. Sullivan and Wachter [2009] analyze male Pennsylvanian workers in 1970-80 and find that mortality rates increases dramatically following job loss and persists (though smaller in magnitude) twenty years later. Using longitudinal data from the U.S., Burgard [2009] finds that the stress associated with perceived economic insecurity decreases self-rated health; a finding that is due to the associated stress rather than actual job losses. Other evidence from the U.S. suggests that even if an individual is able to be reemployed, their self-rated health is restored, but they are at higher risk of developing new health conditions [Strully, 2009].

The experience of job insecurity may be gender specific. Examining workers aged 55 and above, Kalil [2010] finds that job insecurity is associated with higher blood pressure and lower self-rated health in men. Women who experienced job insecurity show higher depressive symptoms and report more hostility, loneliness, and personal stress as compared with women who have no experience with job insecurity and men who do.

Using the Canada's National Population Health Survey, McDonogh [2000] finds that job insecurity lowers self-rated health and increased distress and the use of medications, but had no impact on heavy drinking. Given the psychological distress associated with job insecurity and the observed impact on health, weight related behaviours could also be influenced by economic insecurity.

2.1.3 Economic Insecurity and Obesity

The hypothesis that weight gain is a consequence of economic insecurity is relatively new, but the empirical support is growing both from natural experiments and international comparisons. The conceptual basis for the relationship between economic insecurity and weight gain comes from behavioural biology. There is evidence that when animals are faced with periods of starvation they respond with fattening behaviour [Ekman and Lilliendahl, 1993, Shively et al., 2009]. Smith *et al.* [2009] argue that humans may have an evolutionary vestige that encourages a similar change in behaviour in response to insecurity. In a modern environment where calories are no longer scarce, this instinctual behaviour may lead to excess body weight.

Early evidence provided by Ferrie *et al.* [1998], used the the Whitehall II longitudinal study of British civil service employees to compare a department that were facing privatization with a control group. Using a difference-in-differences approach, they find that employees in the department being shut down increased BMI by 0.3 for men and 0.6 for women, relative to the control group. Using an updated version of the survey, Brunner *et al.* [2007] measure the impact of work *strain* on obesity and find that higher incidence of work related stress is associated with increasing likelihood of obesity. Studying a cohort of 1980 Danish workers over a five year period, Hannerz *et al.* [2004] find that job insecurity and

psychological demands have an impact on obesity. Obese workers exposed to job insecurity gain more weight than those who are, while underweight employees lose weight relative to those with secure jobs.

Smith *et al.* [2009] attempt to find support for the relationship between economic insecurity and weight gain. They find that a decrease of one standard deviation in the Index of Economic Security [Osberg, 2010] (including risk of unemployment, volatility of income and probability of poverty) results in a weight gain between 0.3 and 7 pounds. This effect was partially ameliorated for those individuals with health insurance.

There is another strand of literature testing the hypothesis that the prevalence of obesity in a country is influenced by the national welfare regime [Offer et al., 2010a]. Comparisons between affluent, market liberal countries show that providing less insurance against catastrophic income shocks is positively predictive of a higher rate of obesity in a country, and income insecurity is found to be a better predictor of rates of obesity than inequality [Offer et al., 2010b].

There have also been negative results when testing this hypothesis. Sampling 2782 New York manufacturing workers going through major restructuring, Diana *et al.* [2010] find no statistically significant relationship between expressed job insecurity and weight gain over a 2 year period.

Whether overeating is due to an vestigial instinct, or a rational response to substitute towards cheaper, high calorie food is beyond the scope of this investigation. In either case, if the relationship exists, there are external health costs associated with economic security that need to be accounted for.

2.1.4 Food Insecurity and Obesity

One particularly unfortunate form of economic insecurity is an inability to ensure a stable source of food. A paradoxical relationship has been observed whereby individuals exposed to food insecurity, the possibility of running out of food and not being able to afford more, are more likely to be overweight. Research on the effects of food insecurity began with evidence from the U.S. welfare program in 1995 [Dietz, 1995]. The program gave recipients a bi-monthly payment which fostered an uneven distribution of nutrients throughout the month and was associated with a higher risk of obesity. Subsequent research has tested whether the paradox is due to the over-representation of overweight and food insecurity in low income households or if a constrained food budget leads to lower quality diets [Dinour et al., 2007]. This relationship has been observed in the children of food insecure households [Eisenmann et al., 2011] and mothers [Bhattacharya et al., 2004, Adams et al., 2003] in the United States.

Studies examining Canadian data find the weight of adult women to be positively related to food insecurity [Townsend et al., 2001]. The relationship is stronger for women, so this gender specific role might be due to low income mothers sacrificing their own nutrition

for the sake of their children [McIntyre et al., 2003]. Higher rates of nutrient inadequacy are apparent among adolescents and adults in food-insecure households throughout Canada [Kirkpatrick and Tarasuk, 2008], but some researchers warn that these results may not be robust to *measured* BMI and so may be explained by reporting bias. Using the Longitudinal Study of Child Development in Quebec, Dubois *et al.* [2006] find that children exposed to food insecurity are more than 3 times more likely to be obese and twice as likely to be overweight.

Chapter 3

Data

The primary data source for this analysis is the Canadian Community Health Survey (CCHS) - Annual Component spanning 2000/01, 2003, 2005, 2007/08, 2009/10 and 2010 [Statistics Canada, 2010b]. Prior to 2007, the survey was conducted every two years. From 2007 onwards, data was collected yearly and combined for public use. Statistics Canada conducts this cross-sectional survey to collect information related to the health status, health determinants and demographics of the Canadian public. The sample size, roughly 65,000 respondents per cycle, is sufficiently large to provide reliable interpretation for the country's 115 health-regions. The CCHS uses the Labour Force Survey sampling frame, which is stratified geographically, with clusters in each stratum. All members of the household are listed, and one person above the age of twelve is surveyed. A sample weight is then assigned to each observation to allow meaningful inferences for population characteristics. Statistics Canada provides a public use micro-data file (PUMF), which has been retrieved from Equinox data delivery system. For a more detailed description of the CCHS data sources and methodology, see the guide [2011a].

The CCHS excludes persons living on reserves, full-time members of the Canadian Forces, and the institutionalized population. The population at risk of a sudden loss of income is working aged, so this analysis is restricted to adults between 20-64 years old. Other excluded populations include full-time students, the Territories, those with an activity limiting injury and immigrants, because their health status or economic security is influenced by factors outside the consideration of this study.

The international standard to measuring obesity, set by the WHO is the Body Mass Index (BMI). The CCHS provides derived values from the self reports of height and weight, excluding pregnant mothers:

$$BMI = \frac{weight\ (kg)}{height^2\ (m^2)} \tag{3.0.1}$$

Table 3.1 classifies ranges of BMIs into different weight categories. While the BMI is an imperfect measure of obesity because it does not account for body composition, the measure is used because it is easy to collect through self reports and provides a single unit of analysis. The percentage of body weight composed of adipose tissue is a more accurate measure of obesity, but much more costly to collect [Deurenberg et al., 1998]. Because most studies (including this one) rely on self-reports of weight and height, there are additional issues of self-report bias. When self reports are compared to measured data, there is a consistent bias in adults to overestimate height and underestimate weight [Gorber et al., 2008]. This

result in a systematic downward bias in self-reported data of adult BMI.

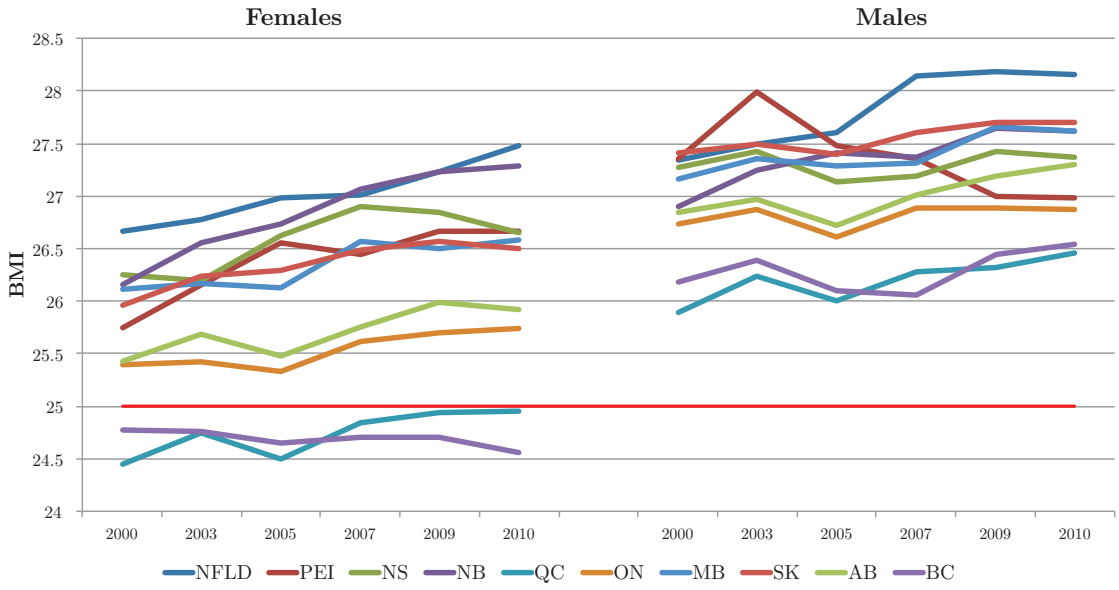
Table 3.1: Definition of BMI Categories

BMI	Category
≤18.5	Underweight
18.5 - 24.9	Normal Weight
25.0 - 29.9	Overweight
≥ 30.0	Obese

The two thresholds, "overweight" and "obese" form the two variables of interest in this study. For an individual to be classified as overweight, their BMI must exceed 25, which implies all respondents who are obese also fall into the overweight category. The use of the two BMI thresholds allows for greater sensitivity to how the independent variables are related to weight at the critical BMI values of 25 and 30.

The provincial average BMI for people 20-64 years old is shown in Figure 3.0.1. The persistent regional differences are suggestive of environmental influences, but further analysis is required to control for demographic differences. Quebec and British Columbia have relatively lower average BMIs, while the Atlantic provinces have consistently higher relative BMIs.

Figure 3.0.1: Average BMI in Canadian Provinces Age 20-64, 2000-2010



Data Source: CCHS [2010b]

The relationship between SES and excess weight is tested using four different specifications. Each model uses a different measure of income: 1 - Household Income, 2 - Personal Income, 3 - Equivalent Income, 4 - Income Distribution. The definitions and rationale for

using these measures is discussed below.

The key measures of SES that are captured in the CCHS are categories of household and personal incomes along with regional income distribution. Questions dealing with income are asked near the end of the survey. Respondents are asked, "What is your best estimate of the total income received by all household members, from all sources, before taxes and deductions, in the past 12 months?"[1]. The interviewer lists ranges of income from less than $5,000 up to $150,000 and over, asking the respondent to "stop me when I have read the category which applies to your household" [Statistics Canada, 2011a]. While the survey collects income in intervals between $5000 (below $50,000) and $10,000 (over $50,000), the PUMF only reports annual household income in *five* categories including "Less than $15,000", $15,000 to $29,999", "$30,000 to $49,999", "$50,000 to $79,999" and "$80,000 or more. Personal income is divided into six categories ranging from "No Income" to "$80,000 or more", but "No Income" and "Less than $15,000" are combined for the sake of comparison. Combining all incomes above $80,000 into a single bracket is a limitation of the data that will be discussed in the conclusion.

The survey also includes data regarding the main source of income, which are reported as "Employment Income", "Unemployment Insurance / Worker's Compensation", "Senior's Benefits" and "Other". There are important differences between family and personal incomes. Under the assumption that *household* income is shared to some extent, it more accurately reflects the economic conditions faced by that individual and therefore the preferred measure for this analysis. Personal income is used only for the discussion of wage being determined by weight.

Another measure of SES used in this thesis is Equivalent Household Income, consistent with the Luxembourg Income Study [2009]. This measure attempts to adjust household income for family size. It is derived from the the midpoint of the reported income quintile ($7500, $22500, $40000, $65000, $80000) and household size (1 to 5 or more persons)

$$\text{Equivalent Fam Inc (Log)} = \ln\left(\frac{\text{Income Midpoint}}{\sqrt{\text{Household Size}}}\right)$$

The resulting variable is treated as continuous rather than categorical. Since equivalent income takes family composition into account, it more accurately reflects the individual respondent's share of household income.

Estimates of the income distribution are used to assign the household to the decile of household income for their corresponding health region[2]. For comparison sake, I have reduced these to quintiles and used the top quintile as the base case. Regional income quintile is used as a measure of *relative* socio-economic status, rather than absolute household income.

[1] Capital gains should not be included in the household income. Income can come from various sources such as from work, investments, pensions or government.

[2] This is possible because income is collected in detailed categories before being aggregated for public use.

The demographic information collected includes age, in four year increments. The highest level of education by the respondent is recorded as "Less than Secondary", "Secondary Graduate", "Other Post-Secondary", and "Secondary Graduate". Cultural or racial origin is given as "White" and "Visible Minority". Sense of belonging to local community is given in four categories from "Very Strong" to "Very Weak". The stated living arrangement of the respondent is captured by categorical variables for a(n) "Unattached Individual Living Alone", "Unattached Individual, Living with Others", "Living with a Partner and no children", "Parent living with Partner and Children", and a "Single Parent Living with Children". The most common living arrangement, living with a partner and no children, is used as the base case.

Aside from the annual component, Statistics Canada conducts smaller surveys to collect information pertaining to specific health topics. In 2004, cycle 2.2 of the CCHS included questions pertaining to nutrition[3]. Income-related food security was identified as an important public health issue [Bush and General, 2007] and is included in the 2007/08 annual component and as an optional component for most provinces in the 2005 and 2009/10 surveys. The provinces not participating in the 2005 food security component are Saskatchewan, Manitoba, New Brunswick and Newfoundland & Labrador. The provinces not participating in the 2009/10 food security component are New Brunswick and PEI. Appropriate sample re-weighting and controls for province & year are used in the analysis of food insecurity to estimate the overall impact on excess body weight in Canada from 2005-2010.

To measure food insecurity, the interviewer asks the respondent to judge the following statement: "You (and other household members) worried that food would run out before you got money to buy more. Was that often true, sometimes true, or never true in the past 12 months?" [2011a]. Another question asks if respondents "couldn't afford to eat balanced meals" within the past year. Responses to both of these questions are the measures of food insecurity used in this paper[4].

One proposed mechanism through which economic insecurity may influence weight is a human response to stress. Reports of self-perceived stress and self-perceived work stress (only available if currently working) are divided into five categories from "Not at all Stressful" to "Extremely Stressful". Self-rated mental health is also on a five point scale from "Excellent" to "Poor" and conceived as a control for individuals who have a higher underlying level of stress. This variable was transformed to be consistent with the stress variables, where higher values are undesirable.

The following variables describe economic conditions at the provincial level and are used for the analysis of economic insecurity. Real GDP growth [2011c] is derived using 2002 constant prices in the following way: $\Delta GDP_t = \ln\left(\frac{GDP_t}{GDP_{t-1}}\right)$. Average Housing Price data

[3]Due to the module's sampling methods, the estimates are not comparable to the annual component in later years.

[4]The survey asks other questions relating to food insecurity, but those variables are not significantly related to excess body weight.

from the Canadian Real Estate Association[2011], are converted to real values using the Consumer Price Index [2011b]. Housing Affordability is a measure of economic insecurity because housing represents a substantial financial obligation, which can make the consequences of income loss more dire. It is calculated by dividing the average real provincial price of a home by the average weekly earnings $\times 52$, representing the average housing value in terms of years of average salary.

The following measures of economic insecurity are taken from the Index of Economic Wellbeing [Osberg, 2010]: Coverage Ratio is the proportion of unemployed who are receiving employment insurance. Coverage Ratio=$(Beneficiaries/Unemployed)$. The number of beneficiaries comes from Employment Insurance Statistics [Statistics Canada, 1994-1998a] and the unemployment rate is from the Labour Force Survey [Statistics Canada, 1976-2011]. The unemployment rate corresponding to the age, sex, year and province is matched to each individual. EI Benefits as a Proportion of Earnings is the ratio of Average Weekly EI Benefits [Statistics Canada, 2010a] divided by the Average Weekly Earnings [Statistics Canada, 2000-2010]. In Canada, EI benefits can be collected after a two week "waiting period". The basic rate for calculating benefits is 55% of average insurable weekly earnings up to a maximum amount. The maximum amount of insurable earnings corresponding to the years of this study are shown below:

Table 3.2: Canadian Maximum Insurable Earnings 2000-2010

2000	2003	2005	2006	2007	2008	2009	2010
$39,000	$39,000	$39,000	$39,000	$40,000	$41,100	$42,300	$43,200

Source: CRA [2011]

The influence of weight related behaviours is well established so the following variables are generally used as controls. Total fruits and vegetables per day is derived from the frequency the respondent consumes fruit, fruit juice, salad, potatoes, carrots and other vegetables. Canada's Food Guide recommends between 7-8 servings for females and 8-10 for males between the ages of 19 and 50, and 7 servings for anyone 50 years and above[5] [Katamay et al., 2007]. The CCHS collects frequency rather than serving sizes and relies on respondent's recall. For this study, females (males) will be classified as consuming the recommended amount of fruits and vegetables if they consume fruits or vegetables more than 7.5 (9) times per day under the age of fifty and more than 7 for those older than fifty. Average daily alcohol consumption is derived from the response to number of drinks in the week prior to the interview. Respondents who self identified as "daily" or "occasional" smokers are captured by dummy variables. The categorical variable "Regular Drinker" captures individuals who average 1 or more drinks per week. Daily energy expenditure during leisure time activities is calculated using the frequency and duration of a wide variety of physical activities, which is then multiplied by the metabolic energy cost (MET) for that

[5]Using this rather than the continuous variable makes it easier to interpret, but less significant.

particular activity. MET is a "value of metabolic energy cost expressed as a multiple of the resting metabolic rate" [Statistics Canada, 2011a]. The derived energy expenditure variable attempts to capture the average daily (kcal/kg) per hour of energy during leisure activities[6].

Table 3.3: Summary Statistics

Variable	Females			Males			
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	Years
BMI	25.790	5.552	156880	27.068	4.550	142176	All
Household Income < $15,000	0.098	0.298	149999	0.073	0.260	130171	All
$15,000 - $29,999	0.164	0.371	149999	0.125	0.331	130171	All
$30,000 - $49,999	0.217	0.412	149999	0.206	0.405	130171	All
$50,000 - $79,999	0.233	0.423	149999	0.248	0.432	130171	All
$80,000 or More	0.287	0.453	149999	0.348	0.476	130171	All
Equivalent Family Income ($)	34,593	17060	118715	38,296	17515	102905	≥ 2005
Energy Expenditure	1.974	1.983	166464	2.150	2.279	139854	All
Daily Fruits & Vegetables (#)	5.058	2.652	148881	4.214	2.502	126123	All
Consumes Recommended F&V	0.273	0.445	168294	0.189	0.392	144162	All
Daily Alcohol Consumption (#)	0.587	0.492	168294	0.746	0.435	144162	All
Daily Smoker (prevalence)	0.235	0.424	167726	0.272	0.445	143619	All
Occasional Smoker ($0 \leftrightarrow 1$)	0.050	0.218	167726	0.055	0.228	143619	All
Worried food w. run out ($0 \leftrightarrow 1$)	0.054	0.226	168294	0.041	0.199	144162	≥ 2005
Bal. meals unaffordable ($0 \leftrightarrow 1$)	0.043	0.203	168294	0.035	0.185	144162	≥ 2005
Self Perceived Stress ($1 \leftrightarrow 5$)	2.936	0.956	167921	2.855	0.995	143723	All
Self Perc. Work Stress ($1 \leftrightarrow 5$)	3.068	0.998	132060	2.983	0.997	124572	All
Self Perc. Mental Health ($1 \leftrightarrow 5$)	1.971	0.932	135956	1.961	0.934	114965	All
Household Size ($1 \leftrightarrow 5$ or more)	2.505	1.189	136950	2.444	1.224	116836	≥ 2005
Unattached Ind. Living Alone	0.203	0.403	166451	0.251	0.433	143145	All
Unattached Ind, w. Others	0.033	0.179	166451	0.046	0.210	143145	All
Living w. Partner	0.297	0.457	166451	0.272	0.445	143145	All
Parent w. Partner and Children	0.295	0.456	166451	0.286	0.452	143145	All
Single Parent w. Children	0.080	0.272	166451	0.019	0.135	143145	All
Unemployment Rate	5.993	2.173	160587	6.875	3.367	138567	All

Note: "All" years represents 2000/01, 2003, 2005, 2007/08, 2009, 2010.

The seven years of data from the CCHS were combined into a single data file and the province level variables were matched to the corresponding year. Table 3.3 presents summary statistics for selected variables. This analysis treats this data as cross-sectional as it is yearly, representative samples of a roughly stable population. Year fixed effects control for any trends over time, which assumes that the relationships tested are stable over the 10 year sample period.

The replacement of earnings through EI, shown in Figure 3.0.2 have remained in the range of 38% to 49% since 1998. The ratio of EI recipients to number of unemployed, shown

[6]A more detailed explanation of these derived variables can be found in CCHS Grouped and Derived Variables Specifications [Statistics Canada, 2005b]

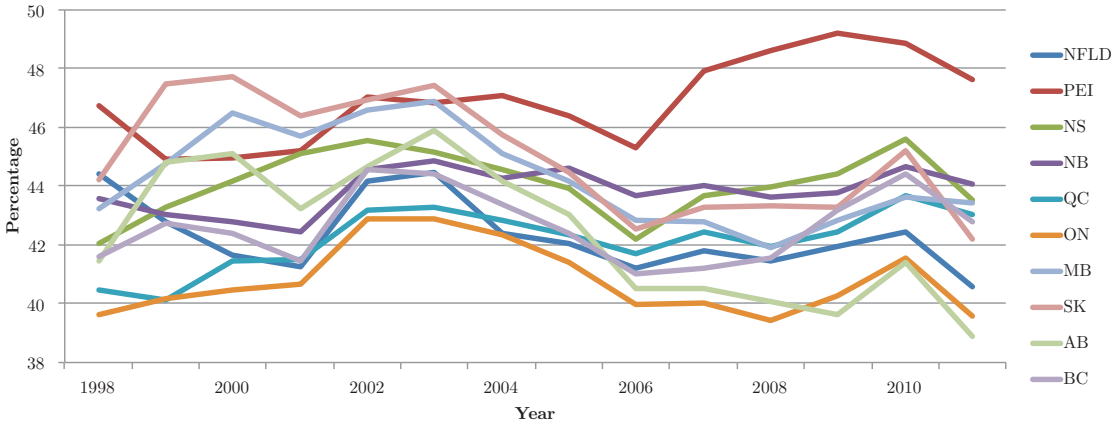
Table 3.4: Summary Statistics - Province Level Variables

Provincial Level Variable	**Mean**	**SD**	**N**
Coverage Ratio: EI Recipients/Unemployed (%)	46.824	20.015	144162
EI Benefits / Ave Earnings (%)	42.684	1.930	144162
Average Real House Price	$254,147	114,891.1	113001
Housing Affordability: Ave Housing Price/Ave Yearly Salary (Years)	6.357	2.365	245221

Note: Data from 2000/01, 2003, 2005, 2007/08, 2009, and 2010.

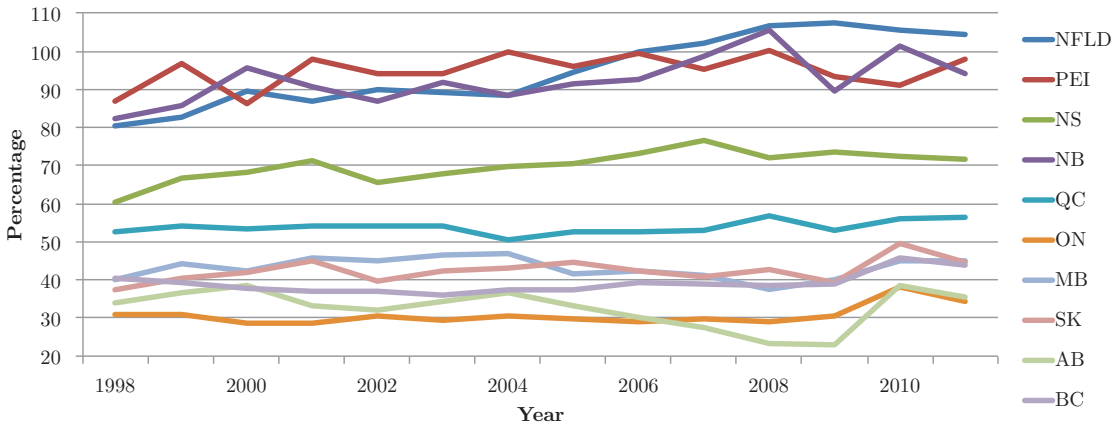
in Figure 3.0.3 shows relative consistency over time, but there is considerable geographic variation, with the Atlantic provinces consistently higher. Excluding Nova Scotia, Atlantic Canada has maintained a coverage ratio above 80% since 1998.

Figure 3.0.2: EI Benefits as Portion of Earnings in Canadian Provinces, 1998-2011



Data Source: IEWB [2010]

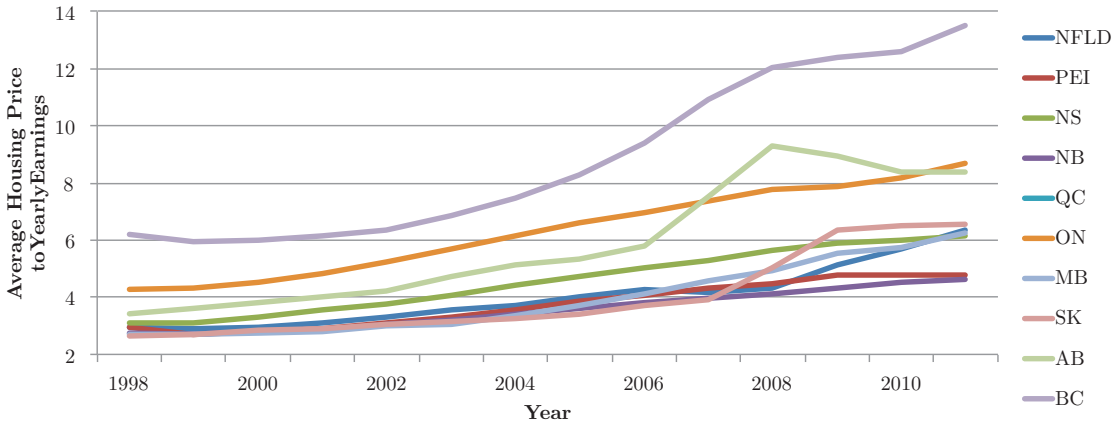
Figure 3.0.3: Coverage Ratio in Canadian Provinces, 1998-2011



Data Source: IEWB [2010]

Economic insecurity is also related to an individual's financial obligations, such as providing food and shelter. The affordability of housing varies significantly from province to province, and is therefore included in this analysis. Housing affordability is a ratio of the provincial average housing price (real) divided by the average yearly earnings (average weekly earnings $\times$ 52). Shown in Figure 3.0.4, the vertical axis represents the average housing price divided by average yearly salary. There is a consistent trend of housing prices increasing faster than average salaries. Using this measure, housing affordability has dropped considerably in Alberta, Ontario and British Columbia over the past decade.

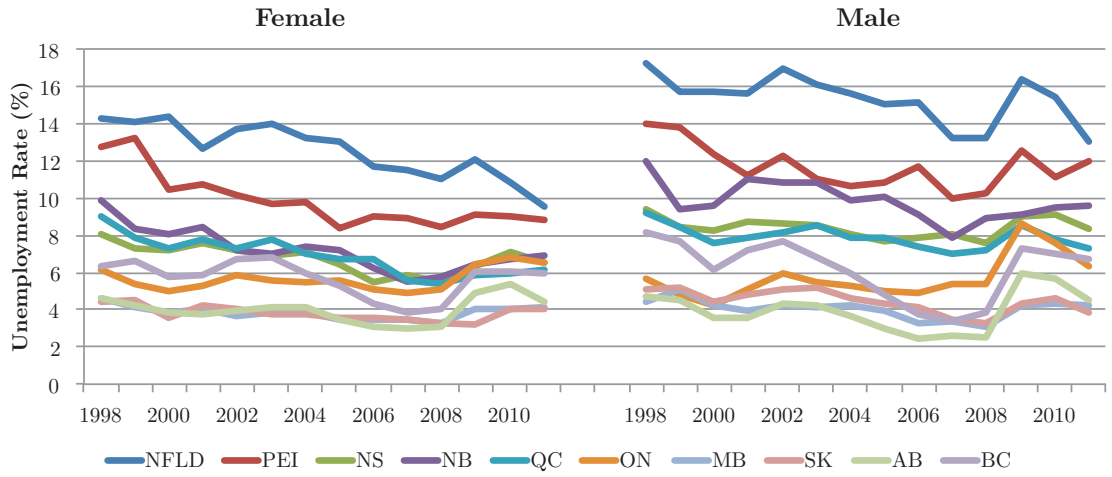
Figure 3.0.4: Housing Affordability in Canadian Provinces, 1998-2011



Data Source: [Statistics Canada, 2000-2010] and [Canadian Real Estate Association, 2011]

The CCHS micro-data user guide [Statistics Canada, 2011d] recommends rescaling the weights so that the average is 1 for the individuals included in the tested population to account for the unequal probabilities of selection into the survey in different years. This sample weight was re-calculated for each estimation, so that the average weight of the sample population in every year was 1. The multivariate logistic regressions were implemented using the `pweight` command in the statistical software program STATA [2011].

Figure 3.0.5: Average Yearly Unemployment Rates in Canadian Provinces Age 20-64, 1998-2011



Data Source: CCHS [2010b]

Chapter 4

Empirical Methodology

The significant differences in body composition between men and women require separate estimations. The binary dependent variables are assigned the following values:

$$Overweight = \begin{cases} 1 & BMI \geq 25 \\ 0 & BMI < 25 \end{cases} \qquad Obese = \begin{cases} 1 & BMI \geq 30 \\ 0 & BMI < 30 \end{cases}$$

With the categorical dependent variables for overweight and obese, logistic regressions are used and the odds ratio (OR) reported. For obesity, it represents the probability of being obese divided by the probability of not being obese, relative to the base case. If the probabilities are equal (50% and 50%) the odds ratio will equal 1. As an example, in a model describing female obesity, an odds ratio of 1.5 for "Atlantic" implies that a woman from the Atlantic provinces is 1.5 times higher odds of being obese (all other included variables held constant). Alternatively if the ratio is lower than 1, the odds are *lower* than the base case.

$$\text{OR}_{Obese} = \frac{P(\text{BMI} \geq 30)}{1 - P(\text{BMI} \geq 30)} \tag{4.0.1}$$

The most common instance in each category is used as the comparison group. The default region is Ontario, education is post-secondary graduate, age is 40-44, annual household income is $80,000 or more and the year 2000. The most common *personal* income is $15,000 to $29,999 but for the sake of comparison with household income, over $80,000 will be used as the base. Robust standard errors are used throughout.For the sake of conserving space, the odds-ratios discussed in the results will only mention their statistical significance if it is below ($p < 0.001$).

Models testing the effect of income, food security, stress and regional disparities rely solely on individual micro-data. The relationship between overweight, obese and each measurement of income is tested using logit regressions in the following form :

$$P(\textbf{Obese}_i) = \alpha + \beta_1 Y_i + \phi X_i + \eta_a + \delta_p + \gamma_t + u_i \tag{4.0.2}$$

Where (Y_i) is the measure of income. In Specification 1, Y_i is a set of dummy variables indicating which bracket the *household* income belongs in (omitting the top bracket). In Specification 2, Y_i is a set of dummy variables indicating *personal* income. In Specification 3, Y_i is treated as a continuous variable for the log of *equivalent* income. Lastly, in Specification 4, Y_i is a set of dummy variables for each income quintile (omitting the top quintile).

The individual characteristics (X_i) include highest level of personal education (dummy

variables), total fruits and vegetables, energy expenditure, dummy variables for smoking and drinking frequency, and living arrangements. The models also include a single constant term (α) and there are a set of dummies for age (η_a), province (δ_p) and for each year (γ_t) included. The error term (u_i) is asymptotically normal.

The goal of using these four measures of SES (household income, personal income, equivalent income and household income distribution) is to determine which is most predictive of overweight and obesity. Although not directly comparable, the relative magnitude and statistical significance of the coefficients from logistic regressions can provide insight into how relative and absolute income relate to these conditions. One method used to determine the relative importance of these income measures is stepwise regressions begin with an unrestricted model that excludes the individual characteristics (X_i) and observe how the income coefficients change when other characteristics such as education are included. This approach attempts to isolate the affects of income from the personal characteristics associated with educational attainment.

Models testing the relationship between economic insecurity and excess body weight measure the impact of province-level variables on an individual's odds of being overweight and obese:

$$\begin{aligned} P(\mathbf{Obese}_i) &= \alpha + \beta_1 Y_i + \beta_2 UR_{apt} + \beta_3 UR_{apt-1} + \beta_4 CR_{pt-1} \\ &\quad + \beta_5 EIP_{pt-1} + \beta_6 HA_{pt-1} + \phi X_i + \eta_a + \gamma_t + u_i \end{aligned} \tag{4.0.3}$$

Here UR_{apt} is the gender-specific provincial unemployment rate for the corresponding year (and a one year lag) and age group. Coverage Ratio from the preceding year (CR_{pt-1}) is specific to the province as is EI Benefits as proportion of earnings (EIP_{pt-1}) and Housing Affordability (HA_{pt-1}). The control variables (X_i), age dummies, and year dummies are identical to the the income model (4.0.2) with the notable exception of province-level dummy variables.

The model used to test the relationship between stress and excess weight relies only on individual micro-data and is restricted to respondents that were employed at the time of the survey:

$$P(\mathbf{Obese}_i) = \alpha + \beta_1 Y_i + \beta_7 Stress_i + \beta_8 WStress_i + \beta_9 MentH_i + \phi X_i + \eta_a + \delta_p + \gamma_t + u_i \tag{4.0.4}$$

Here the impact of self-perceived stress ($Stress_i$), self-perceived work stress ($WStress_i$) and self-perceived mental health ($MenH_i$) are included along with the variables in the income model.

Similarly, the food security model relies only on individual micro-data.

$$\begin{aligned} P(\mathbf{Obese}_i) &= \alpha + \beta_1 Y_i + \beta_{10} WorFood_i + \beta_{11} BalMeal_i \\ &\quad + \beta_{12} HSize + \phi X_i + \eta_a + \delta_p + \gamma_t + u_i \end{aligned} \tag{4.0.5}$$

Where $WorFood_i$ is a set of two dummy variables for respondents who 'sometimes' and 'often' worried food would run out. Respondents who were 'sometimes' or 'often' unable to afford balanced meals ($BalMeal_i$) are captured by a set of two dummy variables. Household size ($HSize$) is an integer from 1- 5. This model is also tested using a sample restricted to parents living with their children.

Models that produce statistically significant estimates are re-run using a linear regression with BMI as the continuous dependent variable to check for robustness.

Graphs of the distribution of BMI, diet and exercise are shown for each level of household income. These distributions are smoothed using the kernel command, to remove some of the noise in the micro-data. The BMI distribution is meant to show how the entire distribution of BMI relates to income rather than just the overweight and obese thresholds. Fruit & vegetable consumption and energy expenditure (or lack thereof) are important pathways to excess body weight. Their graphs show how these behaviours are related to household income. These graphs exclude the top 5% of observations (of BMI, total fruit & vegetable and Daily Energy Expenditure) for presentation purposes.

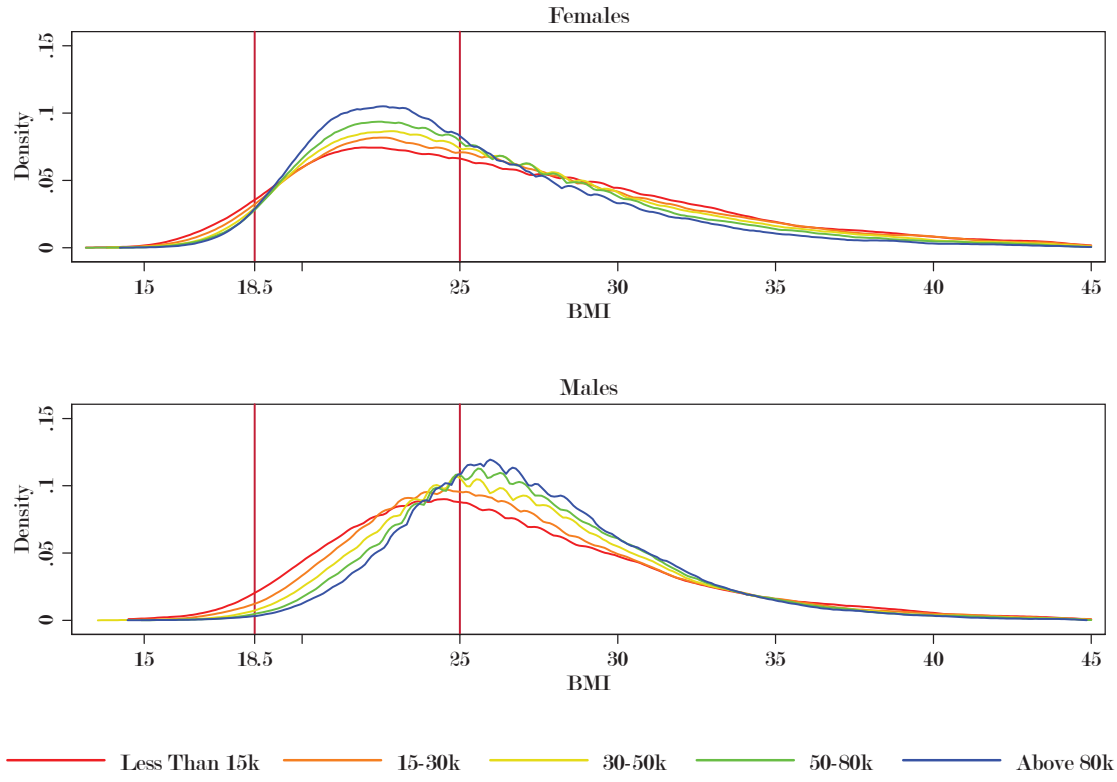
Chapter 5

Results

5.1 Socioeconomic Status and Obesity

The relationship between household income and BMI shows the same gender specific pattern across all years, consistent with previous Canadian estimates using measured BMI [Tjepkema, 2005]. Men with higher incomes are more likely to be overweight and obese, but for women the opposite is true. Figure 5.1.1 shows the smoothed distribution of the BMI in each income bracket. For women in any income bracket, the distribution is densest in the health range (between the red bars). Women in the highest bracket (blue line) are more likely to be within this range and less likely to be obese. Alternatively, men are more densely distributed in the overweight range. The higher income brackets are relatively more likely to be in the overweight and obese range.

Figure 5.1.1: Kernel Distribution of BMI in Canadians Age 20-64 by Household Income Bracket, 2000-2010



Data Source: CCHS [2010b]

The results from Specification 1 for men, shown in Table 5.1 indicate an inverse relationship between *household* income and the odds of being overweight, while no consistent statistical relationship exists between income and obesity. In the baseline model (controlling only for income bracket, age and year), a male making less than $15,000 has lower odds (OR=1.45) of being overweight as compared to the $80,000 and above bracket. The income-overweight relationship is fairly stable to the inclusion of education, lifestyle variables and living arrangements. Education is a strong predictor of overweight and obese males. Relative to post-secondary graduates, men who have not graduated from high school have higher odds (OR=1.19) of being overweight and obese (OR=1.28) in the restricted model.

Table 5.1: Household Income - Males: Estimated Odds of Overweight and Obese

	Overweight	Obese	Overweight	Obese	Overweight	Obese
Less than 15,000	0.552^{***}	1.031	0.528^{***}	0.921	0.650^{***}	1.022
15,000 to 29,999	0.666^{***}	1.089^{*}	0.640^{***}	0.994	0.739^{***}	1.026
30,000 to 49,999	0.758^{***}	1.058	0.739^{***}	0.996	0.816^{***}	1.023
50,000 to 79,999	0.916^{***}	1.088^{**}	0.900^{***}	1.051	0.945^{*}	1.039
Less than Secondary			1.141^{***}	1.380^{***}	1.191^{***}	1.281^{***}
Secondary Graduate			1.085^{***}	1.174^{***}	1.109^{***}	1.162^{***}
Other Post Secondary			1.065	1.185^{***}	1.115^{**}	1.205^{***}
Total Fruits and Vegetables					0.968^{***}	0.981^{***}
Energy Expenditure					0.978^{***}	0.897^{***}
Regular Drinker					0.940^{*}	0.720^{***}
Smoke Daily					0.609^{***}	0.643^{***}
Occasionally Smoke					0.825^{***}	0.839^{**}
Unattached Ind, Alone					0.895^{***}	0.857^{***}
Unattached Ind. w. Others					0.799^{***}	0.862^{*}
Parent w. Partner & Children					1.279^{***}	1.096^{***}
Single Parent with Children					0.832^{*}	0.758^{**}
Constant	1.689^{***}	0.208^{***}	1.631^{***}	0.193^{***}	2.046^{***}	0.365^{***}
Observations	130171	130171	129258	129258	111456	111456
Pseudo R^2	0.026	0.012	0.026	0.015	0.040	0.031

Exponentiated coefficients. Other Controls: Age, Year, Province * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

For women, the opposite pattern is observed with respect to household income (Table 5.2). Below the top income bracket, women are significantly *more* likely to be overweight and obese. In the unadjusted model, being in the bottom quintile is associated with higher odds (OR=1.58) of being overweight and even higher (OR=1.91) for obesity. Education is highly statistically significant, and reduces the variation attributable to income. Relative to post-secondary graduates, women who have not graduated from high school have higher odds (OR=1.21) of being overweight and higher odds (1.25) of obesity (in the restricted model - columns 5,6).

Results from the other specifications are found in the Appendix. A slightly different pattern is observed in Specification 2, when personal income is included rather than household income. For men (Table A.1), the odds of being overweight no longer decrease monotonically with lower personal incomes. For women (Table A.2), the personal income coefficients have smaller magnitude, suggesting that low family income has a stronger association with

Table 5.2: Household Income - Females: Estimated Odds of Overweight and Obese

	Overweight	Obese	Overweight	Obese	Overweight	Obese
Less than 15,000	1.581***	1.918***	1.371***	1.669***	1.418***	1.637***
15,000 to 29,999	1.524***	1.745***	1.382***	1.586***	1.401***	1.520***
30,000 to 49,999	1.411***	1.543***	1.329***	1.460***	1.300***	1.382***
50,000 to 79,999	1.277***	1.323***	1.234***	1.284***	1.210***	1.250***
Less than Secondary			1.518***	1.481***	1.313***	1.256***
Secondary Graduate			1.218***	1.160***	1.156***	1.090**
Other Post Secondary			1.188***	1.206***	1.172***	1.187***
Total Fruits and Vegetables					0.999	1.009
Energy Expenditure					0.867***	0.818***
Regular Drinker					0.628***	0.570***
Smoke Daily					0.760***	0.687***
Occasionally Smoke					0.799***	0.681***
Unattached Ind, Alone					0.814***	0.825***
Unattached Ind. w. Others					0.904	0.896
Parent w. Partner & Children					1.024	0.878***
Single Parent w. Children					0.831***	0.809***
Constant	0.603***	0.180***	0.559***	0.169***	1.111*	0.400***
Observations	149999	149999	149273	149273	131410	131410
Pseudo R^2	0.021	0.017	0.024	0.019	0.048	0.052

Exponentiated coefficients. Other Controls: Age, Year, Province. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

obesity than personal income for women.

In Specification 3, equivalent household income is used to adjust for family size (shown in Table A.3 and A.4). Marginal increases in equivalent income are associated with increased odds of being overweight (OR=1.22) which is consistent with other specifications. Similarly for women, marginal increases in equivalent income are associated with lower odds of overweight and obesity (OR=0.90 and 0.86 respectively)

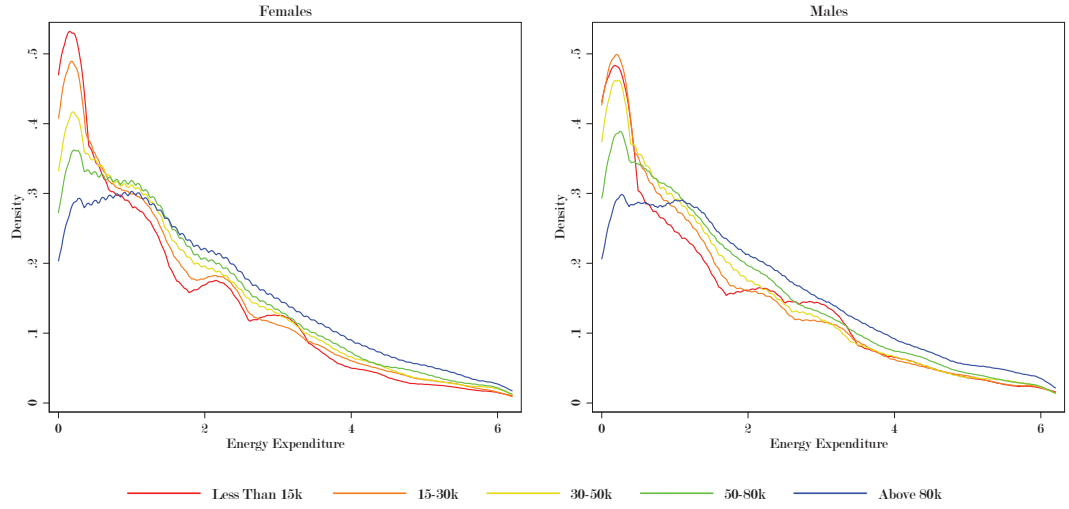
The results for relative income, using the income distribution within the health region are shown in Table A.5 and A.6. For men in the base model (columns 1,2), being outside the top income *quintile* was associated with increased odds of being obese between 12%-17%. But the same regression in using absolute (household and personal) income showed no statistically significant relationship with obesity. One possible explanation is that the *relative* income more accurately represents social standing, and as Brunner [1997] shows, the stress of relatively low status is associated with obesity. However, once education and lifestyle factors are included, relative income is no longer predictive of male obesity. The results for women are consistent with other specifications in that being in lower income quintiles increased the odds of excess weight. The direction and significance of the SES variables was robust to a linear regression with BMI as the continuous dependent variable (not shown).

Overall, the four different specifications provide fairly consistent results for women: Lower household, personal, equivalent and relative income are all associated with higher odds of being overweight and obese. For men, in all specifications, lower income is associated with lower odds of being overweight. Male obesity is more likely in lower *personal* income brackets, lower equivalent income and lower income quintiles, but only when education and

lifestyle factors are not controlled for.

Possible mechanisms for income to effect body weight are through opportunities for physical activity and dietary composition. Levels of both exercise (in Figure 5.1.2) and fruit & vegetable consumption (in Figure 5.1.3) are negatively associated with household income.

Figure 5.1.2: Kernel Distribution of Energy Expenditure in Canadians Age 20-64 by Household Income Bracket, 2000-2010



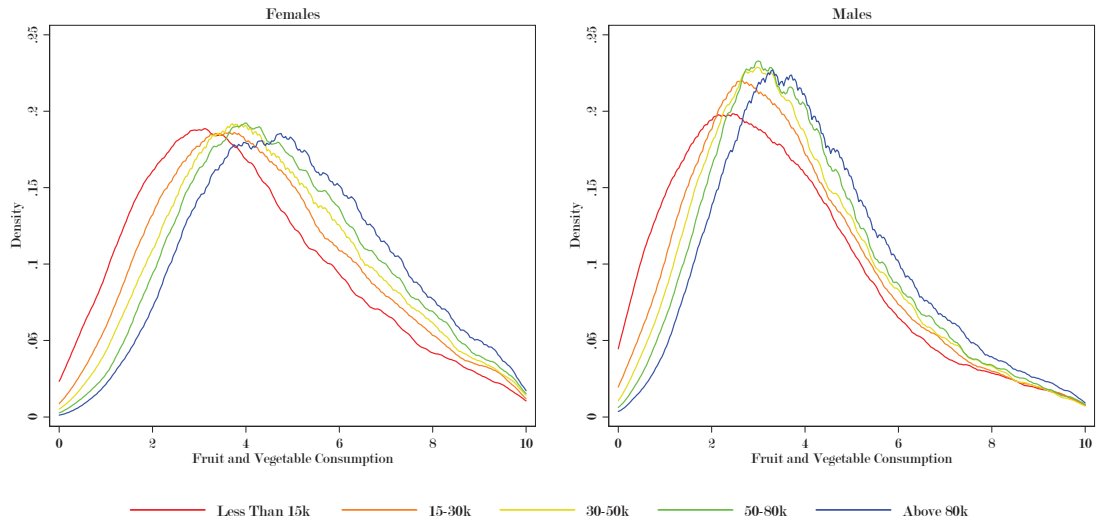
Data Source: CCHS [2010b]

5.2 Economic Insecurity

The model presented in Table 5.3 tests the relationship between province-level indicators of economic insecurity and BMI data for individuals in the corresponding year and province. The data measuring the consequences of unemployment: coverage ratio, EI benefits as portion of earnings, and housing affordability are given at the provincial level. The model presented uses the one year lag of these variables to allow some time for a change in weight to take affect [1]. The lagged coverage ratio of EI recipients to unemployed is statistically significant and unexpectedly, positively signed. However, the odds ratios indicate almost no impact from a marginal increase in coverage ratio. The portion of earnings that are replaced by EI benefits is also associated with higher odds of excess body weight. A marginal increase in the ratio of EI Benefits/Earnings of 1% increases the odds of being overweight or obese to 1.02 for both sexes. Housing affordability (average provincial housing price/provincial average yearly salary) is statistically significant and positively signed. An marginal increase in the average housing price equivalent to 1 year of salary is associated with higher odds of

[1] Current year variables were tested, but not found to be statistically significant

Figure 5.1.3: Kernel Distribution of Fruit and Vegetable Consumption in Canadians Age 20-64 by Household Income Bracket, 2000-2010



Data Source: CCHS [2010b]

overweight and obesity (OR_m= 1.03, OR_f=1.04)

While the direction of these results are not consistent with the literature into economic insecurity, it should be noted that if provincial level dummy-variables are included, only unemployment rate maintains its statistical significance[2]. A lack of variation in the explanatory variables may be responsible for the unexpected results. The coverage ratio in each provinces is fairly consistent over time (see 3.0.3), with higher rates in the Atlantic provinces. The portion of earnings replaced by EI in every provinces has a standard deviation of only 1.93%. Province level summaries of social protection are not statistically related to excess body weight. Greater disaggregation of these variables would allow for a more sensitive test of this model.

Macroeconomic Conditions

GDP growth and year-over year changes in CPI were tested along with one year lags, but no significant relationship was found (not shown). Unlike the other provincial variables, the unemployment data is specific to age and sex. A marginal increase of 1% in the unemployment rate is associated with slightly lower odds of overweight for both sexes (OR_m=0.99, OR_f=0.97) and obesity (OR_f=0.97) for women alone. These results are similar to Ariizume and Schirle [2011], who find decreased mortality is associated with higher unemployment.

[2]Restricting the sample to low-income, working adults did not yield any significant results

Table 5.3: Economic Insecurity: Estimated Odds of Overweight and Obese

	Males		Females	
	Overweight	Obese	Overweight	Obese
Coverage Ratio Lag	1.003***	1.002**	1.003***	1.002**
	(3.71)	(2.58)	(5.57)	(3.01)
EI Benefits as Proportion of Earnings Lag	1.023***	1.019***	1.021***	1.019***
	(4.40)	(3.29)	(4.80)	(3.65)
Housing Affordability Lag	1.025***	1.025***	1.042***	1.047***
	(9.55)	(8.17)	(17.36)	(16.82)
Provincial Unemployment Rate	0.988*	0.992	0.971***	0.966***
	(-2.38)	(-1.32)	(-4.07)	(-4.04)
Provincial Unemployment Rate Lag	1.008	0.995	1.013	1.009
	(1.58)	(-0.83)	(1.91)	(1.06)
Constant	0.712	0.204***	0.685*	0.289***
	(-1.55)	(-6.52)	(-1.99)	(-5.65)
Observations	106874	106874	125044	125044
Pseudo R^2	0.034	0.024	0.042	0.050

Exponentiated coefficients; t statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Other Controls: Age, Houshold Income, Education, Year, Physical Activity, Fruits and Veg, Living Arrangement, Smoking or Drinking Occasionally/Often

Stress

As psychological stress is a consequence of economic insecurity, the relationship between an individual's self-perceived stress level and excess body weight is tested using individual micro-data. Respondents report their stress on a scale from 1 (not at all stressful) to 5 (extremely stressful). They report work stress related to decision latitude, authority, job insecurity and general work stress using the same scale[3]. Self-reported mental health is given on a scale from 1 (Excellent) to 5 (Poor), and is included as a control.

Table 5.4 shows the results, indicating that a marginal increase in the five point work stress scale is associated with higher odds of overweight (OR=1.06) for men, but not significantly related to obesity. A similar increase for women increases odds of overweight and obese (OR=1.05) . Marginally worse self reported health is associated with higher rates of overweight and obesity in women, but not men. These results are in keeping with the existing literature [Brunner et al., 2007] relating higher levels of work stress with excess body weight. The direction and significance of the stress variables is robust to a linear regression with BMI as the continuous dependent variable (not shown).

5.3 Food Insecurity

Food insecurity is disproportionately experienced by those in low-income households and

[3]All forms of work related stress were tested individually and with the reported variables, but were not found to be significant predictors of overweight or obese.

Table 5.4: Self Reported Stress: Estimated Odds of Overweight and Obese

	Males		Females	
	Overweight	Obese	Overweight	Obese
Self-Perceived Work Stress	1.059***	1.027	1.050***	1.051**
	(4.05)	(1.60)	(3.75)	(3.10)
Self-Perceived Stress	0.986	1.013	0.987	0.986
	(-0.97)	(0.72)	(-0.91)	(-0.88)
Self-reported Mental Health	1.024	1.035*	1.093***	1.073***
	(1.77)	(2.14)	(6.67)	(4.55)
Constant	1.411***	0.223***	0.600***	0.234***
	(4.91)	(-17.40)	(-7.34)	(-17.01)
Observations	90247	90247	94782	94782
Pseudo R^2	0.029	0.014	0.023	0.016

Exponentiated coefficients; t statistics in parentheses
Other Controls: Province, Age, Income, Education, Year

those who depend on EI. Figure 5.3.1 shows the rates of respondents who were "worried food would run out before [they] could afford more", grouped by categories of family income and the main source of family income. The survey indicates that 37.3% of respondents with family income below $15,000 were exposed to some food insecurity in the preceding year. This figure falls to 18.2% for those in the $15,000 to $29,999 income bracket. Fully 42.7% of families whose main source of income is unemployment insurance experience some food insecurity, compared to just 6.3% of those whose main source is employment income.

Figure 5.3.1: Worried Food Would Run Out Before They Could Afford to Buy More. Canadians Age 20-64, 2005-2010

Data Source: CCHS [2010b]

As discussed earlier, evidence from the U.S. supports the hypothesis that insecure access to food increases the likelihood of having excess weight [Dinour et al., 2007, Wilde and

Ranney, 2000]. The results for women of the logit model testing this hypothesis with Canadian data is shown in Table 5.5. Women who *often* worried that food would run out before they could afford to buy more, were more likely to be overweight (OR=1.28,p<0.05) and obese (OR=1.30.p<0.05) relative to women who did not experience food insecurity. Those who *sometimes* worried that food would run out had similar odds ratios.

Another measure of food insecurity is the inability to afford a balanced meal. Women who were *often* unable to afford a balanced meal were more likely to be overweight (OR=1.32) and obese (OR=1.34). Those who were sometimes unable to afford balanced meals also showed significantly increased odds of excess weight.

Table 5.5: Food Security - Females: Estimated Odds of Overweight and Obese

	All				Mothers	
	Overweight	Obese	Overweight	Obese	Overweight	Obese
Less than 15,000	1.408***	1.689***	1.240***	1.358***	1.151	1.285*
	(7.12)	(9.53)	(4.00)	(5.02)	(1.45)	(2.22)
15,000 to 29,999	1.375***	1.601***	1.315***	1.440***	1.245**	1.436***
	(8.94)	(11.45)	(7.15)	(8.24)	(3.26)	(4.64)
30,000 to 49,999	1.250***	1.413***	1.244***	1.353***	1.177**	1.367***
	(6.95)	(9.38)	(6.55)	(7.90)	(2.92)	(4.82)
50,000 to 79,999	1.239***	1.266***	1.246***	1.248***	1.267***	1.363***
	(6.95)	(6.61)	(7.03)	(6.10)	(4.78)	(5.41)
Often Worried Food			1.277*	1.295*	1.506**	1.491*
Would Run Out			(2.52)	(2.40)	(2.62)	(2.27)
Sometimes Worried Food			1.292***	1.294***	1.364***	1.293**
Would Run Out			(4.66)	(4.14)	(3.76)	(2.66)
Often Unable to			1.323**	1.340**	1.102	1.352
Afford Balanced Meal			(2.81)	(2.73)	(0.54)	(1.63)
Sometimes Unable to			1.242***	1.266***	1.161	1.128
Afford Balanced Meal			(3.42)	(3.36)	(1.47)	(1.02)
Household size			1.048***	0.987	1.002	0.913***
			(4.35)	(-1.05)	(0.07)	(-3.35)
Constant	0.725***	0.254***	0.596***	0.257***	0.696***	0.330***
	(-7.94)	(-27.74)	(-9.41)	(-20.48)	(-3.38)	(-8.47)
Observations	88891	88891	87064	87064	32040	32040
Pseudo R^2	0.025	0.022	0.027	0.024	0.019	0.027

Exponentiated coefficients; t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Other Controls: Province, Age, Education, Year

The results testing food insecurity for men (Table 5.6) are not statistically significant. This gender difference may be due to mothers sacrificing their own nutrition to feed their children, as suggested by McIntyre [2003]. When the sample is restricted to mothers, the impact of severe food insecurity becomes a stronger predictor of overweight and obese.

Table 5.6: Food Security - Males: Estimated Odds of Overweight and Obese

	All				Fathers	
	Overweight	Obese	Overweight	Obese	Overweight	Obese
Less than 15,000	0.519***	0.907	0.598***	0.962	0.635**	0.846
	(-12.74)	(-1.72)	(-8.73)	(-0.61)	(-2.92)	(-0.95)
15,000 to 29,999	0.629***	0.993	0.695***	1.053	0.687***	1.082
	(-10.88)	(-0.14)	(-7.94)	(0.94)	(-4.01)	(0.75)
30,000 to 49,999	0.733***	1.021	0.781***	1.074	0.663***	0.982
	(-8.97)	(0.52)	(-6.86)	(1.77)	(-6.02)	(-0.24)
50,000 to 79,999	0.887***	1.062	0.915**	1.088*	0.889*	1.059
	(-3.62)	(1.62)	(-2.65)	(2.21)	(-1.99)	(0.93)
Often Worried Food			0.861	0.922	0.875	1.084
Would Run Out			(-1.28)	(-0.64)	(-0.59)	(0.32)
Sometimes Worried Food			0.901	0.913	0.969	0.931
Would Run Out			(-1.61)	(-1.17)	(-0.27)	(-0.52)
Often Unable to			1.127	1.361*	1.652	1.685*
Afford Balanced Meal			(1.01)	(2.51)	(1.95)	(2.13)
Sometimes Unable to			0.969	1.137	0.993	1.311
Afford Balanced Meal			(-0.44)	(1.52)	(-0.05)	(1.70)
Household size			1.085***	1.076***	1.006	1.009
			(7.18)	(5.67)	(0.21)	(0.29)
Constant	2.007***	0.276***	1.507***	0.213***	2.493***	0.291***
	(13.23)	(-21.21)	(6.31)	(-21.22)	(6.48)	(-8.58)
Observations	76776	76776	75313	75313	22132	22132
Pseudo R^2	0.034	0.015	0.036	0.015	0.016	0.010

Exponentiated coefficients; t statistics in parentheses $^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$
Other Controls: Province, Age, Education, Year

All of these results remain relatively unchanged when personal income is used as opposed to family income. Using a linear regression with BMI as the continuous dependent variable, the food insecurity coefficients for women remain statistically significant and positively signed (not shown).

5.4 Lifestyle Variables

In assessing the role of economic conditions, it is important to control for the known correlates of obesity. The results of this logistic regression, shown in section 5.2, should be interpreted as all other included variables held constant. The notable exclusions are income and education, because the goal is to demonstrate how the surveyed lifestyle variables relate to overweight and obesity.

Physical activity during leisure time is another established negative correlate of obesity [Tjepkema, 2005, Craig et al., 2005]. An increase in average daily expenditure of 1 kcal/kg per hour (roughly equivalent to a 20m walk) reduces men's odds of being obese (OR=0.90) and overweight (OR=0.98). The effect of exercise is more dramatic for women, lowering the odds of obesity (OR=0.82) and overweight (OR=0.87).

Caloric intake is well established as a determining factor for excess body weight. Consumption of fruits and vegetables, the only dietary data included in the annual component, has been shown to be negatively related with excess weight [Craig et al., 2005, Raine et al., 2004, Langlois et al., 2009] and is a reasonable proxy for healthy eating habits [Garriguet, 2009]. An additional serving of fruits & vegetables is associated with slightly *lower* odds of men being overweight and obese. For women, there is no statistically significant relationship between a marginal increase in fruit and vegetable consumption and being overweight or obese. Unfortunately this variable only captures the frequency of consumption, and cannot control for dietary composition. More fruits and vegetables might be correlated to more food of all types.

Relative to the base age group 40-44, older men are at increasingly higher odds of being overweight and obese. Men 60-64 years old are more likely to be overweight (OR=1.67) and for obese (OR=1.41). Women show an increasing pattern for overweight, jumping from an odds ratio of 1.40 when 50-54 years old to 1.93 when 60-64 years old. Interestingly, there is no statistically significant pattern for female *obesity* over the age of 40, but women in their 30's are relatively more likely to be obese. These results are comparing cohorts, and not meant to be interpreted as the the change in odds as an individual ages.

Alcohol consumption and smoking habits differ across the BMI distribution [CIHI 2011]. Men identified on average as having one drink per week are less likely to be obese (OR=0.66) and less likely to be overweight (0.91). Women who drink regularly are also less likely to be obese (OR=0.45) and overweight (OR=0.55). Men who smoke daily are at much lower odds to be overweight (OR=0.61) and roughly the same for obese. The odds for women are

Table 5.7: Control Variables: Estimated Odds of Overweight and Obese

	Male		Female	
	Overweight	Obese	Overweight	Obese
Energy Expenditure	0.980***	0.896***	0.867***	0.818***
Total Fruits and Vegetables	0.967***	0.972***	0.991**	0.999
25 to 29 years	0.719***	0.871**	0.843***	0.965
30 to 34 years	0.962	1.048	1.054	1.165***
35 to 39 years	1.128***	1.131**	1.098**	1.127**
45 to 49 years	1.302***	1.282***	1.181***	0.976
50 to 54 years	1.422***	1.298***	1.401***	1.048
55 to 59 years	1.586***	1.408***	1.675***	1.137**
60 to 64 years	1.674***	1.406***	1.926***	1.124**
Smoke Daily	0.617***	0.687***	0.834***	0.762***
Occasionally Smoke	0.828***	0.825***	0.837***	0.736***
Regular Drinker	0.912***	0.658***	0.550***	0.451***
Atlantic	1.196***	1.138***	1.269***	1.169***
Quebec	0.781***	0.754***	0.762***	0.728***
West	0.971	0.933*	0.966	0.998
Unattached Ind, Alone	0.926*	0.884**	0.999	1.041
Unattached Individual With Others	0.866**	0.881*	1.020	1.003
With Partner	1.280***	1.043	1.130***	1.112**
Parent with Partner and Children	1.496***	1.125**	1.095**	0.923*
Single Parent with Children	0.890	0.764**	1.006	0.997
Belonging to Community 'Very Strong'	1.091**	1.149***	1.043	1.056*
2003	1.079**	1.057	1.093***	1.181***
2005	0.932*	1.054	1.009	1.183***
2007	0.990	1.174***	1.091***	1.288***
2009	1.042	1.289***	1.083**	1.351***
2010	1.080	1.302***	1.093*	1.400***
Observations	119849	119849	143250	143250
Pseudo R^2	0.038	0.031	0.046	0.051

Exponentiated coefficients $^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

less dramatic for overweight (OR=0.83) and obese (OR=0.76). The inclusion of income in this regression (not shown) causes minimal reductions in the magnitude of the alcohol and tobacco variables.

Sedentary behaviour and sleep habits [Tremblay et al., 2007] are captured in the CCHS, but did not have a statistically significant effect on the odds of being overweight or obese.

Chapter 6

Concluding Remarks

6.1 Summary and Conclusion

This paper investigates the relationship between economic conditions and obesity in working aged Canadians. The associations between excess weight and measures of income and economic insecurity are estimated empirically. These relationships are gender specific, with overweight and obesity found to be higher in women with low SES or exposure to food insecurity.

The relationship between overweight, obesity and SES in Canada is complex. Overall, the results of this study find low household income to be related to relatively *lower* odds of excess weight in males and relatively *higher* odds for women. These results are consistent with Tjepkema's [2005] findings for Canadian adults using measured BMI.

The same general pattern was found for the other measures of SES including personal income, equivalent income and relative income distribution. Subtle differences between these results suggested that low *household* income is more closely related to female obesity than *personal* income even when family composition is controlled for. The results for men's personal income were less significant than household income. One possible explanation is that healthier diets and opportunities for exercise are costly, and family income more accurately represent an individual's economic resources than personal income.

The relationship between education and excess weight is fairly straightforward: higher levels of education are associated with lower rates of overweight and obesity for both men and women (controlling for income), with a much stronger association for women. This could be due to a better understanding of health determinants, or endogenous to some personal characteristics affecting both educational attainment and weight.

The tests of economic insecurity at the provincial and obesity do not yield results consistent with the current literature. The use of provincial level measures of the employment insurance program may not be sufficiently disaggregated to detect any significant result. There is minimal variation in the coverage ratio over the sample decade, and changes in EI benefits as a portion of earning are largely due to average weekly earnings (the denominator). The variation in measures of economic insecurity *within* Canada is less than the variation *between* countries [Sharpe and Osberg, 2009]. This might explain why Smith *et al.*'s [2009] international comparison found evidence supporting the association with obesity, but my provincial comparison has not.

Food security is a significant predictor of excess weight in women, especially mothers.

This paradoxical relationship could be attributable to shift towards a cheaper, high calorie diet. The inability to afford a consistent source of food and exposure to the risk of starvation are extreme forms of economic insecurity. The high levels of stress associated with this risk could influence dietary choices. The gender specificity of this relationship may suggest that the stress of budgeting for food falls disproportionately on women. Mothers who are exposed to food insecurity are at even higher odds of becoming obese. As suggested by McIntyre [2003], when faced with these conditions, mothers sacrifice their nutrition for the sake of their children .

The mechanism through which economic insecurity increases obesity is a behavioural change in response to stress. Work related stress is found to be predictive of overweight and obese in women and overweight in men. These results are consistent with longitudinal data from [2007]. However, stress resulting from job insecurity was not significantly associated with obesity.

6.2 Future Research

There are several limitations to cross-sectional studies that are certainly present in this research. The possibility of endogeneity is difficult to control for. I have attempted to include as many relevant variables as possible to reduce unobserved variation, but telephone surveys cannot possibly capture all the determinants of a person's body weight. Relevant personal characteristics such as motivation or valuing health can only be captured through proxies such as education and physical exercise. These issues are sometimes addressed through the use of a relatives BMI as an instrumental variables, which requires much more detailed data. Genetic factors such as metabolism cannot be controlled for, but this research focused on associations at the population level.

The reliance on self-reports, while cost effective, is subject to downward bias in BMI. Testing these relationships with the year of measured BMI data is inconclusive given the sample size (N<3000). Better data relating to diet is required to monitor and evaluate policies attempting to reduce obesity. Relying on self-reports of fruit & vegetable consumption provides an incomplete picture of dietary habits.

A limitation of using income brackets is that the highest bracket includes all household earning greater than $80,000. This top-coded income may affect results and obscure relevant variation at the upper end of the income distribution.

While this paper does not find direct evidence of a relationship between aggregate measures of economic insecurity and obesity at the provincial level, individual micro-level measures of food insecurity are associated with increased risk of being overweight and obese, especially for mothers.

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Appendix A

Additional Results

Table A.1: Personal Income - Males: Estimated Odds of Overweight and Obese

	Overweight	Obese	Overweight	Obese	Overweight	Obese
Less than 15,000	0.629^{***}	1.224^{***}	0.590^{***}	1.097^{*}	0.668^{***}	1.066
15,000 to 29,999	0.766^{***}	1.046	0.729^{***}	0.982	0.805^{***}	1.018
30,000 to 49,999	0.992	1.087^{**}	0.954	1.052	0.994	1.099^{**}
50,000 to 79,999	1.096^{**}	1.084^{*}	1.065^{*}	1.079^{*}	1.056	1.109^{**}
Less than Secondary			1.094^{***}	1.372^{***}	1.160^{***}	1.292^{***}
Secondary Graduate			1.077^{**}	1.162^{***}	1.113^{***}	1.153^{***}
Other Post Secondary			1.075^{*}	1.155^{***}	1.126^{**}	1.184^{***}
Total Fruits and Vegetables					0.969^{***}	0.978^{***}
Energy Expenditure					0.981^{***}	0.898^{***}
Regular Drinker					0.946^{*}	0.721^{***}
Smoke Daily					0.620^{***}	0.650^{***}
Occasionally Smoke					0.822^{***}	0.803^{***}
Unattached Ind., Alone					0.909^{**}	0.878^{**}
Unattached Ind. W. Others					0.857^{**}	0.863^{*}
Living with Partner					1.201^{***}	1.021
Parent w. Partner & Children					1.373^{***}	1.113^{**}
Single Parent w. Children					0.831^{*}	0.756^{**}
Constant	1.582^{***}	0.197^{***}	1.579^{***}	0.184^{***}	1.845^{***}	0.345^{***}
Observations	144102	144102	140519	140519	120356	120356
Pseudo R^2	0.027	0.012	0.028	0.015	0.042	0.032

Exponentiated coefficients. Other Controls: Age, Year, Province. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.2: Personal Income - Females: Estimated Odds of Overweight and Obese

	Overweight	Obese	Overweight	Obese	Overweight	Obese
Less than 15,000	1.390***	1.387***	1.315***	1.320***	1.270***	1.294***
15,000 to 29,999	1.234***	1.159***	1.244***	1.183***	1.257***	1.240***
30,000 to 49,999	1.048	0.951	1.097**	1.011	1.148***	1.083*
50,000 to 79,999	0.898**	0.826***	0.963	0.900*	1.046	1.027
Less than Secondary			1.541***	1.555***	1.370***	1.330***
Secondary Graduate			1.178***	1.148***	1.138***	1.100***
Other Post Secondary			1.175***	1.208***	1.171***	1.193***
Total Fruits and Vegetables					0.995	1.003
Energy Expenditure					0.871***	0.822***
Regular Drinker					0.618***	0.554***
Smoke Daily					0.766***	0.696***
Occasionally Smoke					0.821***	0.719***
Unattached Ind, Living Alone					1.043	1.079
Unattached Ind. w. Others					1.031	0.991
Living w. Partner					1.138***	1.116**
Parent w. Partner & Children					1.106**	0.925*
Single Parent w. Children					1.039	1.015
Constant	0.629***	0.212***	0.560***	0.187***	1.005	0.395***
Observations	168234	168234	164739	164739	144094	144094
Pseudo R^2	0.021	0.014	0.025	0.017	0.047	0.050

Exponentiated coefficients. Other Controls: Age, Year, Province. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.3: Equivalent Household Income - Males: Estimated Odds of Overweight and Obese

	Overweight	Obese	Overweight	Obese	Overweight	Obese
Adjusted Family Income (Log)	1.223***	0.912***	1.238***	0.961*	1.200***	0.987
Less than Secondary			1.065*	1.341***	1.113**	1.237***
Secondary Graduate			1.071*	1.198***	1.096**	1.185***
Other Post Secondary			1.047	1.206***	1.088	1.230***
Total Fruits and Vegetables					0.971***	0.984*
Energy Expenditure					0.982***	0.899***
Regular Drinker					0.969	0.725***
Smoke Daily					0.597***	0.642***
Occasionally Smoke					0.810***	0.838**
Constant	0.216***	0.754	0.186***	0.408***	0.343***	0.592*
Observations	102905	102905	102243	102243	87594	87594
Pseudo R^2	0.025	0.012	0.025	0.014	0.034	0.029

Exponentiated coefficients. Other Controls: Age, Year, Province. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.4: Equivalent Household Income - Females: Estimated Odds of Overweight and Obese

	Overweight	Obese	Overweight	Obese	Overweight	Obese
Adjusted Family Income (Log)	0.774^{***}	0.735^{***}	0.831^{***}	0.791^{***}	0.897^{***}	0.856^{***}
Less than Secondary			1.517^{***}	1.511^{***}	1.340^{***}	1.285^{***}
Secondary Graduate			1.237^{***}	1.182^{***}	1.188^{***}	1.113^{**}
Other Post Secondary			1.231^{***}	1.253^{***}	1.203^{***}	1.219^{***}
Total Fruits and Vegetables					0.999	1.008
Energy Expenditure					0.861^{***}	0.816^{***}
Regular Drinker					0.624^{***}	0.564^{***}
Smoke Daily					0.770^{***}	0.713^{***}
Occasionally Smoke					0.807^{***}	0.699^{***}
Constant	11.35^{***}	7.397^{***}	5.041^{***}	3.237^{***}	4.682^{***}	3.180^{***}
Observations	118715	118715	118185	118185	102479	102479
Pseudo R^2	0.020	0.014	0.023	0.017	0.046	0.049

Exponentiated coefficients. Other Controls: Age, Year, Province. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.5: Household Income Quintile - Males: Estimated Odds of Overweight and Obese

	Overweight	Obese	Overweight	Obese	Overweight	Obese
Family Income - Quintile 1	0.697^{***}	1.176^{**}	0.677^{***}	1.071	0.749^{***}	1.085
Family Income - Quintile 2	0.795^{***}	1.139^{**}	0.782^{***}	1.072	0.809^{***}	1.044
Family Income - Quintile 3	0.933	1.142^{**}	0.921^{*}	1.092^{*}	0.915^{*}	1.053
Family Income - Quintile 4	0.994	1.122^{**}	0.989	1.100^{*}	0.994	1.106^{*}
Less than Secondary			1.085^{*}	1.345^{***}	1.122^{*}	1.192^{***}
Secondary Graduate			1.075^{*}	1.214^{***}	1.102^{**}	1.207^{***}
Other Post Secondary			1.069	1.179^{**}	1.155^{*}	1.226^{**}
Total Fruits and Vegetables					0.968^{***}	0.981^{*}
Energy Expenditure					0.980^{**}	0.894^{***}
Regular Drinker					0.935	0.728^{***}
Smoke Daily					0.625^{***}	0.634^{***}
Occasionally Smoke					0.807^{***}	0.843^{*}
Unattached Ind, Alone					0.858^{**}	0.811^{***}
Unattached Ind. w. Others					0.827^{*}	0.795^{*}
With Partner					1.088	0.981
Parent w. Partner & Children					1.359^{***}	1.055
Single Parent w. Children					0.839	0.742^{*}
Constant	2.047^{***}	0.271^{***}	2.013^{***}	0.260^{***}	2.288^{***}	0.495^{***}
Observations	72577	72577	72376	72376	58547	58547
Pseudo R^2	0.031	0.012	0.031	0.014	0.046	0.032

Exponentiated coefficients. Other Controls: Age, Year, Province. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.6: Household Income Quintile - Females: Estimated Odds of Overweight and Obese

	Overweight	Obese	Overweight	Obese	Overweight	Obese
Family Income - Quintile 1	1.706***	1.928***	1.525***	1.689***	1.441***	1.583***
Family Income - Quintile 2	1.463***	1.648***	1.367***	1.522***	1.319***	1.450***
Family Income - Quintile 3	1.358***	1.407***	1.305***	1.349***	1.228***	1.258***
Family Income- Quintile 4	1.153***	1.157***	1.130***	1.129**	1.114**	1.100*
Less than Secondary			1.491***	1.595***	1.255***	1.312***
Secondary Graduate			1.213***	1.192***	1.145***	1.123**
Other Post Secondary			1.240***	1.237***	1.217***	1.195**
Total Fruits and Vegetables					0.997	1.011
Energy Expenditure					0.858***	0.810***
Regular Drinker					0.620***	0.576***
Smoke Daily					0.788***	0.726***
Occasionally Smoke					0.819**	0.716***
Unattached Ind, Alone					0.916	1.015
Unattached Ind. w. Others					0.997	1.041
With Partner					1.175**	1.270***
Parent w. Partner & Children					1.064	0.920
Single Parent w. Children					0.926	0.958
Constant	0.664***	0.237***	0.647***	0.226***	1.282***	0.472***
Observations	83989	83989	83804	83804	68263	68263
Pseudo R^2	0.023	0.018	0.025	0.021	0.050	0.055

Exponentiated coefficients. Other Controls: Age, Year, Province. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$