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**Poverty, Food Insecurity and Overweight/Obesity in the Canadian
Population**

By
Marissa McGuire

Thesis submitted to the Faculty of Graduate and Postdoctoral Studies in partial fulfillment of
the requirements for the MSc degree in Epidemiology

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ABSTRACT

This study, based on the Canadian Community Health Survey (2004), examined the relationship between food insecurity and overweight/obesity among Canadian adults by sex and family type using logistic regression analysis; we also provided an environmental scan of policies, programs and initiatives to address food insecurity.

In our final adjusted models, food insecure women **with hunger** were significantly more likely to be overweight/obese than food secure women [OR=2.3, CI=1.2, 4.3]. Our environmental scan revealed broad recognition of the importance of addressing food insecurity and concrete recommendations to do so. We found far less recognition of the implications of food insecurity for healthy weights within a policy context.

The food insecurity/overweight/obesity relationship and its policy implications are complex; we need a better understanding of how underlying social and economic conditions, sex, and family type relate to income, food security and healthy weights.

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DISCLAIMER

Part of the research and analysis presented in this thesis are based on data from Statistics Canada and the opinions expressed do not represent the views of Statistics Canada.

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ABBREVIATIONS

BMI	Body mass index
CCHS	Canadian Community Health Survey
CI	Confidence Interval
COOL RDC	Carleton Ottawa Outaouais Local Research Data Centre
CV	Coefficient of variation
DRI	Dietary reference intake
F/P/T	Federal, provincial and territorial
ICC	Intraclass correlation coefficient
MET	Metabolic equivalent
PSU	Primary sampling unit
PPS	Probability proportionate to size
OR	Odds ratio
REF	Reference category
SE	Standard error
SES	Socioeconomic status
WHO	World Health Organization

Chapter 1: INTRODUCTION

1.1 Thesis Outline

This thesis examines the relationship between food insecurity and overweight/obesity among Canadian adults and explores the relationship by sex and family type. This study also provides an environmental scan of policies, programs and initiatives (in place and recommended) targeting food insecurity in Canada, and food insecurity and healthy weights.

Chapter 1 provides an introduction to the topics of overweight/obesity and food insecurity. Chapter 2 provides a review of the epidemiology of overweight/obesity and food insecurity, highlighting prevalence estimates, determinants and important health outcomes. Existing explanations to explain the potential relationship between food insecurity and overweight/obesity are presented to help provide a foundation for this study. Chapter 3 summarizes a recently conducted systematic review on this relationship, specifically highlighting the methods used, key results and the limitations of the included studies. Additional relevant studies that have been published since the systematic review was undertaken are also presented to provide the reader with the most current information available. Chapter 4 outlines the purpose and objectives of this thesis, presents the conceptual framework used to inform the current research and discusses the study rationale. In Chapter 5 the methods used in this thesis, both for the data analysis and the environmental scan of policies, programs and initiatives targeting food security, are discussed. Chapter 6 presents the results from our analyses of the Canadian Community Health Survey 2.2 (CCHS) (2004) and Chapter 7 presents the findings from our environmental scan. Finally, this thesis concludes with a detailed discussion of our findings in Chapter 8.

1.2 Overview of Chapter 1

In this chapter, we open with a discussion of some of the definitions and concepts that form the basis of research in the area of overweight and obesity (section 1.3). This is followed by a discussion on the measurement of overweight and obesity in scientific research (section 1.4). Section 1.5 provides a definition and overview of food insecurity and section 1.6 discusses the evolution of its measurement in the scientific literature. This chapter concludes with a brief statement of the issue under investigation and a discussion of the rationale behind studying overweight and obesity in the context of the social determinants of health (section 1.7).

1.3 Definition of overweight and obesity

The most basic definition of overweight is an excess weight in proportion to height. Obesity, in contrast, is defined as an excess amount of body fat. The most commonly used markers of overweight and obesity are based on body mass index (BMI) cut-points which are discussed in section 1.4. For convenience and because overweight and obesity have similar health risks, researchers in this field often combine BMI categories to create one overall overweight/obesity BMI cut-point. Thus, many researchers use the terms overweight and obesity interchangeably; this will be the case in the literature discussed in this thesis.

1.4 How are overweight and obesity measured?

BMI is the most common measure of body fat, and the most widely accepted measure for evaluating health risks according to weight status.¹⁻³ It is a simple index of body fatness calculated by dividing body weight in kilograms by the square of height in metres squared (kg/m^2).⁴ While it is possible to accurately measure body fat directly, these methods are often expensive and pose logistic difficulties.^{1,2} BMI offers a crude measure of body fat

through indirect measurement which is relatively easy to ascertain at the individual level, in particular through self-reported data but can also be calculated based on measured height and weight.^{2, 5} The data can then be aggregated to the population level. Although many cut-offs have been used to define overweight and obesity based on BMI, the most practical current guidelines for use in adults, and those most frequently used, including within Canada, have been adopted from the World Health Organization (WHO).^{6, 7} In this classification system, adults classified as normal weight have a BMI between 18.5kg/m² and 24.9 kg/m², those classified as overweight have a BMI between 25kg/m² and 29.9 kg/m² and those who are obese have a BMI equal to or greater than 30 kg/m².⁷ Pregnant and lactating women and individuals under the age of 18 are not included in this classification system.⁷

Different degrees of health risk are associated with each respective category which are described in Table 1.1.⁷ The upper normal limit of a BMI of 24.9 kg/m² for individuals may be generous in terms of health risks because the optimal population mean BMI is now thought to hover between 21.0 kg/m² and 23.0kg/m².²

Table 1.1: BMI classification for adults 18 years of age and older⁷

Classification	BMI category (kg/m²)	Relative risk of developing health problems
Underweight	<18.5	Increased
Normal weight	18.5-24.9	Least
Overweight	25.0-29.9	Increased
Obese Class I	30.0-34.9	High
Obese Class II	35.0-39.9	Very High
Obese Class III	≥40.0	Extremely High

In interpreting BMI data, it is important to keep in mind that BMI has limitations. Most notably, it classifies weight based upon weight and height only and therefore does not take into account body composition (adiposity vs. lean weight) or fat distribution on the body.^{2, 5} It is prone to error among very muscular individuals, adults with a very lean body structure,

youth who have not yet reached their full height and individuals over the age of 65.⁵ Other systems of health risk classification, such as using different BMI cut-points to denote health risks or entirely different approaches to classifying health risk based on waist circumference measurement, may be more appropriate in different population groups.

For example, a different system has been proposed for Asian populations where a BMI cut-point of 25.0 is indicative of obesity vs. 30.0 but there is still some debate regarding the need and validity of this different system.^{2, 8} Waist circumference measurement is an alternate body fat measurement used by health professionals and researchers which may be more useful for identifying health risks among normal weight and overweight individuals, particularly for type 2 diabetes and cardiovascular disease.^{3, 7, 9, 10}

1.5 Definition of food insecurity

Food security means that “all people at all times have access to enough food for an active healthy life” (p.156).¹¹ Conversely, food insecurity is a term that has been broadly defined as the “limited, inadequate, or insecure access of individuals and households to sufficient, safe, nutritious, personally acceptable food both in quality and quantity to meet their dietary requirements for a healthy and productive life” (p.1).¹² Variations of this definition exist but the main concept is always that food insecure individuals and households have limited access to food or availability of food or have limited/uncertain ways of acquiring food in a socially acceptable manner. This thesis uses the term “food security” and “food insecurity” to refer to opposite ends of the same concept.

Food security status can be explored from several perspectives and on multiple levels: individual, household, community, regional, national and world-wide.¹³ The main dimensions of food security can be divided into two central components: the ability to

reliably access food and the production and supply of food.¹⁴ Research primarily interested in the first dimension of food security often examines household and individual food security and is focused on poverty, inequity and social policy, viewing food insecurity as part of a broader problem related to low income.¹⁴ Research on food security as it relates to the production and supply of food focuses more on *food* and issues related to developing an environmentally sustainable food system to help ensure food security at the community, regional, national and international level.¹⁴ This thesis addresses the former dimension of food security and focuses on individual and household level food security, recognizing that the experience of food insecurity may differ even at these two levels; individual food insecurity is often more severe and characterized by food deprivation and hunger, whereas household food insecurity is more often related to difficulties in acquiring and managing food.¹³

Household food insecurity can be described as a managed process whereby individuals first experience anxiety over food quantity and quality and then often move to a situation of compromised food quality and in the most severe cases, progress to compromises in food quantity which may lead to hunger.¹⁴ The four key components of food insecurity can be summarized as follows: (i) preoccupation or worry about the food supply; (ii) unsuitable food or poor food quality; (iii) shortage of food; and (iv) lack of control over the food situation.¹⁵

1.6 How is food insecurity measured?

In the early 1980s evidence began to surface in the United States which suggested that levels of hunger were rising; however, research in this area was greatly hindered by the absence of an accepted definition and measure of hunger.¹⁶ Since then, researchers and

policy-makers have been looking for measurements of food insecurity that are simple to use and easy to interpret. Most of the literature on the measurement of food insecurity emanates from the United States. The focus here is simply to provide an overview of the current measurements of individual and household level food insecurity available. For a detailed discussion of the evolution of food security measurements, and their respective reliability and validity assessments, the reader is referred to an article by Keenan *et al.* (2001).¹⁷

In response to the National Nutrition Monitoring Act of 1990, a food security measurement project team was established in the United States.¹¹ This project team, comprised of researchers, federal agencies and, private and non-profit organizations, worked together to establish a standardized set of questionnaires for measuring food security.¹¹ Radimer and others at Cornell University and Wehler and colleagues initiated a great deal of the work in this area, and set the foundation for the measurement of food security in the United States, and now elsewhere around the world.^{11, 16} Stemming from these initiatives is the U.S. Household Food Security Survey Module, the most widely used and comprehensive of the measurements currently in existence, discussed in greater detail in paragraphs to follow.^{16, 17}

The most carefully quantified aspect of food insecurity in current measures is the component of the definition which refers to 'having enough food to meet basic needs as perceived and experienced within the household'.¹⁷ There are several measurement tools in use today, some of which are single-item measures (i.e. measures based on a single question) where as others rely on multiple questions and classify food security status on a scale such as the U.S Household Food Security Survey Module. There are currently three single-item indicators commonly used for measuring food security at the household level: (i)

the food sufficiency questions, (ii) the expanded food and nutrition education program evaluating/reporting system question and (iii) the concern about food security question.¹⁷ These measures are reviewed at length in the Keenan *et al.* (2001) article.¹⁷

Scales for measuring food insecurity at the household level include the Community Childhood Hunger Identification Project (CCHIP) hunger index (developed by Wehler *et al.*); the Radimer/Cornell measures of hunger and food security (developed by Radimer *et al.*); and the U.S. Household Food Security Survey Module (developed by the federal interagency Food Security Measurement Project).¹⁷

As was previously mentioned, the U.S. Household Food Security Survey Module is the most comprehensive instrument developed to date for the measurement of household level food security status¹⁷; as such, it is the only one described at length here. This survey module provides a continuous measure of food security severity levels and comprises an 18-item set of indicators;^{11, 17} these 18 questions were selected based on extensive exploratory analyses, tests, validations, goodness-of-fit analyses and other properties needed in a reliable measurement scale (please refer to Appendix A for the specific items in the U.S. Household Food Security Core-Module Questionnaire).¹⁸ All of the questions have two common components: each explicitly asks about circumstances in the last 12 months and each is specifically asked in the context of financial insecurity.¹⁸

The questions used are intended to capture anxiety related to food budget or supply, experiences related to running out of food, perceptions of inadequate intake by respondents themselves or other household members and food use.^{11, 18} All of these questions specify financial limitations as the underlying reason for the answer/behaviour/conditions.¹¹ These questions do not capture aspects of nutritional adequacy or safety of diets per se.¹⁸ Based on

research, these questions were designed to reflect the experiential and behavioural stages of food insecurity as it becomes more severe.¹⁸

From the core survey module, consisting of the set of food security questions, a single overall measure called the food security scale can be derived. The food security scale is a linear scale which measures the degree of severity of food insecurity/hunger experienced by a household in terms of a single numerical value; this scale is expressed as a numeric value between 0 and 10.¹⁸ Although the statistical procedure that determines a household's scale value is complicated, it mainly depends on the number of increasingly severe indications of food insecurity that the household has experienced, as indicated by affirmative responses to the increasingly severe sequence of survey questions. For details, please refer to Bickel *et al.* 2000.¹⁸ The scale score can then be used to classify households into one of four food security status categories for policy and research purposes (Fig 1.1, Box 1.1).¹⁸

Figure 1.1 Household food security status-categorical measurement¹⁸

Food Secure	Food Insecure:		
	Food Insecure without Hunger	Food Insecure with Hunger:	
		(less severe) "Moderate"	(more severe) "Severe"

Box 1.1 U.S Household Food Security Categories

Food secure: Household members show no or minimal evidence of food insecurity.

Food insecure without hunger: Food insecurity is evident in household members' concerns about adequacy of the household food supply and in adjustments to household food management, including reduced quality of food and increased unusual coping patterns. Little or no reduction in members' food intake is reported.

Food insecure with MODERATE hunger: Food intake for adults in the household has been reduced to an extent that implies that adults have repeatedly experienced the physical sensation of hunger. In most (but not all) food insecure households with children, such reductions are not observed at this stage for children.

Food insecure with SEVERE hunger: At this level, all households with children have reduced the children's food intake to an extent indicating that the children have experienced hunger. Adults in households with and without children have repeatedly experienced more extensive reductions in food intake.

An abbreviated 6-item sub-set scale of the 18-item scale is available for surveys where time constraints or lack of computer assisted interviewing preclude the use of the 18-item scale.

There has been an increasing demand worldwide for direct and rigorous methods to measure household food security,¹⁹ and national surveys in several countries now include measures of food security including New Zealand, Australia and Canada.¹⁶ Until recently, Canada has relied on food bank use statistics as a proxy measure for the prevalence of food insecurity. The first Canadian national survey to include any indicator questions on food insecurity was the National Longitudinal Study of Children and Youth (NLSCY) in 1994.²⁰ Since then, the National Population Health Survey (NPHS) and the CCHS have both incorporated indicator questions on food insecurity.²⁰ The CCHS 2.2 (2004) is the first Canadian survey to use a multiple-indicator measure of household food security.²¹ The food security questionnaire included in the CCHS 2.2 (2004) is based on the U.S Household Food Security Survey Module discussed above and the data derived from this questionnaire were

interpreted by Statistics Canada in accordance with the *Guide to Measuring Household Food Security, revised 2000*¹⁸ as is the food security data presented in this thesis. Health Canada recently released a report on household food security in Canada for 2004 based on the CCHS 2.2 (2004) as well; however, they chose to use a different method for interpreting the food security data and advise on their new approach for doing so in their report.²¹ The household food security module included in the CCHS 2.2 (2004) will be included in CCHSs to follow which will allow for consistent comparability of the prevalence of household food security in Canada over time.²¹

In addition to the methods presented above for measuring household/individual level food security status, instruments are available to measure food security at the community level; it is beyond the scope of this chapter to discuss these measurements. Again, interested readers can refer to a Keenan *et al.* (2001) article for a discussion of community level food security measurements.¹⁷

1.7 Statement of the issue under investigation

As a detailed literature review presented in Chapter 2 will reveal, the prevalence of both overweight/obesity and food insecurity are believed to be increasing. Both are important health concerns that tend to be more prevalent in lower socioeconomic status groups in developed countries.

Because on the surface it appears that overweight and obesity are simply the result of a mismatch between energy consumed and expended,¹⁰ this issue is often studied on an individual basis and discussed in relation to individual dietary practices and physical activity. Beyond the surface, however, lies a complex interaction between family,

community, regional, national and international-level factors which contribute to overweight and obesity by influencing individual dietary practices and physical activity.⁴

While the fundamental behavioral determinants of overweight/obesity such as poor diet and physical inactivity are well established, the environmental and social conditions underlying these behaviours, such as living in a food insecure environment, are less well understood. This suggests that our understanding of overweight/obesity would be enhanced by simultaneously exploring some of the underlying social determinants of health such as food security; this may provide further insight into potential means of addressing overweight/obesity and its determinants through a variety of policy options.

The potential relationship under investigation in this thesis is that between food insecurity and overweight and obesity among Canadian adults. Findings are discussed in the context of current and recommended policies, programs and initiatives targeting food insecurity and healthy weights.

Chapter 2: LITERATURE REVIEW

2.1 Overview of Chapter 2

The purpose of chapter 2 is to provide a general overview of the overweight/obesity and food insecurity literature and to introduce the reader to the possible **paradoxical** link between the two concepts. A more in depth analysis of the food insecurity-overweight/obesity relationship follows in Chapter 3 with the presentation of results from a recently conducted systematic review specific to this relationship.

The first section of this chapter begins by summarizing some of the relevant evidence on overweight and obesity (section 2.2). More specifically, it provides an overview of the prevalence of overweight and obesity (section 2.2.1), discusses some of the health risks and economic costs associated with overweight and obesity (sections 2.2.2 and 2.2.3) and introduces the reader to some of the key determinants of overweight and obesity (section 2.2.4). This is followed by a more detailed discussion of the social and environmental determinants of overweight and obesity (section 2.2.5) and possible explanations for the differences in rates of overweight and obesity across diverse socioeconomic groups (section 2.2.6). The section on overweight and obesity concludes by providing the reader with an overview of the determinants of healthy eating (section 2.2.7).

The second section of this chapter provides a summary of the evidence on food insecurity (section 2.3). Similar to the first section of this chapter it provides an overview of the prevalence of food insecurity (section 2.3.1) and discusses some of the key determinants and health outcomes associated with food insecurity (sections 2.3.2-2.3.4). Finally, in section 2.4, potential explanations for a relationship between food insecurity and overweight and obesity are introduced.

2.2 Summary of the evidence: overweight and obesity

2.2.1 Prevalence of overweight and obesity

Trends in overweight and obesity in adults show considerable variability internationally. At the population level, a comprehensive review of the literature found consistent increases in the proportion of adults who are overweight or obese in developed nations.²² Flegal (1999) reviewed publications of large-scale systematic surveys from 1989-1998 using WHO definitions of overweight and obesity. A summary of the findings indicate that the prevalence of obesity is highest in Western Samoa (over 75% in urban Samoa) and other Pacific island populations, intermediate in European countries and countries such as the United States, with considerable population mixtures, and lowest in less developed countries such as Brazil and some Asian countries, including China and Japan. Large and recent increases in overweight and obesity (greater than 5 percentage points) were noted in many industrialized nations including Canada, Finland (men), New Zealand, and the United States. Smaller increases (less than 5 percentage points) were detected in countries such as Australia, Germany, Israel, the Netherlands and Sweden. In a separate review, Kumanyika *et al.* (2002) found that the majority of studies reveal that more women are obese than men.⁴

In Canada, numerous population-based surveys with differing methodologies (e.g. self-reported vs. measured height and weight) have been used to provide national data on trends of overweight and obesity.⁵ Irrespective of which surveys or studies are used, data consistently reveal increasing rates of overweight and obesity. Thus, only select studies are discussed here. Evidence from three national surveys (Nutrition Canada Survey 1970-1972, Canada Health Survey 1978-1979 and Canadian Heart Health Surveys [CHHS] 1986-1992), all based on measured height and weight, were compiled to provide the most comparable

data for assessing trends in overweight and obesity among adults in Canada between 1970 and 1992.²³ The compiled data indicated that both median height and weight increased progressively over time.²³ Among men, the proportion of overweight and obese individuals gradually increased from 1970-1972 to 1986-1992. The steady increase was mostly uniform in the overweight and obese categories. Trends were similar across all age groups. Among women, substantial increases in both overweight and obesity were noted between 1970-1972 and 1978-1979. In the following period (1978-1979 to 1986-1992), the proportion of obese women increased further but this time period was also accompanied by a slight decrease in the proportion of women who were overweight. This decrease was entirely accounted for by the fact that overweight and obesity decreased in women aged 45-69, where as gradual increases were noted for women aged 20 to 44 in all three time periods.²³ In all three survey periods, for men and women aged 20-69 years, more men were overweight than women but more women were obese than men.²³ These findings are consistent with other previously conducted analyses of trends in Canada .²⁴

The most recent Canadian figures are based on data from the CCHS 2004, the same data used for this thesis, which directly measured respondents' height and weight.²⁵ These data indicate that 23.1% of adult Canadians, 5.5 million people aged 18 or older, were obese; an additional 36.1%, 8.6 million, were overweight.²⁵ Compared to the United States, Canada's adult obesity rate is still significantly lower (23.1% vs. 29.7%).²⁵ The only significant difference in obesity rates between men and women was in obesity class III (the highest BMI category, see Table 1.1), in which there was a higher percentage of women than men. The highest rates of overweight and obesity were found in the middle age group (45-64y), and the lowest among the youngest age group (18 to 24y).²⁵ At the provincial level, rates of

obesity did not vary greatly; however men in Newfoundland and Labrador and Manitoba had significantly higher rates than the national average (33.0% and 32.9% respectively vs. 22.9%). Women in Newfoundland and Labrador, Nova Scotia and Saskatchewan, had significantly higher rates than the national population average (34.5%, 30.3% and 32.9% respectively vs. 23.2%).²⁵

2.2.2 Health risks associated with overweight and obesity

Increasing rates of overweight and obesity represent an important public health concern because both overweight and obesity are major risk factors for numerous diseases.⁴ Several recent reviews of the literature have found that overweight and obese individuals are at an increased risk of developing numerous chronic medical conditions including: heart disease, type 2 diabetes, hypertension, stroke and some forms of cancer, as well as a wide range of debilitating conditions including osteoarthritis, gallbladder disease, respiratory difficulties, skin problems and reproductive problems.⁴

The risk of cardiovascular disease and type 2 diabetes, associated with overweight/obesity, appears greater in men than women; however, for the same BMI measurement, other overweight/obesity comorbidities, such as respiratory difficulties, are more common among women.⁹ Risk of overweight/obesity related comorbidities is modified by body fat distribution; abdominal obesity, more commonly found in men, is linked to some of the more worrisome health outcomes including cardiovascular disease and type-2 diabetes, partly explaining some of the sex differences in health outcome patterns.^{4, 9} Racial origin also plays a modifying role as exemplified by increasing rates of type 2 diabetes, at lower BMI levels, among individuals of South Asian origin. This can largely be explained by differences in body fat distribution but may also be related to early programming events

in an infant's life (e.g. birth weight and mother's BMI during pregnancy).^{2,9} The psychological and social impacts of overweight and obesity include clinical depression, lowered self-esteem, job discrimination and numerous other forms of social stigmatization.⁴

A prospective cohort study which used data from the Framingham Heart Study in the United States concluded that overweight and obesity may lessen life expectancy markedly, especially among young adults.²⁶ The observed decreases in life expectancy in this study were similar to the decreases in life expectancy seen in smokers.²⁶ To investigate the temporal trends in the mortality burden associated with overweight and obesity in Canada, Katzmarzyk and Ardern (2004) combined data from six cross-sectional national population health surveys and one more recent prospective cohort study. Overall, they found that overweight and obesity accounted for approximately 57,000 deaths in Canada between 1985-2000.²⁷ The greatest relative increases in overweight and obesity related deaths were seen in Newfoundland, with a 58.9% increase, and the lowest in British Columbia, with an increase of 33%.²⁷

2.2.3 Economic costs associated with overweight and obesity in Canada

In addition to being associated with numerous chronic health problems and reduced life expectancy, overweight and obesity also present significant economic challenges to our health care system. A considerable amount of health care dollars are spent on managing and treating obesity-related conditions in Canada.²⁸ In their seminal work on the cost of obesity in Canada, Birmingham *et al.* (1999) estimated the total direct cost of obesity in Canada to be greater than \$1.8 billion per year, corresponding to 2.4% of total health care expenditures.²⁸ However, this work focused only on the direct costs (e.g. drugs, hospitals, and physician care) and did not account for indirect costs such as work loss due to disability,

and thus, only represented a portion of the economic burden of obesity. More recently, Katzmarzyk and Janssen (2004) estimated both the direct and indirect costs of physical inactivity and obesity in Canada for the year 2001.²⁹ To do so, they first undertook a systematic review to investigate the specific diseases associated with physical inactivity and obesity, the results of which were used to estimate costs. Results indicated that in 2001, the indirect and direct costs associated with obesity in Canada was \$4.3 billion (\$1.6 billion on direct cost and \$2.7 billion on indirect costs).²⁹ Sensitivity analyses indicated that this figure may have been as low as \$2.8 billion and as high as \$6.3 billion.²⁹

2.2.4 Overview of the determinants of overweight and obesity

On the surface, the aetiology of overweight and obesity appears to be rather simple but a more in depth analysis reveals a complex array of determinants. At the most basic level, overweight and obesity result from an imbalance between energy consumed and used.¹⁰ An individual will become overweight (which may escalate to obesity) when energy intake exceeds expenditure for a prolonged period of time.¹⁰ Indeed, initially overweight and obesity were studied solely in the context of dietary intake and physical inactivity; these fundamental behavioral determinants of overweight and obesity have been continuously re-established. At the regional level in Canada for example, physical inactivity and high rates of low fruit and vegetable consumption remain good predictors of obesity.³⁰ Still, weight gain usually only arises in an environment that is conducive to this mismatch in energy balance¹⁰; however, the environmental and social conditions underlying these overweight and obesity promoting behaviours are less well understood.

In a recently published report on overweight and obesity in Canada, the Canadian Population Health Initiative (CPHI) of the Canadian Institutes for Health Information

(CIHI), reviewed the determinants of overweight and obesity from a population health perspective.³¹ This report concluded that several factors including education, income, social support networks, employment and working conditions, early child development, physical environments, personal health practices and coping skills, biological and genetic factors, gender and culture all have a role to play in the aetiology of overweight and obesity.³¹

In fact, there now seems to be a general consensus in the literature that the root causes of overweight and obesity are quite complex and involve genetic, environmental, behavioural, social and cultural factors. In support of this argument, experts in the field have summarized available evidence citing a host of factors as determinants underlying this important public health concern including, but not limited to: increasingly sedentary lifestyles, the availability of low-cost energy dense foods, urban planning, changing technologies and changes in the food environment at home, school and work. Many of these factors fall into the categories presented in the CPHI report.³¹ This suggests that our understanding of overweight and obesity would be enhanced by examining this issue through a population health lens which considers the broad range of factors that have an impact on an individual's health. In particular, research in this area would benefit from further exploration of some of the underlying social determinants of overweight and obesity.

Finally, it is important to keep in mind that the environmental and social determinants of overweight and obesity are all embedded within a global environment.⁴ Given the complexity and the multiple determinants of obesity, only a few select examples have been presented in this section of the review.

2.2.5 Social determinants of overweight and obesity

Overweight and obesity are not randomly distributed across populations but rather are related to socioeconomic status (SES). Definitions of SES vary from one study to the next but the term usually refers to one or more of the following indicators: income, education, employment/occupational status and combined indicators.⁵ The important early work of Sobal and Stunkard (1989) conducted over 15 years ago demonstrated a clear inverse relationship between SES and obesity in women in developed countries; the relationship in men was more ambiguous.³² Their extensive review included 144 studies from across the globe. While most of the studies included in this review were not on the relationship between SES and obesity as such, the body of literature was substantive enough to allow for an integrative review on the topic. This review did not however distinguish between indices of SES.

Since then, several studies have specifically examined the relationship between SES and overweight and obesity in developed countries. In a more recent and comprehensive review of overweight and obesity in Canada, Raine (2004) highlights several studies from industrialized countries in support of earlier work and sheds more light on the interactions among the various indicators of SES and overweight and obesity.⁵ Raine's (2004) findings are briefly summarized here with specific reference made to the primary research. Data from a random sample of 26 populations surveyed in the WHO MONICA (Monitoring Trends and Determinants in Cardiovascular Disease) project demonstrated that lower education was associated with higher BMI in roughly all of the male and nearly all of the female populations.³³ An Australian study based on national survey data revealed that women employed in low status jobs were 1.4 times as likely to be overweight as women employed

in high status positions; this relationship was not consistent in men.³⁴ In England, health surveys reveal that obesity risk is greater among men and women with less education and inferior economic circumstances.³⁵ Longitudinal analysis of London civil servants (Whitehall II) demonstrated that lower employment grade was strongly related to gains in BMI from 25 years of age over the next 25 years approximately.³⁶

Swedish, Finnish and Swiss studies have obtained similar results. In Sweden, low SES was found to be a strong determinant of overweight and obesity in a group of 300 women.³⁷ In Finland, overweight was associated with current unemployment and obesity with long-term unemployment; both overweight and obesity were associated with low income.³⁸ Among a working sample of Swiss men and women, education level and occupation status were both found to be inversely related to BMI; in women, the effect was synergistic.³⁹

Even more recently, Ball and Crawford (2005) endeavored to systematically review temporal changes in weight across SES levels.⁴⁰ This review provides an in-depth analysis of SES and weight and presents findings by sex, age group and SES index measure. Only the main findings are summarized here. In total, 24 discrete studies were analyzed (some of which overlap with Raine's findings presented earlier). Overall, the findings were mixed, some providing evidence of a relationship between SES and weight change, others finding no association. More focused analyses of large non-black samples and methodologically sound studies demonstrated a consistent inverse relationship between occupation status and weight gain for both men and women; findings based on education were slightly less consistent, in particular among men, but still provided some support for an inverse

relationship between education and weight gain. When income was used as marker for SES, findings were conflicting.

Data specific to Canada are less consistent. Based on data from the 2000-2001 CCHS, the Canadian Institute for Health Information reported that rates of overweight and obesity were positively related to income level among men; women in the highest income group, on the other hand, were the least likely to be overweight or obese.⁴¹ More current data from the CCHS 2004 are even less straightforward.²⁵ In general, among both men and women, those with lower education levels were more likely to be obese. As well, women who had some uncompleted post-secondary education had higher rates of obesity. With respect to income, risk of obesity was lowest in the highest income households compared to lower-middle income households among men; among women, those in the middle and upper-middle income households had significantly elevated obesity rates compared with women in the highest income households. After controlling for age, these results remained unchanged in men but in women, only those in middle income households had a significantly higher obesity rate.²⁵

2.2.6 Potential explanations for differences in the prevalence of overweight and obesity across diverse socioeconomic groups

The disproportionate rates of overweight and obesity generally observed among the socially disadvantaged can partially be explained by the fact that unhealthy dietary practices consistent with the development of overweight and obesity tend to be clustered together among the socially disadvantaged; this includes the high consumption of saturated fats and refined carbohydrates as well as low fruit and vegetable intake.⁴² Studies from several industrialized nations, including the United States, Australia and several European countries,

have consistently demonstrated that both dietary quantity and quality decrease as income decreases.⁴³⁻⁴⁷ The diet of lower socioeconomic groups in Britain provides cheap energy-dense foods such as high-fat meat products, high-fat dairy products, fats, sugars, preserves, potatoes and cereals with little intake of fruits, vegetables and whole-wheat breads.⁴⁷ Compared with the highest income groups, intake of nutrients among lower-income groups as a percentage of the reference nutrient intake is consistently lower for all nutrients.⁴⁷

While Canadian evidence is sparse, due in part to a previous lack in national nutritional intake data (this issue will likely be resolved with the release and subsequent analyses of the CCHS 2004), it is very likely that similar to other developed countries, there are socioeconomic gradients in diet, such that higher-income Canadians consume healthier diets than do low-income Canadians.⁴⁵ In the province of Quebec, analysis of provincial level data [Quebec Nutrition Survey (1990)] revealed a positive income gradient for several micronutrients.⁴⁸ Analyses of household food expenditure data in Canada also provide valuable insight and have demonstrated that as income increases, households appear to make more nutritious food choices by selecting lean meats, poultry and fish as well as low-fat milk for example.⁴⁹ Additionally, total food expenditures are lower among low-income households in comparison to other households and low-income households purchase significantly fewer servings of food, including fruits and vegetables.^{43, 49} While data from the CCHS 2004 will eventually further inform this area of research, currently only preliminary analyses are available. This preliminary analysis found that the percentage of calories obtained from fat rises with income (i.e. opposite of what one might expect) and that adults in the highest income bracket are less likely than those in the lowest to consume fewer than 5 daily servings of fruits and vegetables.⁵⁰

2.2.7 Overview of the determinants of healthy eating

A recent synthesis of the literature on the determinants of healthy eating in Canada revealed that individual level factors, such as food preference and nutritional knowledge, are necessary, but not sufficient, in the explanation of dietary behaviour which is highly contextual.⁵¹ Eating behaviour is determined by a complex set of interacting factors including: the interpersonal environment created by family and peers, the physical environment, which determines food availability and accessibility, the economic environment, in which food is a commodity to be marketed for profit, and finally the social environment, determined by social status.⁵¹

In an attempt to explain gradients in dietary choices across SES groups in greater detail, researchers have recently begun to investigate the cost of healthy eating. This area of research strongly suggests that sensible diets cost more. Studies conducted both in Europe and North America have shown that there is an inverse relationship between energy density and energy cost, such that energy-dense foods composed of refined grains, added sugars or fats often represent the lowest-cost option for the consumer.^{46, 52, 53} The energy density of foods is a function of their water content; energy-dilute foods are heavily hydrated whereas energy-dense foods are dry and often contain fat, sugar and starch.⁵⁴ For example, a French study noted that the energy costs for oil, margarine, potatoes, sugar, and beans were substantially lower than energy costs for lean meat, vegetables and fish.⁵³ The authors concluded that disparities in energy cost between fats and fresh produce were in excess of 1000%.⁵³ A similar study conducted in the United States found that potato chips, chocolate and locally bottled soft drinks provide dietary energy at a lower cost than healthier foods including lean meat, fish, fruits and vegetables.⁵²

Food is only one need among numerous competing needs for the limited funds available in low-income households and given that it is one of the only flexible budget items, money for food is often eroded by other essential expenditures, such as rent.⁴⁶ For families on social assistance, one study found that even when the full food allowance from social assistance funds is available to be spent on food, it is still insufficient to purchase an adequate diet, let alone an optimally nutritious one.⁴⁶ These findings are consistent with results obtained by Vozoris and colleagues (2002) who examined the affordability of a nutritious diet for households on welfare in Toronto.⁵⁵ To do so they created three hypothetical household categories, which coincide with welfare benefit categories, and compared monthly basic standard of living costs to actual monthly income. They found discrepancies between welfare incomes and basic needs, in particular, among single-person and two-parent families living in market rental housing. Living in rent-to-income housing helped to reduce the disparity. For the single parent families considered in this study, funding fell short of basic needs for 6 months of the year; for families with children, the discrepancy between welfare income and necessary income increased as the children grew older reflecting increased food need and the need for larger housing facilities.⁵⁵

Though the cost of food alone is arguably one of the most significant barriers that low-income groups must overcome in order to acquire food security, it is not the only one. The seemingly simple act of buying groceries may be further complicated by other issues which at first glance appear to be unrelated to food, such as child care and transportation. Many households living on low incomes live in areas where local shopping facilities and transport networks are limited, and where the price of food is higher.^{46, 56-58} Morland et al. (2002) conducted a U.S. based study and found that large supermarkets, which offer a wider

variety of foods at lower prices, were more often located in wealthier vs. poorer neighbourhoods.⁵⁷ Canadian studies have reported that the cost of food is higher in lower-income neighbourhoods by as much as 5%.⁴⁶ This phenomenon has also been noted in some of Canada's northern communities and in many European countries.^{58, 59} Traveling elsewhere to purchase cheaper foods necessitates the use of scarce resources, notably time and money. For those with children, traveling elsewhere is not only an added expense but also poses logistic difficulties.⁴⁶ The increasing concentration of larger chain grocery stores as sources of quality, affordable foods, coupled with the demise of local shops has major, yet often overlooked, consequences for low-income families.⁵⁸

Although it may seem counter-intuitive, one of the strongest prevailing theories for a link between overweight/obesity and SES is that SES affects one's ability to purchase healthy and/or adequate amounts of food, both indicators of food insecurity, which then leads to overweight/obesity. Despite a great deal of research in this area, a clear understanding of the relationship between SES, dietary habits and overweight and obesity is still lacking.

2.3 Summary of the evidence: food insecurity

2.3.1 Prevalence of food insecurity in Canada

Directly related to food affordability, availability and quality is food insecurity. The first indication that food insecurity was a serious problem in Canada came in the early 1980s, when, in response to hunger in their communities, food banks proliferated.^{60, 61} As was discussed in Chapter 1, until recently, Canadian statistics on the prevalence of food insecurity were limited to food bank use statistics. The first national survey to include any indicator questions on food insecurity was the National Longitudinal Study of Children and

Youth (NLSCY) in 1994.²⁰ Since then, the National Population Health Survey (NPHS) and the Canadian Community Health Survey (CCHS) have both incorporated indicator questions on food insecurity.²⁰

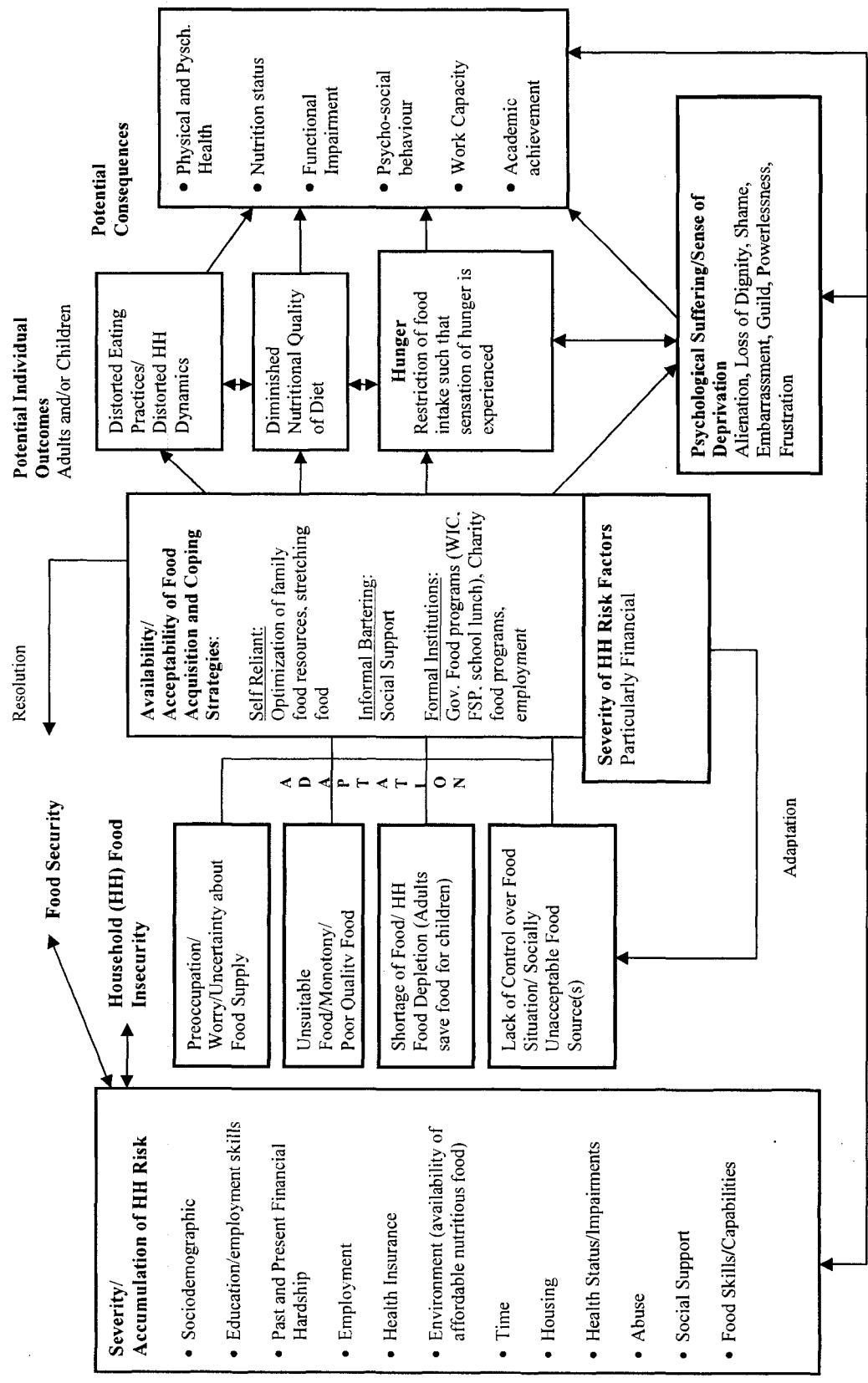
Tarasuk (2005) recently undertook a review paper on household food insecurity in Canada, in which she highlights the trends in food insecurity prevalence in Canada as measured on national population health surveys up until the 2000-2001 CCHS.²⁰ While national survey data cannot be used to directly assess changes in the prevalence of food-insecurity over time, as different survey questions have been used to assess food security status from one survey to the next, Tarasuk (2005) found that the data supports the inference from food bank use statistics that household food insecurity is increasing.²⁰

In Canada in 2000/2001 food insecurity was estimated at 14.7%.⁶² Likewise, in the United States, 14.6% of households were classified as food insecure in 2002.⁶³ However, more recent analyses (CCHS 2004) published by Health Canada indicate that 9.2% of the population live in food-insecure households, an apparent decrease since 2001.²¹ Still, what appears to be a decrease in the prevalence of food insecurity from 2001 to 2004 should not necessarily be viewed as positive because, as previously mentioned, different survey methodologies prevent any meaningful comparative analyses. It is also important to note that the populations surveyed here often exclude vulnerable population groups such as Aboriginal peoples on reserves, persons residing in the territories and certain remote areas and homeless individuals.²⁰ Thus, any figures from national survey data are likely to be underestimated.

2.3.2 Introduction to the determinants of and health outcomes associated with food insecurity

Alaimo (2005) recently synthesized a large body of research on food insecurity and published a conceptual framework which underscores the relationship between the determinants of, as well as health and other outcomes of food insecurity as experienced by individuals and families (Fig 2.1).¹⁵ Some key aspects of this conceptual framework are elaborated upon in later sections of this review.

Figure 2.1 : Conceptual framework of food insecurity¹⁵



Note: Reproduced with permission (Appendix J)

2.3.3 Determinants of food insecurity

Numerous factors are related to food insecurity and these are summarized in Figure 2.2.¹⁵ Similar to overweight and obesity, food insecurity is also related to indicators of SES such as low-income and financial insecurity. While the primary risk factor for food insecurity is income, sociodemographic factors such as education, race/ethnicity, family composition and other factors including housing status, the food environment (availability of affordable nutritious food) and abuse may also affect food security status.¹⁵ In Canada, the United States, Britain and Australia, the odds of reporting food insecurity increase with declining income and in some instances, with reliance on social assistance.⁶²⁻⁶⁶ Although the measures of food insecurity included in Canadian national surveys in the past have been limited, they have still greatly expanded our understanding of some of the additional determinants and risk factors for food insecurity in Canada. Based on data from the Canadian Community Health Survey (2000/01), more than 40% of people in low- or lower-middle income households reported food insecurity.⁶² This survey also indicated that more women than men were food insecure (16% vs. 13%); however, this difference was primarily due to differences in income and family structure. Canadian research further indicates that lone parent families, in particular those headed by women, children, off-reserve Aboriginals and residents of the territories are especially vulnerable to food insecurity.^{62, 65, 67} More recently, it has been suggested that students relying on government assistance to fund their education may also be at greater risk of food insecurity.⁶⁸

2.3.4 Health outcomes associated with food insecurity

Our current understanding of the health outcomes of food insecurity is based on a number of studies, most of which have been conducted in the United States on low-income

populations.¹⁵ Generally, insufficient food, either in quality or quantity, has been associated with poorer health and may lead to serious health problems.^{69, 70} While research consistently shows that the food-insecure are at increased nutritional risk,^{71, 72} given that food insecurity often operates within the context of poverty, which has independent and well-documented adverse health effects, it is difficult to identify the specific health consequences of food insecurity.⁷³ Studies based in the United States demonstrate that food-insecure individuals have lower intakes of a variety of essential nutrients which may compromise their health and that the odds of consuming intakes below 50% of the recommended dietary allowance are higher among individuals in food-insecure households.^{71, 72} Tarasuk and Beaton (1999) found that Canadian women who reported hunger in their households had consistently lower intakes of energy and several nutrients.⁷⁴ Disordered eating patterns and a decrease in the number of fruits and vegetables consumed have both been reported as the severity of food insecurity increases.^{75, 76} In food-insecure families with children, poor diet quality is more common among adults than children. In Atlantic Canada and elsewhere, studies have revealed that mothers tend to prioritize their children's diet over their own.⁷⁷⁻⁷⁹ In a study of 141 low-income lone mothers in Atlantic Canada, mothers' dietary intakes were found to be consistently poorer than their children's; the researchers concluded that low-income single mothers tend to compromise their own nutritional intake in order to preserve the adequacy of their children's diet.⁷⁷ This behaviour is consistent with research demonstrating that self-sacrifice as a means of coping is common among low-income lone mothers.⁸⁰ Olson (2005) believes the important role that women play in family feeding makes them more vulnerable to the consequences of food insecurity.⁸¹

Individuals living in the context of food insecurity have also been found to be at increased odds of suffering from depression and distress,⁷⁰ and report feelings of extreme lack of control, of powerlessness, inequity, frustration and alienation.⁷⁶

In addition to nutritional and psychological consequences, food insecurity has been associated with higher odds of reporting poor/fair health, with poor functional status, poor mobility and multiple chronic conditions *including overweight and obesity*.^{70, 82-90}

A more detailed discussion of the literature documenting a positive association between overweight/obesity and food insecurity follows in Chapter 3; prior to this, we provide an overview of the explanations for this relationship below.

2.4 An overview of the explanations for a relationship between food insecurity and overweight and obesity

The validity of research indicating widespread food insecurity in low-income populations in food-rich countries has been questioned because of the high prevalence of overweight and obesity in this same population sub-group.⁹¹ Because overweight and obesity are most often associated with excessive food intake and underweight with hunger, it might seem somewhat paradoxical to consider the possibility that food insecurity might be positively related to BMI. However, given that overweight/obesity and food insecurity are both increasing and both are associated with SES in affluent countries, in addition to what we know about the higher costs of healthy eating and barriers to food access, researchers have recently begun to examine the relationship between food insecurity and BMI.

Several potential mechanisms have been postulated to explain the positive association that has been observed between food insecurity and body weight. Much of the discussion on this issue comes from the United States. Presented in Box 2.1 are the five key explanations

that have been proposed to account for a potential positive relationship between food insecurity and obesity. These explanations were explored at a recent roundtable on food insecurity and obesity in the United States.⁹²

Box 2.1 Proposed explanations for a relationship between overweight/obesity and food insecurity

Explanation 1: Food insecurity leads to the purchase and consumption of low-cost, energy dense foods that promote weight gain

Proponents of this explanation argue that any increased risk of overweight/obesity found among the food insecure is related to the direct effects of food insecurity on diet.⁸⁴ The central argument here is that individuals who are food insecure have a limited variety of foods available to them, resulting in the consumption of energy-dense, low-cost foods. This argument is well supported by the literature presented earlier in this review which discusses the high costs of healthy foods and barriers to accessing nutritional foods.

Explanation 2: Hunger is cyclical and leads to weight gain because of cyclical food consumption

The rationale underlying this explanation is based on the argument that if food is only available cyclically, individuals who are food insecure may overeat when more money is available and when foods are less sparse, resulting in binge like eating patterns known to be associated with weight gain.^{83, 89, 93, 94} An alternate possibility, likely to be more prominent among the severely food insecure, would be that severe cyclical food deprivation would lead to malnutrition and weight loss.^{87, 95}

Explanation 3: Food insecurity and obesity result from the social and economic experience of poverty

The hypothesized mechanism here can be described by a third factor argument. The belief is that both food insecurity and obesity are social issues which result from poverty. As such, obesity is not only a health problem but a social and economic issue with an accompanying social stigma similar to that of food insecurity.⁹²

Explanation 4: Food insecurity is a stressor that leads to a weight related stress response

The argument for this explanation is that the experience of stress, as a result of food insecurity, may induce a variety of physiological and behavioural responses, including disordered eating, decreases in physical activity, depression and substance abuse, which may in turn lead to weight gain.⁹²

Explanation 5: Hunger and obesity cannot co-exist

Finally, this explanation argues that food insecurity and obesity are two opposite extremes on the food consumption spectrum and that it is illogical to contemplate the notion that hunger and obesity might co-exist in the same individual. Related to this argument is the idea that it is possible that individuals who are overweight and/or obese view themselves as food insecure because the amount of food they deem necessary is higher on average than normal weight persons. However, as Adams *et al.* (2003) argue, food related costs will depend in part on foods selected and may not be directly related to total caloric intake, thereby making obesity an unlikely cause of food insecurity.⁸⁴

2.5 Summary and Conclusions

Chapter 2 has provided an overview of the epidemiological literature on overweight/obesity and food insecurity and an introduction to the study of a food insecurity-overweight/obesity relationship. The potential food insecurity-overweight/obesity relationship is explored in greater detail in Chapter 3.

Chapter 3: OVERVIEW OF A SYSTEMATIC REVIEW ON FOOD INSECURITY AND BODY MASS INDEX AMONG ADULTS IN FOOD RICH COUNTRIES

3.1 Overview of Chapter 3

Chapter 3 summarizes a recently conducted systematic review of observational studies examining the relationship between food insecurity and BMI in food rich countries. This review was conducted as part of the systematic reviews course, and prior to the approval of the thesis topic. The results of this systematic review are presented here to expand upon the results of the literature review presented in Chapter 2. This chapter provides a more focused discussion on the relationship under investigation in this study, highlights important gaps in the literature, and provides a foundation for this thesis.

Section 3.2 states the objectives of the systematic review, section 3.3 presents the methods used, section 3.4 provides the systematic review results and section 3.5 includes some discussion of the systematic review results and study limitations. Finally, in section 3.6, studies which have been published since the completion of the systematic review are summarized to provide the reader with the most up to date information.

3.2 Systematic review objectives

The objective of this systematic review was to use observational studies to assess the relationship between food insecurity and BMI among adults (18y +) living in developed countries so as to generate knowledge and inform future research in this area.

3.3 Systematic review methods

A written protocol was prepared in advance and can be obtained from the author; the protocol for this review was prepared in accordance with the guidelines put forth by the Campbell Collaboration.⁹⁶ When applicable, this review was prepared in accordance with the latest QUORUM checklist [unpublished, provided by Professor David Moher]. While a

single reviewer completed the majority of this systematic review due to time and resource constraints, expert advice was sought from Jessie McGowan, Beverly Shea and Lise Dubois throughout the review process.^a

3.3.1 Eligibility criteria

Studies were evaluated for inclusion based on five criteria: population, independent variable of interest (exposure), dependent variable of interest (outcome), study design and language of publication.

The target population consisted of adults 18 years of age or older residing in a developed country as defined by the United Nations Human Development Index (Please see Appendix B for a listing of included countries).⁹⁷ Studies with populations under 18 years of age were excluded as BMI is prone to error among youth who have not yet reached their full height and to allow for better comparison across studies.⁵ Studies conducted among populations in developing countries were excluded as the experience of food-insecure people in developing countries, and the constructs underlying their understanding and expression of that experience, likely differs from those in high-income countries.⁹⁸ Furthermore, the observation that overweight and obesity are more prevalent among lower SES groups is based on data from developed countries.^{33-39, 42}

The independent variable of interest (exposure) was food insecurity. Considerable effort has been undertaken to conceptualize relevant variables and develop measurement instruments for assessing food insecurity as was discussed in Chapter 1,⁶¹ nevertheless, researchers still use a variety of similar questions to ascertain exposure to food insecurity. Therefore, for the purposes of this review, any study which used a measure of food

^a While it is generally agreed that at least two reviewers should screen articles, apply eligibility criteria, abstract data and assess quality, this was beyond the scope of the present review.

insecurity/security or food insufficiency/sufficiency defined a priori to the study which captured one or more of the following dimensions of food insecurity using a survey questionnaire was included:

- “not eating the desired quality or variety of foods (compromised quality);
- being concerned about not having enough to eat; and
- not having enough to eat.”^{31, 62}

Only measures of food insecurity at the household or individual level were included in this review in accordance with the study’s objectives. Surrogate measures of food insecurity, such as food stamp participation and food assistance, were not accepted as measures of food insecurity. The rationale underlying this decision is that food-stamp participation may be an indicator of poverty but not necessarily of food insecurity.⁹⁹

The dependent variable of interest (outcome) was BMI. For the purposes of this systematic review, studies which calculated BMI based on either self-reported or measured height and weight were included. Studies using other outcome measures for body fatness such as skin fold thickness and waist circumference were excluded. The rationale for this exclusion criterion is that BMI allows for meaningful comparisons between populations and it is relatively easy to ascertain either via measured or self-reported data.^{5 [b]}

Study designs eligible for inclusion in this review included cohort, case control, cross-sectional and case-series studies as well as randomized and non-randomized studies; however, given the nature of the topic, we acknowledged prior to taking on this systematic review that experimental study designs were highly unlikely for ethical reasons. Review

^b Please note that because studies in this area of research are most often cross-sectional, the designation of exposure and outcome is often based on the underlying explanation the researchers wish to examine as well as on the methods of statistical analysis. Therefore, studies which modeled food insecurity as the outcome and BMI as the exposure were not excluded; rather, they are discussed separately in the results section.

articles were excluded as the interest of this review was primary research. All relevant studies uncovered, irrespective of publication status, were included.

Only studies published in English were eligible for inclusion in this review due to limited time and resources. The potential bias introduced by this criterion is elaborated upon in the discussion section.

3.3.2 Search strategy

A comprehensive search was conducted to identify all relevant studies regardless of publication type. Three electronic databases were searched using the OVID search interface, including CINAHL (1982 to January Week 4 2006), MEDLINE (1996 to January Week 4 2006), and PsychINFO (1806 to January Week 5 2006) between February and March 2006. A detailed search strategy was developed for use in MEDLINE and then adapted for each database.

Little research has been done examining the relationship between food insecurity and health outcomes⁹¹ which likely explains why there were no index terms available in the electronic databases for food insecurity. Because research in this field is in the early stages of development, several terms to describe the concept of food insecurity are used interchangeably (e.g. food poverty, food insufficiency, and hunger-the most severe form of food insecurity). In order to capture all potentially relevant articles, the search strategy used for this review was highly comprehensive. As a result, we expected to uncover a large number of unrelated articles.

Search terms were based on the independent variable (food insecurity) and dependent variable (BMI) of interest, and limited to the population of interest (human adults) and to the English language. The exposure key words were searched using the

Boolean operator “OR” as were the outcome key words. The exposure and outcome search terms were combined using the Boolean operator “AND”. All subject heading terms were exploded and any free terms were truncated appropriately. Detailed descriptions of the database search strategies are presented in Appendix C.

In addition, the reference lists of all relevant articles (including reviews) were examined for reports of additional studies and study authors were contacted to retrieve grey literature when necessary. The February, March and April 2006 issues of two prominent journals in the field, the *Journal of Nutrition* and the *International Journal of Obesity and Related Metabolic Disorders* were hand searched to identify potential studies published after the dates included in the database search. Finally, three content experts were contacted (Dr. Lise Dubois, Dr. Marilyn Townsend and Dr. Christine Olson) to identify unpublished or ongoing studies, though contributions of these authors were limited at the time of submission of this review (i.e. no additional studies were uncovered here).

3.3.3 Study selection

All relevant citations, including titles and abstracts, were imported into a reference database (Reference Manager 11). Duplicates were identified and removed using the batch duplicate search operation using several different fields for comparison. A manual check was completed to remove the remaining duplicates. In the initial broad screen, a single reviewer (MM) independently screened all titles and abstracts of all relevant citations by exposure, outcome and overall non-relevance. Specifically, the reviewer (MM) screened the list of citations to identify and retain studies for further review which were broadly related to food insecurity and weight status. If it was unclear whether the study met the

inclusion/exclusion criteria for the exposure or outcome of interest, the full text of the report was obtained for further assessment.

Full reports for those studies screened in after the initial broad screen were collected via the University of Ottawa library, internet searching and through contact with authors. A single reviewer (MM) then applied the full inclusion criteria, including population, exposure, outcome and study design, to the full text. Articles considered eligible after the full-text review were included in the final set of studies for this systematic review. All excluded studies and reasons for exclusion were documented (Appendix E).

3.3.4 Data abstraction

A data abstraction form was developed to guide this review and to describe the characteristics of the included studies. The data abstraction form was subsequently piloted and reviewed by the content expert (LD). A sample of the final data abstraction form can be found in Appendix D.

While a single reviewer (MM) independently abstracted data from all studies meeting the inclusion criteria, a second reviewer (LD) was available for consensus throughout the process and independently verified each data abstraction form. The information collected from each study was specific to the objectives of this review and included information on study characteristics (e.g. title, year published, publication type), study design (e.g. objectives, design, exposure and outcome measurements), population (e.g. source of population, age range, sex, process of subject selection), methods of data analysis (e.g. statistical analyses conducted, reported measures of association and statistical stability) and finally information on study results (major results, value for the measure of association and associated statistical stability and limitations). The reviewer was not blinded to the

names of authors, journal or institution. For a detailed list of the information collected, please see Appendix D.

3.3.5 Quality assessment

To our knowledge, at the time of submission of this systematic review, there was no standard quality assessment form available for observational studies, specifically for cross-sectional studies. Therefore, the quality assessment form used for the purposes of this review was developed in accordance with the type of study design we believed we were most likely to encounter in this review (cross-sectional studies) and was adapted based on other available generic critical appraisal forms for observational studies.^{100, 101} As a result, the quality assessments conducted in this review were likely highly subjective and the results obtained should be interpreted with caution. The quality assessment form can be found as a sub-section on the data abstraction form in Appendix D.

3.3.6 Data analysis

Data were qualitatively synthesized to examine each included study with respect to study design, population, exposure, and outcome measurements. Inconsistencies across studies and sources of methodological heterogeneity were identified and reported. A brief summary of each included study is presented along with a description of the reported effect measures and associated measures of statistical stability. Based on the qualitative assessment of heterogeneity, a quantitative synthesis of the data was not deemed appropriate. Thus, sensitivity and subgroup analyses were not performed, and publication bias was not assessed quantitatively.

3.4 Systematic review results

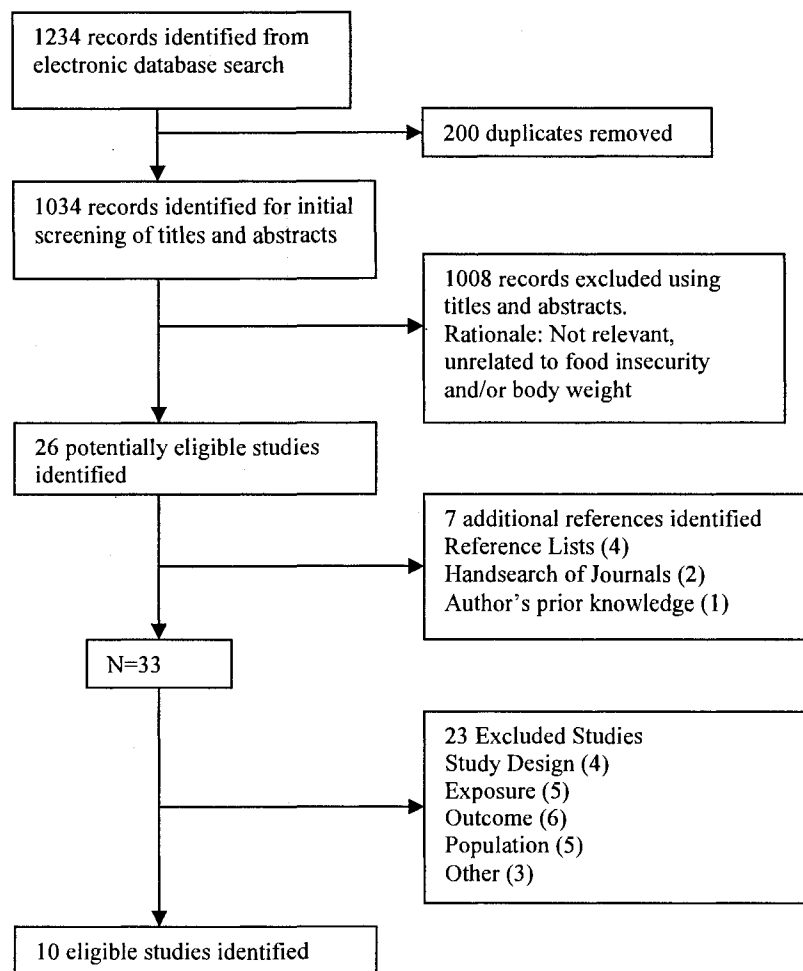
3.4.1 Results of study selection

A flow diagram of the search results is presented in Figure 3.1. The electronic database searches generated 1234 citations, including 200 duplicates, resulting in the identification of 1034 unique citations for the initial screening of titles and abstracts. 61 citations were excluded on the basis of language during the search phase.

Following the initial screening, 26 potentially eligible studies were retrieved.^{52, 65, 70, 83-88, 91, 102-117} An additional 7 citations were identified; 4 through reference list searching^{89, 95, 118, 119}; 2 through hand searching of journals^{120, 121}; and 1 based on prior knowledge of an existing non-governmental organization report.¹²² Therefore, 33 reports were determined to be potentially relevant.^{52, 65, 70, 83-89, 91, 95, 102-122}

Inclusion/exclusion criteria were applied to these 33 reports. Of the 33 full text reports obtained, 20 studies were excluded on the basis of population [n=5]^{65, 103, 106, 109, 112}, inappropriate exposure (independent variable) [n=5]^{104, 105, 107, 117, 121}, inappropriate outcome (dependent variable) [n=6]^{108, 110, 113, 114, 116, 122}; and inappropriate study design [n=4].^{52, 91, 111, 118} An additional 3 studies were excluded due to discrepancies in reporting in the document [n=1]¹²⁰; draft report to be kept confidential at authors' request (pending publication) [n=1]¹¹⁹ and a duplicate publication (thesis dissertation) confirmed by the author [n=1].¹¹⁵ Please note that several of the studies were excluded for multiple reasons and only one is listed here; see Appendix E for a list of these excluded studies and detailed reasoning. Thus, a total of 10 reports, describing 10 independent studies fulfilled the inclusion criteria at the time of submission of this report.^{70, 83-89, 95, 102}

Figure 3.1: Flow diagram outlining the results of the literature search and the selection of studies for inclusion in the review.



3.4.2 Study characteristics

Study characteristics of the included studies are described in Table 3.1. Eight studies were conducted in the United States^{83-86, 88, 89, 95, 102}, 1 in Canada⁷⁰ and 1 in Finland.⁸⁷ All reports were published between 1997 and 2005; 7 in English language journals^{70, 83-87, 102} and 3 in the grey literature:^{88, 89, 95} All 10 studies employed cross-sectional study designs with varying study objectives.

The studies also varied with respect to study population, measures of food insecurity and measures of body mass index. Four studies were conducted based on national

population samples^{70, 83, 87, 89}; 4 based on state-level populations^{84, 86, 88, 102} and 2 based on more local populations.^{85, 95} All 10 studies were conducted among adults aged 18 years or older. Six studies included both men and women^{70, 83, 86-88, 102} whereas 4 focused on women^{84, 85, 89, 95}, 2 of which were specific to women with children.^{85, 95} Two studies focused specifically on low-income populations (defined as adults living in households with incomes below 200% of the federal poverty line).^{85, 88}

Measures of food insecurity were not consistent across studies. Only 2 studies specifically reported using a previously validated measure of food insecurity.^{70, 83} Similarly, measures of BMI differed across studies. Seven studies calculated BMI based on self-reported height and weight^{70, 83, 84, 86-88, 102} and 3 based on measured height and weight.^{85, 89, 95} In addition, specific BMI outcomes of interest and cut-points varied across studies (i.e. some studies were interested in overweight denoted by a specific BMI cut-point, others in obesity or a combination).

Table 3.1: Study Characteristics

Author(s), Year, & Country	Publication Type	Study Design & Objectives	Study Population & Age Range and Sex	Subject Selection & Sample Size	Independent Variable of Interest Modeled (Exposure) & Measurement	Dependent Variable of Interest Modeled (Outcome) & Measurement
Adams <i>et al.</i> 2003 ⁸³ United States	Journal Article	Cross-Sectional To determine the prevalence of food insecurity with and without hunger in Californian Women and to examine the relationship between food insecurity and obesity	Data were obtained from the 1998 and 1999 California Women's Health Survey (CWHHS) Age > 18 y Women	Random selection via random digit dialling 8169 participants (Response rates 70% in 1998 and 81% in 1999). Complete data: Non-Hispanic whites N=3699 Asian, Black and Hispanic N=2352	Food Insecurity: Evaluated using a subset of four questions adapted from the U.S. Household Food Security Module (HHFSM)	BMI BMI > 30kg/m ² =obesity Based on self-reported height and weight
Bastotis and Lino. 2002 ⁸⁰ United States	Publication of the USDA Centre for Nutrition Policy and Promotion	Cross-sectional To examine the relationship between food insufficiency and overweight status	Data from 1988-1994 National Health and Nutrition Examination Survey (NHANES III) The survey includes the civilian non-institutionalized population of the contiguous United States. Women between the ages of 19 and 55 who did not live alone were selected.	Sampling method unclear Sample size 33,994 (response rate not indicated) N for analysis = 5241.	Food Sufficiency: Measured by a woman reporting that her household had enough food to eat (food sufficient households); Food insufficiency: measured by a woman reporting that her household sometimes or often did not have enough to eat (food insufficient households).	BMI Overweight: BMI > 25kg/m ² ; Obesity :BMI ≥ 30kg/m ² Based on measured height and weight
Frongillo <i>et al.</i> 1997 ⁸⁵ United States	Publication of the Institute for Research on Policy	Cross-sectional The objectives of this study were two-fold 1. to examine the relationships between food insecurity and income with two nutritional consequences: adiposity and dietary consumption of fruits and vegetables 2. to assess whether disordered eating patterns is a mediator for the effects of food insecurity and income on these nutritional consequences.	The sampling frame was based on the 1989 health census of the county of upstate New York. Women with children living in their households. Age: 20-39y, excluding women with > 16 y of education.	Recruited via phone or by home visit. Survey response rate=86%. A pool of 639 women was selected from the census. 52% could not be contacted. Of the remaining 308 women refusal rates were 18% among women presumed to be in the lowest SES group, 40% in the intermediate SES strata and 32% in the highest SES group. 7 women were between the ages of 15-19 and were subsequently dropped from the analysis. Final N= 193	Food insecurity: Evaluated based on the Radimer/Cornell hunger and food insecurity measure. Each respondent was categorized into one of four food insecurity groups based on their responses to the Radimer/Cornell food insecurity items.	BMI Two outcome variables for adiposity were used: BMI and obesity (BMI > 29kg/m ²). Based on measured height and weight

Author(s), Year, & Country	Publication Type	Study Design & Objectives	Study Population & Age Range and Sex	Subject Selection & Sample Size	Independent Variable of Interest Modeled (Exposure) & Measurement	Dependent Variable of Interest Modeled (Outcome) & Measurement
Harrison <i>et al.</i> 2005 ⁸⁸ United States	Publication of the UCLA center for Health Policy Research	Cross-sectional To examine prevalence of food insecurity among low-income Californian adults by region, ethnicity, household type, by food stamp participation, and WIC participation. A brief analysis of the relationship between food insecurity and overweight is also presented.	Data from the 2001 (revised) and 2003 California Health Interview Survey (CHIS). CHIS 2001 was revised for comparability with 2003 survey. Adults: 18y or older	Random-digital dial telephone survey methodology of residential households- statistically adjusted to compensate for households without telephones Food Insecurity findings based on 11,975 (CHIS 2003) and 18,113 (CHIS 2001) interviews of adults living in households with incomes below 200% of the federal poverty line.	Food Insecurity: Food insecurity with and without hunger measured by an abbreviated six-item scale derived from the 18-item U.S. Household Food Security Instrument reported over the last 12 months.	BMI Based on self-reported height and weight.
Kaiser <i>et al.</i> 2004 ⁸⁵ United States	Journal Article	Cross-sectional To examine the relation between food insecurity and weight status in low-income Latino women. Specific research questions: 1) Is food insecurity positively associated with being overweight or obese? 2) Is past food insufficiency positively associated with currently being overweight or obese? 3) Do observed relations differ by level of acculturation?	Low-income Latino women in 6 California counties. To be eligible, the following criteria had to be met by subject: 1) identified herself and her child as Latino, Mexican, Mexican American, Chicano, or Hispanic; 2) at least one biological child born between June 1, 1995, and February 1, 1998; 3) the family had an income \leq 200% of the poverty level; 4) the subject was aged \geq 18 y (or was an emancipated minor); and 5) willing to sign the Human Subjects consent form. A subject was excluded from the study for any of the following reasons: 1) currently pregnant or had been pregnant within the previous 3 mo; 2) planned to move within the next 2 wk; and	Subjects were recruited from a variety of community-based agencies via a convenience sampling method. N=561, data available for n=559 No response rate reported	Food insecurity and food insufficiency: A 10-item adult subscale and a 4-item adult subscale were used based on the 18-item US Department of Agriculture Food security scale (FSS) [Please see article for measurement details].	BMI Overweight: BMI \geq 25.0 to $<$ 30.0 kg/m ² ; Obesity: BMI \geq 30.0 kg/m ² . Based on measured height and weight

Author(s), Year, & Country	Publication Type	Study Design & Objectives	Study Population & Age Range and Sex	Subject Selection & Sample Size	Independent Variable of Interest Modeled (Exposure) & Measurement	Dependent Variable of Interest Modeled (Outcome) & Measurement
Laraia <i>et al.</i> 2004 ¹⁰² United States	Journal article	Cross-sectional To explore the relationship between concern about enough food and body mass index.	3) self-reported alcohol or substance abuse, mental illness, or other illness that could affect accurate responses, body weight, or diet. Study population sampled from the 1999 Behavioral Risk Factor Surveillance System (BRFSS), an ongoing state-based survey of the civilian, non-institutionalized U.S. population aged ≥ 18 years excluding pregnant women. Analysis focused on Louisiana and New York state	Selection via random-digit-dialling. Included in analysis: N= 3, 945 respondents Louisiana: n=1,570 New York: n= 2,375 No information provided on response rate	BMI Categories: • <18.4 kg/m ² (underweight), • 18.5 - 24.9 kg/m ² (normal), • 25 - 29.9 kg/m ² (overweight), • 30 - 34.9 kg/m ² (obese), • ≥ 35 kg/m ² (morbidly obese) Based on self-reported height and weight.	Concern about enough food to eat (Food insecurity): Respondents were asked: "In the past 30 days, have you been concerned about having enough food for you or your family?" Yes- subject considered to be concerned about having enough food to eat. No-not concerned about having enough food to eat
Sarlio-Lahteenkrova and Lahtelma. 2001 ⁸⁷ Finland	Journal article	Cross-sectional To examine whether economic disadvantage and body size are associated with food insecurity.	Data obtained from the Finnish "Survey on Living Conditions", a government survey conducted in 1994. Sample represents non-institutionalized population. Income data for 1993 were linked from the taxation register, and completed education from the national register of educational degrees at Statistics Finland. Adults Age: 25-64y	Sampling method unclear. 73% response rate N=8650	BMI Categories: • Thin (BMI < 20 kg/m ²) • Normal weight (BMI= 20 - 24.9 kg/m ²) • Overweight (BMI= 25 - 29.9 kg/m ²) • Obese (BMI ≥ 30 kg/m ²) Based on self-reported height and weight.	Food insecurity over the past 12months based on 5 questions about fears and experiences of insecurity-from the Edmonton food Policy Council's survey/based on the adult hunger scale. To detect the most severe form of food insecurity, where the quantity of food is reduced, respondents were further identified if they responded affirmatively to at least four questions. These respondents were studied as a separate group in the logistic regression analysis (scores 4-5 = 1, scores 0-3 = 0).
Townsend <i>et al.</i> 2001 ⁸⁵ United States	Journal article	Cross-sectional To examine the relationship between food insecurity and overweight status.	Data from the Continuing Survey of Food Intakes by Individuals (CSFII)-provides representative sample of the US general population (Data from the 1994, 1995 and 1996 survey were combined). Adults Age: 20y or older Men N=5004	Stratified multistage probability design to obtain representative samples of US households. A final sample was generated to meet the following criteria: ≥ 20 y old, reported height and weight available, income data available, non-pregnant and non-lactating.	Food insecurity: based on one question with four response elements Q: Which of the following statements best describes the food eaten in your household in the last 3 mo? • Enough of the kinds of food we want to eat (=No food	BMI Categories: Overweight BMI cut-point Men = 27.8 kg/m ² Women = 27.3 kg/m ² Based on self-reported height and weight.

Author(s), Year, & Country	Publication Type	Study Design & Objectives	Study Population & Age Range and Sex	Subject Selection & Sample Size	Independent Variable of Interest Modeled & Measurement	Dependent Variable of Interest Modeled (Outcome) & Measurement
VanEenwyk and Sabel, 2003 ⁸⁶ United States	Journal article	Cross-sectional To assess the relation between obesity and concern about food security.	Data from the 1995-1999 BRFSS (see Laraia). Analysis focused on Washington State Adults Age: 18y and over	Women N=4537 No information provided on response rate	<ul style="list-style-type: none"> • Enough but not always the kinds of food we want to eat (=Mild insecurity) • Sometimes not enough to eat (=Moderate insecurity) • Often not enough to eat (=Severe insecurity) 	BMI Obesity was defined as BMI \geq 30.0 kg/m ² Based on self-reported height and weight.
Vozoris and Tarasuk, 2003 ⁷⁰ Canada	Journal article	Cross-sectional To estimate the prevalence of household food insufficiency, identify sociodemographic characteristics of households most likely to report food insufficiency, and examine the likelihood that individuals in households reporting food insufficiency would report poor physical, mental and social health, and selected chronic health conditions.	Data from the health from the public use microdata health file for the household survey of the Cycle 2 (1996/1997) National Population Health Survey (NPHS). Sample includes household residents in all 10 provinces, with the exclusion of population of Indian Reserves, Canadian Armed Forces Bases, and the Territories as well as some remote areas in Ontario and Quebec, long-term residents of hospitals or residential care facilities and persons who are homeless. Adults Ages: 20-64 y	No details provided on subject selection or response rate (see NPHS). Women N=25815 Men N=24400	<p>Food insecurity: defined as answering "yes" to the question "In the past 30 days, have you been concerned about having enough food for you or your family?"</p> <p>Food insufficiency: Household respondents were asked if, over the past 12 mo, their household had "ever run out of money to buy food." Those who responded affirmatively were then asked two additional questions: 1) "Did anyone in your household receive food from a food bank, soup kitchen, or other charitable agency?" 2) "Which of the following best describes the food situation in your household?" a) always enough food to eat; b) sometimes not enough food to eat; or c) often not enough food to eat."</p>	BMI Categories: <ul style="list-style-type: none"> • Underweight: BMI < 19.0 kg/m² • Normal weight: BMI of 19.0–24.9 kg/m² • Overweight: BMI of 25.0–29.9 kg/m² • Obesity (Obese Class I): BMI of 30.0–34.9 kg/m² • Morbid obesity (Obese Class II-III): BMI \geq 35.0 kg/m² Based on self-reported height and weight.

3.4.3 Methodological quality

As previously discussed in the methodology section of this review, there is no standard quality assessment form available for observational studies, specifically cross-sectional studies. The results of the quality assessment checklist for this review were too cumbersome to present in detail in the main text; quality assessment results can be found in Appendix F. Please note that these assessments were likely highly subjective, thus the results should be interpreted with caution.

3.4.4 Results of individual studies

Please note that only results deemed to be relevant to this review's objectives from each individual study are reported in this section. Detailed study results from each included study are described in table 3.2.

Of the 10 included studies, 8 used multivariable logistic regression as the main analysis to examine the relationship between food insecurity and BMI, though, as previously discussed, measures of food insecurity and BMI differed across studies.^{70, 83-87, 95, 102} Of these 8 studies, 6 modeled BMI (dichotomous variable) as the outcome with food insecurity as the independent variable of interest in predicting BMI^{70, 83-86, 95}; and 2 modeled food insecurity (dichotomous variable) as the outcome with BMI as the independent variable of interest in predicting food insecurity.^{87, 102}

Of the former 6 studies, 4 reported significantly greater odds of being overweight and/or obese among the food insecure in at least one sub-group analysis,⁸³⁻⁸⁶ 1 reported significantly decreased odds of being overweight among the food insecure⁷⁰ and 1 reported no significant results.⁹⁵ Townsend *et al.* (2001) focused their regression analysis on women after finding that food insecurity was related to overweight in women ($p < 0.0001$) but not

men ($p=0.44$) in bivariate analysis.⁸³ In this study, women classified as mildly food insecure were at an increased odds of being overweight [OR=1.3, $p=0.0050$] but no significant differences were reported among the moderately or severely food insecure. Similarly, Adams *et al.* (2003) reported that food insecurity without hunger was associated with increased odds of obesity in non-Hispanic white women [OR=1.36, $p<0.05$] and others [OR=1.47, $p<0.05$]; whereas food insecurity with hunger was associated with increased odds of obesity for Asians, Blacks and Hispanics [OR=2.81, $p<0.05$] but not for non-Hispanic white women [OR=0.82, $p>0.05$].⁸⁴

VanEenwyk & Sabel (2003) reported that adults (not just women) who were food insecure were more likely to be obese than those who were food secure [OR=1.29; 95% CI (1.04,1.83)].⁸⁶ Most recently, Kaiser *et al.* (2004) found that women who were food insecure with hunger were significantly more likely to be obese using two different food insecurity scales [OR=1.98, $p=0.03$ (10-Item scale); OR=2.41, $p=0.02$ (4-Item scale)]; no significant differences were reported among those classified as food insecure without hunger.⁸⁵

Vozoris & Tarasuk (2003) found that after adjusting for potentially confounding factors, the only association that remained significant was that men in food-insufficient households were less likely to be overweight [OR=0.7, 95% CI (0.5, 0.9)].⁷⁰

Frongillo *et al.* (1997) reported no significant results in the logistic regression analysis but reported that household food insecurity in women was positively associated with BMI in linear regression analysis; the p -value was marginally non-significant at the 0.05 level of significance [Beta-coefficient = 2.27, $p=0.06$].⁹⁵

Of the 2 studies using logistic regression which modeled food insecurity as the outcome with BMI as the independent variable of interest in predicting food insecurity, 1

reported a curvilinear relationship between food insecurity and BMI⁸⁷ and 1 reported no significant results.¹⁰² Sarlio-Lahtennekorva & Lahelma (2001) found that adults who were underweight were more likely to report fears of running out of money to buy food and severe food insecurity [OR=1.6, 95% CI (1.1, 2.2) and OR=2.0, 95% CI (1.2, 3.4) respectively]; similarly, those who were obese were also more likely to report fears of running out of money to buy food [OR=1.4, 95% CI (1.1, 1.9)].⁸⁷ Laraia *et al.* (2004) reported no significant association between morbid obesity and food insecurity among adults after adjusting for confounding variables; sex did not modify the relationship.¹⁰²

Of the 2 remaining included studies, primary analysis was based on a simple comparison of the prevalence of overweight and/or obesity by food security status.^{88, 89} Basiotis & Lino (2002) found that a significantly higher percentage of women in food insufficient households were overweight compared to those in food sufficient households (58% vs. 47%, no measure of statistical stability reported).⁸⁹ Recently, Harrison *et al.* (2005) reported that women in food-secure households had an average BMI of 26.8 vs. 28.2 and 28.4 among women in households reporting food insecurity with and without hunger respectively (results significantly different at $\alpha=0.05$).⁸⁸

The considerable diversity in populations and the inconsistencies in measures of food insecurity and BMI in addition to the inconsistencies in statistical methods (including various methods of controlling for potential confounders) precluded the pooling of outcomes for this review (see table 3.1 and 3.2). As such, no summary measure of effect is presented nor is a forest plot.

Table 3.2: Individual Study Results

Study	Main statistical analyses conducted and presented	Reported measures of association & associated measure of statistical stability (where possible, only Odds ratios (OR) are presented)	Methods used to control for confounding during data analysis
Adams <i>et al.</i> 2003 ⁸⁴	<ul style="list-style-type: none"> Prevalence of Obesity by food security status and race/ethnicity Logistic regression was used to model the relationship between Food Insecurity and Obesity 	<ul style="list-style-type: none"> White, non-Hispanic race/ethnicity: Food insecure, hunger OR = 0.82 (0.57–1.55) Food insecure, no hunger OR= 1.36 (1.00–1.84)* Asian, Black and Hispanic race/ethnicity: Food insecure, hunger OR= 2.81 (1.84–4.28)* Food insecure, no hunger OR= 1.47 (1.07–1.94)* <p>95% Confidence Intervals (CIs) are presented * P < 0.05, Significant result</p>	<p>Variables included in the model:</p> <ul style="list-style-type: none"> Income Age Race/ethnicity Education Country of birth Walking status General health status
Basiotis and Lino. 2002 ⁸⁵	<p>Method of analysis is unclear:</p> <ul style="list-style-type: none"> Prevalence of overweight and obesity was calculated by food sufficiency status. Mean BMI was calculated by food sufficiency status. 	<ul style="list-style-type: none"> A significantly higher percentage of women in food insufficient households were overweight compared to those in food sufficient households (58 vs. 47 %). No significant differences in terms of mean BMI or percent obese between women in food insufficient vs. sufficient households. 	<ul style="list-style-type: none"> None reported
Frongillo <i>et al.</i> 1997 ⁸⁵	<ul style="list-style-type: none"> Linear and logistic regression analyses were used to model the relationships between food insecurity and BMI and food insecurity and obesity (BMI >29kg/m²) respectively. 	<p>No measure of statistical stability was reported.</p> <ul style="list-style-type: none"> <i>Linear Regression:</i> Household food insecurity was positively associated with BMI (coefficient=2.27, p=0.06). The coefficient for Individual Food Insecurity was 0.07 (p=0.96). <i>Logistic Regression:</i> Household food insecurity: (coefficient = 0.17, p=0.61) Individual Food Insecure: (coefficient = -0.31, p=0.45) 	<p>The following variables were included in the regression model for all levels of food insecurity:</p> <ul style="list-style-type: none"> Height Income Education Single parent Employed <p>Each level of food insecurity (household, individual and child hunger) was kept in the model simultaneously.</p> <ul style="list-style-type: none"> None reported
Harrison <i>et al.</i> 2005 ⁸⁸	<ul style="list-style-type: none"> Comparison of average BMI among low-income adults in households reporting food insecurity vs. household not reporting food insecurity. 	<ul style="list-style-type: none"> In CHIS 2003, low-income women in food-secure households had an average BMI of 26.8 vs. 28.2 and 28.4 among women in households reporting food insecurity with and without hunger respectively (significant at alpha= 0.05). No significant differences were noted among men. No numerical data available in report for 2001 CHIS. 	

Study	Main statistical analyses conducted and presented	Reported measures of association & associated measure of statistical stability (where possible, only Odds ratios (OR) are presented)	Methods used to control for confounding during data analysis
Kaiser <i>et al.</i> 2004 ⁸⁵	<ul style="list-style-type: none"> The relation of maternal BMI to food insecurity and demographic variables was analyzed using the Person product-moment correlation for continuous variables and the Mantel-Haenszel chi-square test for ordered categorical variables. Logistic regression was used to model risk factors for obesity. 	<ul style="list-style-type: none"> 10-item adult scale Food insecure –ORs for Obesity (Without hunger) OR = 1.16 (0.81, 1.73) (With hunger) OR=1.98 (1.14, 3.53) p=0.03* 4-Item adult subscale Food insecure-ORs for obesity (Without hunger) 1.25 (0.86, 1.82) (With hunger) 2.41 (1.23, 4.74) p=0.02* <p>No significant differences in weight status by prevalence of food insufficiency</p> <p>95% CI's are presented with p-value in some cases. * Significant result</p>	<p>Several confounding variables were strongly correlated; a hierarchical approach was used to select the best model to predict maternal weight.</p> <p>Confounding variables included in final model:</p> <ul style="list-style-type: none"> Parity Years spent in the United States Per capita income
Laraja <i>et al.</i> 2004 ¹⁰²	<ul style="list-style-type: none"> Logistic regression was used to regress concern about enough food onto the dichotomous variable, morbidly obese. Analysis stratified by sex 	<p>Adjusted relative risk of reporting concern over having enough food to eat by morbid obesity status:</p> <ul style="list-style-type: none"> Louisiana: 1.52 (0.76, 3.02) New York: 1.54 (0.84, 2.83) Sex did not modify relationship <p>95% CI's are presented</p>	<p>Variables included in final model:</p> <ul style="list-style-type: none"> Education income race/ethnicity marital status general health
Sartio-Lahteenkorva and Lahtelma 2001 ⁴⁷	<ul style="list-style-type: none"> Logistic regression was used to model BMI groupings as independent variables to predict food insecurity, using each of the single item questions and the summary scale of severe food insecurity as outcome variables. 	<p>BMI <20kg/m²</p> <p>Outcome modeled:</p> <ul style="list-style-type: none"> Fears of running out of food of money to buy food OR=1.6 (1.1-2.2) Severe food insecurity OR=2.0 (1.2-3.4) <p>BMI ≥ 30kg/m²</p> <p>Outcome modeled:</p> <ul style="list-style-type: none"> Fears of running out of food of money to buy food OR=1.4 (1.1-1.9) <p>95% CI's are presented (only significant OR's are reported here)</p>	<p>Variables included in final model:</p> <ul style="list-style-type: none"> Age Educational attainment Sex Economic Disadvantage
Townsend <i>et al.</i> 2001 ⁸³	<ul style="list-style-type: none"> ANOVA and Tukey's test for pairwise differences was used to analyze differences among food insecurity categories by overweight status. Linear regression was used to determine which 	<p>In the bivariate analysis, food insecurity was related to overweight in women (p<0.0001), but not in men (p=0.44).</p> <p>OR's were reported for each category of food insecurity for</p>	<p>Variables included in final model:</p> <ul style="list-style-type: none"> Ethnicity Age Education

Study	Main statistical analyses conducted and presented	Reported measures of association & associated measure of statistical stability (where possible, only Odds ratios (OR) are presented)	Methods used to control for confounding during data analysis
	<p>variables best predict overweight and logistic regression was used to predict the probability of being overweight.</p>	<p>women only: Mild OR=1.3 (1.08, 1.52) p=0.0050* Moderate OR=1.5 (0.90, 2.61) p=0.1180 Severe OR=0.39 (0.05, 2.83) p=0.3530</p> <p>95% CI's are presented with corresponding p-values. * Significant result</p>	<ul style="list-style-type: none"> • Food stamp participation • Vigorous exercise levels • Television/widco game use (hours/day) • Income (Continuous)
VanEenwyk and Sabel, 2003 ⁸⁶	<ul style="list-style-type: none"> • Logistic regression was used to model the relationship between Food Insecurity and Obesity 	<p>OR= 1.29 (1.04-1.83)</p> <p>95% CI's are presented</p>	<p>Variables included in the model:</p> <ul style="list-style-type: none"> • Income • Education
Vozoris and Tarasuk, 2003 ⁷⁰	<ul style="list-style-type: none"> • Logistic regression was used to examine the relationship between household food insufficiency and BMI. For BMI all models were stratified by sex. 	<p>Men:</p> <p>Underweight: OR =1.3 (0.5-3.2) Normal weight : OR =1.2 (0.9-1.6) Overweight: OR =0.7 (0.5-0.9)* Obesity: OR =1.2 (0.8-1.8) Morbid Obesity: OR = 1.2 (0.7-2.0)</p> <p>Women:</p> <p>Underweight: OR= 1.0 (0.7-1.6) Normal weight : OR =1.0 (0.8-1.2) Overweight: OR=1.2 (0.9-1.5) Obesity: OR=0.9 (0.7-1.2) Morbid Obesity: OR= 0.8 (0.5-1.4)</p> <p>95% CI's are presented * Significant result</p>	<p>Variables included in the model:</p> <ul style="list-style-type: none"> • Age group • Education level • Income adequacy • Functional health

3.5 Discussion

While the results of this systematic review are not definitive in terms of the relationship between food insecurity and BMI, taken together, the evidence suggests that food insecurity may be positively related to overweight/obesity, particularly among women. Six of the 10 included studies found a significantly positive association between overweight/obesity and/or BMI and food insecurity in at least one sub-group analysis.^{83-86, 88, 89} Moreover, 1 additional study found a positive association between household food insecurity and BMI among women, but the association was marginally non-significant (P=0.06).⁹⁵ Two further studies reported unadjusted results in support of a positive relationship between obesity and food insecurity, 1 among adults¹⁰² and 1 in women⁷⁰, but these associations became non-significant after controlling for several potential confounding factors in the analysis. However, the latter study also reported that food insecure men were significantly less likely to be overweight.⁷⁰ Finally, 1 study reported a curvilinear relationship between food insecurity and BMI such that individuals reporting food insecurity were significantly more likely to be both underweight and obese.⁸⁷ The fact that the results vary to some extent may be due to differences between studies, including differences in the study population, sample size, food security measurement, definitions of BMI cut-points denoting overweight and obesity, and control of potentially confounding variables.

3.5.1 Limitations

While no previously validated method of quality assessment was available for this review, several limitations at the study-level are worth discussing. All 10 of the included studies were cross-sectional studies with data from the two major constructs collected at the same point in time. As a result, all results are constrained in specifying the direction of

causality between food insecurity and BMI. In order to consider the temporal sequence of these two constructs, longitudinal data would be required. Methods of food insecurity measurement were not all reportedly validated and several studies relied on self-reported height and weight to ascertain BMI. This method of BMI ascertainment is subject to reporting bias; several population based surveys in Canada have revealed that BMI is higher, on average, when ascertained through measured vs. self-reported data.³¹ In addition, many of the potentially confounding variables included in the analyses, for example, indicators of physical activity, were not previously validated measures. Results of individual studies may have been affected by unmeasured confounders; however, confounding is not likely to explain the observed association between food insecurity and BMI across all studies collectively, as several confounding variables were considered in the majority of included studies. Furthermore, differences in income do not account entirely for observed differences in BMI across food security groups as 8 of the included studies in this review controlled for income in their analysis.^{70, 83-87, 95, 102}

Because many studies used random-digit dialling or convenience sampling methods, the results of these studies can not necessarily be generalized beyond those populations who would have had equal opportunity of being sampled. Moreover, population level data does not usually capture the most severely disadvantaged individuals (e.g those living on reserves or who are homeless or without a telephone), thus; food insecurity was likely underestimated in several of the included studies. As well, 8 of the 10 included studies were conducted in the United States, such that the generalizability of the results beyond the US population is unclear.

Beyond study-level limitations, several review-level limitations were identified. The initial search was restricted to English language publications due to a lack of time and resources available for translation. However, had this restriction not been imposed, only an additional 61 studies would have surfaced in the initial search (less than an additional 5%); a majority of these studies would likely have been irrelevant given the yield from the English-language studies identified and our focus on high-income countries. In addition, there is evidence that English language restrictions do not change the results of systematic reviews in conventional medicine.¹²³

Publication bias may also have affected the results of this review. Due to inconsistencies across studies a quantitative synthesis of the data was not feasible thereby precluding a quantitative assessment of publication bias. While unpublished data were sought indirectly through dissertations included in the PsychINFO database, through contact with content experts (LD, MT, CO) and through reference searching, it is possible that other eligible studies have been conducted, but that these were not published. Evidence based on meta-analyses from randomized control trials suggests that the exclusion of grey literature may lead to exaggerated estimates of effects.¹²⁴ It may or may not be reasonable to extrapolate these findings to observational studies; nonetheless, this point is worth considering when interpreting the results of this review. Additionally, 1 study has reported that only about half of the studies presented as summaries or abstracts at professional meetings are subsequently published and that an important factor influencing full publication is the presence of significant findings.¹²⁵ This review included 3 studies found in the grey literature through reference searching,^{88, 89, 95} 2 of which reported significant

findings though these results were based on a simple comparison of the prevalence of overweight/obesity by food security status.^{88, 89}

The inability to fully critically evaluate the quality of the included studies is an additional limitation of this review. To our knowledge, no validated method of quality assessment was available for cross-sectional study designs. Therefore, very little information is reported with regards to our quality assessment checklist.

Finally, one major limitation of this review is that a single reviewer (MM) completed the majority of this review. Despite having a set of inclusion/exclusion criteria defined a priori; this may have led to selector bias, i.e the reviewer may have been biased in the selection of studies for inclusion. A second reviewer working independently would have minimized the risk of this bias. In an effort to minimize errors, 2 reviewers (MM, LD) reviewed all data abstraction information.

3.6 Update: Discussion of additional relevant studies published since the undertaking of the systematic review

In order to provide the most comprehensive and up to date review of publications in the area of research under investigation for this thesis project, we systematically updated earlier findings of this systematic review by replicating the search strategy in April 2007; the only difference in this second search was that an additional limit was added: the date of publication was restricted to 2006 onwards (the assumption here is that any relevant studies published prior to 2006 would have surfaced in the original systematic review). While the same screening and eligibility criteria were applied to the studies uncovered in this search, we did not formally abstract data or conduct any quality assessments of the included studies, or document reasons for exclusion. The purpose of this section is simply to provide an

overview of any additional publications exploring the relationship between food security status and BMI since 2006.

The electronic database searches generated 192 citations, including 48 duplicates, resulting in the identification of 148 unique citations for the initial screening of titles and abstracts. Following the initial screening of titles, 3 potentially eligible studies were retrieved,^{120, 126, 127} of which one had previously been identified in the original systematic review but was excluded due to a discrepancy in reporting;¹²⁰ this discrepancy has since been resolved.

Inclusion/exclusion criteria were applied to these 3 reports and 2 met the eligibility criteria. Both studies were conducted in the United States; 1 of these studies was based on a cross-sectional study design,¹²⁶ and one was primarily a longitudinal study with a relevant cross-sectional component.¹²⁰ Each study is briefly summarized in turn. In addition, the third study, which would not technically be eligible for inclusion in the systematic review, is also summarized here given its particular relevance to the current study.¹²⁷

Holben and Pheley (2006) used a cross-sectional convenience sample of 2580 adults aged 18 and older from several poorer rural counties in the state of Ohio to study the relationship between diabetes risk and overweight/obesity in food insecure vs. food secure households.¹²⁶ Household food security categories were based on the U.S. household food security module and BMI was based on measured values of height and weight. Individuals with a BMI $\geq 25\text{kg/m}^2$ and $< 30\text{kg/m}^2$ were classified as overweight, and those with a BMI $\geq 30\text{kg/m}^2$ were classified as obese. Chi-square analysis was used to compare obesity status among the food secure and insecure and the student t-test was used to compare mean BMI between food secure and food insecure participants. The prevalence of obesity was greater

in the food insecure households compared to the food secure households (48.1% vs. 35.1%, $p < 0.001$), and the prevalence of obesity increased linearly with severity of food insecurity (χ^2 linear association, $p < 0.001$). In addition, in women, mean BMI was higher among food insecure households than in food secure households (30.8 vs. 29.1, $t_{1272} = -2.0$, $p = 0.04$).

The authors report their method of sampling (convenience sampling) as the main limitation of their study, as it is not likely generalizable. Other notable limitations include lack of control factors and the use of a cross-sectional survey.

Jones and Frongillo (2006) use data from the 1999 and 2001 Panel study of Income Dynamics (PSID) to evaluate whether or not participation in a food stamp program ameliorates the effects of food insecurity on weight change; they also briefly explore the relationship between food security status and BMI using data from the 1999 PSID.¹²⁰ Analyses conducted were based on 5303 women between the ages of 18 and 74. The main outcome of this study was weight change between 1999 and 2001, and weight and height were based on self-reported measures. Food security status was based on the U.S. household food security module; based on this module, women were classified as food secure or food insecure (i.e. food insecurity categories were collapsed due to small cell counts). Chi-square analysis was used to compare overweight/obesity status among food secure and food insecure households using the 1999 cross-sectional data set. Although the longitudinal analyses conducted would not technically be eligible for inclusion in the systematic review because weight change is based solely on kilogram differential and not BMI, to be thorough, and because these analyses are relevant to the current study, these results are also reported here. In the latter analyses, two regression models were used. The first was a lagged model which estimates the effect of changing food insecurity and changing food stamp program

participation (FSP) on subsequent weight change (controlling for potential confounders at baseline) and the second was a dynamic model used to estimate the effects of changing food insecurity and changing FSP participation, controlling for changing covariates and time-invariant covariates, on weight change. In these analyses, changing food insecurity status was measured based on a four-category variable created to denote whether the household was persistently food secure, became food secure, became food insecure or was persistently food insecure.

Based on the cross-sectional analyses, women who were food insecure were more likely to be overweight than women who were food secure (61.3% vs. 56.7%, chi-square=30.1, $p < 0.0000$). However, in the longitudinal analyses, the only significant finding with respect to food security status and weight change was that women who were persistently food insecure tended to lose weight over time (average of 7kg).

The two primary limitations discussed in this study are the use of a dynamic model rather than a fixed-effect model and the fact that body measurements were self-reported.

Using the same sample as above, Jones and Frongillo (2007) published a second set of analyses.¹²⁷ The purpose of the second analysis was to examine the relationship between food insecurity and subsequent weight gain in women. The main outcome was self-reported weight gain defined as 2.3kg or greater over the 2 year period between rounds of survey data collection; this definition was selected based on the literature. A categorical variable was created to indicate initial weight status and was based on BMI. Women were classified as having “healthy weight” at baseline if their BMI was less than $25\text{kg}/\text{m}^2$, as overweight if their BMI was greater than or equal to $25\text{kg}/\text{m}^2$ but less than $30\text{kg}/\text{m}^2$ and obese if their BMI was equal to or exceeded $30\text{kg}/\text{m}^2$. Food security status was again based on the U.S.

household food security module; based on this module, women were classified as food secure or food insecure (i.e. food insecurity categories were collapsed due to small cell counts). Several different, yet complementary, sets of analyses were carried out. The authors calculated crude and adjusted probabilities of being classified as a weight gainer and logistic regression was used to predict the odds of being a weight gainer according to baseline food security status. In addition, crude and adjusted mean weight changes were calculated by baseline food security status and initial weight category for women who were classified as weight gainers; to test for mean differences in weight gain, t-statistics were calculated. Finally, multiple linear regression was used to control for covariates including: age, race/ethnicity, self-rated health, physical activity, smoking status, alcohol consumption, presence of a young child, income, marital status, and housing status.

Results indicated that regardless of initial weight status, food insecurity was not associated with statistically significant subsequent weight gain in women. More specifically, among food-insecure women, the probability of reporting a weight gain of 2.3 kg or more was highest in women who were classified as 'healthy weight' at baseline (32%), followed by obese (29%) and overweight women (25%). On the other hand, among food-secure women, the probability of reporting a weight gain was highest in women who were obese at baseline (33%), and similar in women who were a healthy weight (29%) and overweight at baseline (27%). Examining weight gainers independently showed that those who food insecure and overweight at baseline experienced less additional weight gain than those who were food-insecure and not overweight at baseline (difference=3.9kg, $p<0.02$). Consistent with the unadjusted findings, in the adjusted models, being food insecure at baseline was not

associated with significant weight gain in the following 2 year period. The main limitation reported in this publication was the use of self-reported height and weight.

3.7 Conclusions

Based on cross-sectional analyses, the updated findings of this systematic review support our original systematic reviews results which suggested that there is a positive relationship between food insecurity and overweight/obesity, particularly in women. However, neither of the two longitudinal analyses provided any evidence that food insecurity leads to overweight/obesity. In fact, one longitudinal study found that persistently food-insecure women tend to lose weight over time.¹²⁰ Notably, all three of the more recently published studies were also based in the United States. Despite the fact that two longitudinal studies published thus far do not support a causal relationship between food insecurity and overweight/obesity, the authors of these studies caution that more research of this nature, using more rigorous methods (e.g. measured height and weight and more measurement points over time) is needed.^{120, 127}

Chapter 4: STUDY PURPOSE, OBJECTIVES, RATIONALE AND CONCEPTUAL FRAMEWORK

4.1 Overview of Chapter 4

Results from the systematic review presented in Chapter 3 show that, despite several previous studies of the relationship between food insecurity and overweight/obesity, this potential relationship has not been explored in depth in the Canadian population. Indeed, only two Canadian studies thus far have explored the relationship between food insecurity and BMI. These two studies were both based on data from the National Population Health Survey which used self-reported height and weight, and in both cases the authors were interested in the relationship between food insecurity and several potential health problems.^{65, 70} The results were inconsistent; Che and Chen (2001) reported that food-insecure individuals had significantly greater odds of being obese, whereas Vozoris and Tarasuk (2003) found that after adjusting for potentially confounding factors, the only association that remained significant was that men in food-insufficient households were less likely to be overweight.^{65, 70} Only the latter study met inclusion criteria for the systematic review. This systematic review also indicated that results are inconsistent when explored by sex and that no studies have explored the impact of family type (i.e one's role in the household) on the potential relationship between food insecurity and overweight/obesity.

Furthermore, many studies conducted to date on this topic, including both Canadian studies, have important limitations related to the measurement of key variables. Most notably, methods of food insecurity measurement were not all reportedly validated and most studies have relied on self-reported data to ascertain BMI.

This brief chapter outlines the overall purpose for this thesis research (section 4.2), the specific study objectives (section 4.3) and a conceptual model depicting the potential relationship between food insecurity and BMI (section 4.4).

4.2 Study purpose

The overall purpose of this thesis was to generate new knowledge regarding the relationship between food insecurity and overweight/obesity among adults so as to inform future research in this area and to assist researchers and policy-makers in determining the most appropriate interventions, programs and policies. This thesis had two specific objectives that contributed to this overall purpose (section 4.3).

4.3 Study objectives

4.3.1 Objective 1

The first objective was to determine if food insecurity is related to overweight/obesity in a nationally representative sample of the Canadian population, and if so, to determine whether or not this relationship differs by sex and by family type.

Primary research hypothesis: Food insecurity is positively related to overweight/obesity in women.

Secondary research hypothesis: Family type will modify the relationship between food insecurity and overweight/obesity in both men and women; specifically, food-insecure respondents with children will have greater odds of being overweight/obese than food-insecure respondents without children.

To evaluate these hypotheses we analyzed data from the Canadian Community Health Survey Cycle 2.2 (2004), a recent nationally representative cross-sectional survey collecting health information from Canadian adults. This survey included a validated measure of food

insecurity and a calculation of BMI based on measured height and weight. Objective 1 is addressed in Chapter 5 (methods) and Chapter 6 (results).

4.3.2 Objective 2

The second objective of this thesis was to describe policies, programs, and initiatives (in place and recommended) targeting food security in Canada, focusing on food security and healthy weights where possible.

Specifically, we used an environmental scan to: (i) identify key Canadian articles and documents that discuss policies related to food security (and in relation to healthy weights where possible); (ii) highlight new or existing policies, programs, or initiatives in Canada with a stated objective of addressing food security; and (iii) highlight key points of debate on new or existing policies and programs targeting food security. Objective 2 is addressed in Chapter 5 (methods) and Chapter 7 (results).

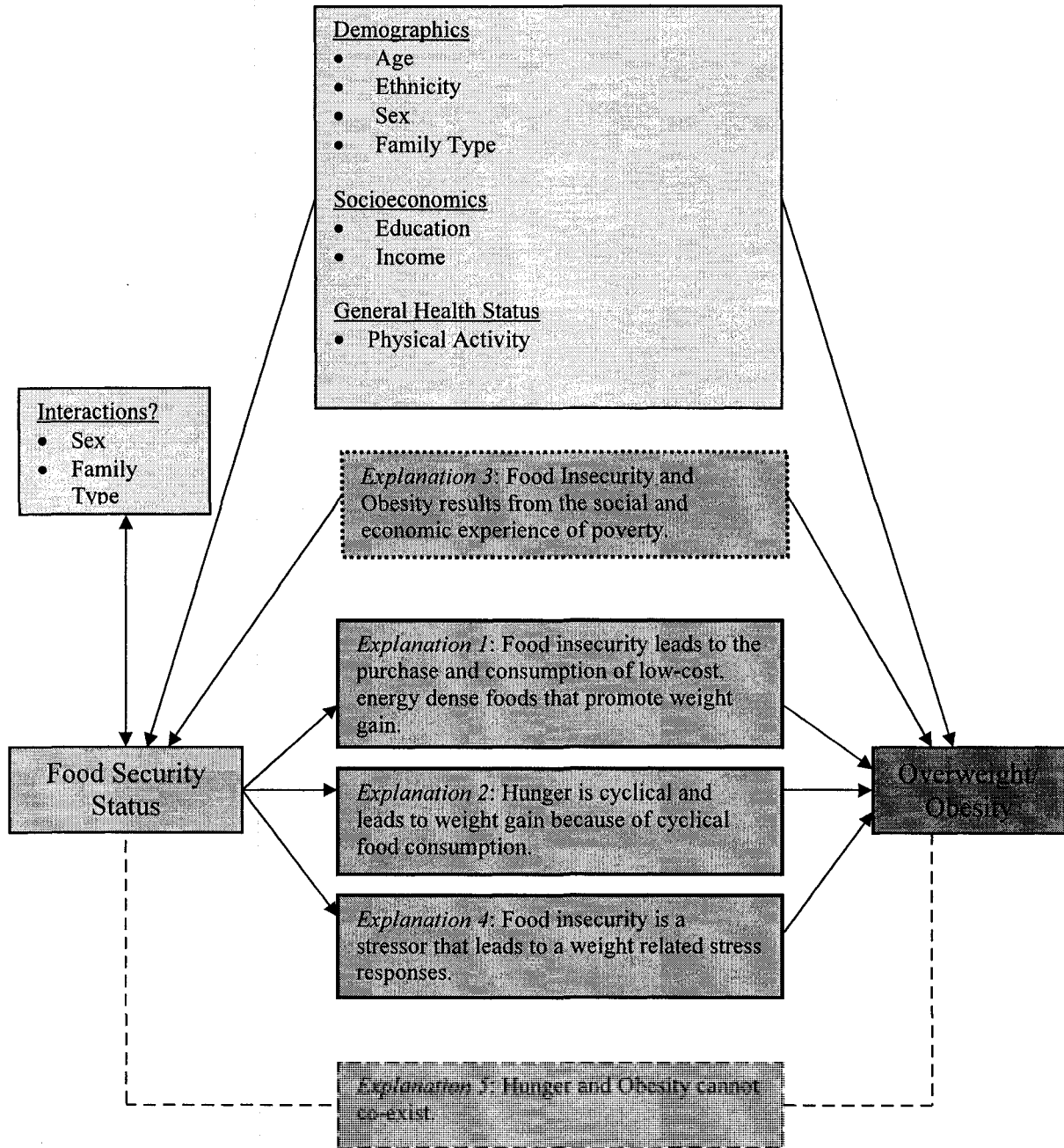
4.4 Conceptual model guiding research

The following conceptual model has been adapted for this thesis, with permission, from a theory-informed model put forth by Townsend *et al.* (2001) (Fig 4.1, Appendix J).⁸³ The adaptations made are based on the results of the literature review presented in Chapter 2 and the systematic review presented in Chapter 3. According to this model, food security status influences BMI through one of many explanations or through a combination of explanations. Food security status and BMI may be influenced by age, sex, family type, ethnicity, education, income which may be considered potential confounding factors in studying the relationship.

It is beyond the scope of this study to evaluate these explanations, identifying the specific factors that may act as mediators in the relationship between food insecurity and

overweight/obesity. Rather, the focus of the current study is to broadly explore this relationship, using measured height and weight data, and to explore the possible interactions between sex, family type, food insecurity and overweight/obesity. The conceptual model and explanations are important, though, in terms of guiding the inclusion of potential confounding variables in the analyses; and in terms of providing a perspective for interpreting the thesis findings, identifying how they relate to this developing body of research.

Figure 4.1: Conceptual framework describing the relationship between food insecurity and overweight and obesity



4.5 Summary

Chapters 2 and 3 of this thesis demonstrate that the hypothesized relationship between food insecurity and overweight/obesity comprises a socially relevant and potentially rich area of research.⁹¹ This is a unique project because it is the first study of this

nature to explore, in detail, the relationship between food insecurity and overweight/obesity by sex and by family type using a nationally representative sample of the Canadian population (CCHS 2.2, 2004). Moreover, overweight/obesity data in the CCHS 2.2 (2004) are based on actual measured height and weight (vs. self-reported), using a standardized protocol. The latter aspect is especially important given that both Canadian studies conducted to date on this topic were based on self-reported height and weight which is likely to be biased, in terms of consistently underestimated rates of overweight and obesity.^{25, 31, 65, 70}. In addition, we will explore this relationship by family type, hypothesising that respondents with children who report food insecurity would be more likely than food-insecure respondents without children to be overweight/obese. The rationale for this secondary hypothesis, based on our interpretation of the findings of our literature review (Chapter 2), is that food-insecure parents might sacrifice their own nutritional well-being for their children, putting them at an even greater risk for a poor diet and cyclical eating (Explanation 2).

Finally, the policy relevance of this study will be enhanced by an environmental scan of policies, programs and initiatives in Canada addressing food security; and where possible, food security and healthy weights. This scan will provide a policy context through which we can interpret our analytic findings from the CCHS 2.2 (2004) and it will also serve as stand alone document that can provide part of the information base for the development of plans and actions to reduce food insecurity in Canada.

Chapter 5: STUDY METHODS

5.1 Overview of Chapter 5

In this Chapter, we present the methods used in our analysis of the CCHS 2.2 (2004) and in our environmental scan of policies, programs and initiatives targeting food security in Canada. Specifically, section 5.2 provides an overview of the CCHS 2.2 [such as sample characteristics and sample design (section 5.2.1)] and the survey measures used to analyze the relationship between food insecurity and overweight/obesity in the Canadian population (section 5.2.2). In section 5.3, we provide a detailed discussion of our approach to the analysis of data from the CCHS 2.2 (2004). This section discusses the implications for data analysis when using a complex survey design (section 5.3.1), discusses the weighting strategy and our adjustment for differential representation (section 5.3.1.2) and discusses our adjustment methods for the design effect in variance estimation through the use of the bootstrapping technique (section 5.3.1.3). Finally, section 5.4 outlines the methods we used for our environmental scan and includes details on eligibility criteria (section 5.4.1), our search strategy (section 5.4.2) and our document selection (section 5.4.3).

5.2 Food insecurity and overweight/obesity in the Canadian population: Analysis of the Canadian Community Health Survey-Nutrition Cycle 2.2 (2004)

5.2.1 Overview of the CCHS 2.2: sample and sampling design^c

The Canadian Community Health Survey-Nutrition (CCHS, Cycle 2.2, 2004) was developed by Statistics Canada in consultation with an expert advisory group. It was designed to “provide reliable, timely information about dietary intake, nutritional well-being

^c Unless otherwise specified, all information provided about the CCHS survey content and design is based on the following three references:

1. Statistics Canada. Canadian Community Health Survey, Cycle 2.2-Nutrition (2004). Detailed Information for cycle 2.2. 2004.¹²⁸
2. Statistics Canada. Canadian Community Health Survey, Cycle 2.2-Nutrition (2004). Overview, Survey Design, Content and Data Availability: 24-Hour Dietary Recall Component, General Health Component. 2005.¹²⁹
3. Statistics Canada: Canadian Community Health Survey 2004. User Guide for the Public Use Microdata file. 2005.¹³⁰

and their key determinants to inform and guide programs, policies, and activities of federal and provincial governments and local health agencies” (p.4).¹³⁰ The survey’s main objectives included:

- “estimating the distribution of usual dietary intake in terms of foods, food groups, dietary supplements, nutrients and eating patterns among a representative sample of Canadians at national and provincial levels;
- gathering physical measurements for accurate body weight assessment;
- measuring the prevalence of household food insecurity,
- collecting data on selected health conditions and socio-economic and demographic characteristics of respondents.” (p.4).¹³⁰

The resulting survey consists of two distinct, yet complementary parts: (1) the **general health** component, and (2) the **24-hour dietary recall** component. All of the necessary data for this thesis are found in the general health component which collected information on the respondent’s general health status, including food insecurity and physical height and weight measurements, along with various socio-demographic characteristics.

The CCHS 2.2 is based on a complex multistage sampling scheme and includes a sample of Canadian residents of all ages living in private occupied dwellings in all Canadian provinces. Individuals residing in the territories, on Crown Lands as well as individuals who were institutionalized, on-reserve Aboriginals, full-time members of the Canadian Forces and residents of certain remote areas (e.g. some regions in northern Ontario and northern Quebec) were not included in the sample.

A two-step strategy was used to allocate the sample: (1) 80 sample units (individuals) were allocated to provide representative estimates by dietary reference intake

(DRI)^d by age/sex group for each province and, (2) the remaining units were allocated to provinces using a power allocation scheme where the power (q) = 0.7 (except Prince Edward Island [P.E.I.]). Please refer to Table 5.1 for targeted sample size details. The provincial samples were subsequently stratified into two strata, urban and rural, by proportionately allocating the strata based on the number of dwellings in each stratum. This was done to ensure a good urban and rural representation. Sample sizes were subsequently enlarged, based on the out-of-scope rate and non-response rates from previous cycles of the CCHS, before data collection; this served to account for very remote and empty dwellings as well as non-response.

Table 5.1: Targeted sample size by province

Province	1 st step 80/domain	2 nd step power q=0.7	Total sample
Newfoundland & Labrador	1,120	542	1,662
Prince Edward Island	1,120	0	1,120
Nova Scotia	1,120	837	1,957
New Brunswick	1,120	713	1,833
Quebec	1,120	3,744	4,864
Ontario	1,120	5,620	6,740
Manitoba	1,120	1,050	2,170
Saskatchewan	1,120	856	1,976
Alberta	1,120	1,996	3,116
British Columbia	1,120	2,442	3,562
Canada	11,200	17,800	29,000

After buy-in from Health Canada, Ontario, PEI and Manitoba, the final sample size was slightly more than 35,000. The purpose of the provincial and federal sample buy-ins varied somewhat, but the overall goal was to obtain sufficient sample sizes to provide reliable estimates for each province and for Health Canada's respective domains of interest.

^d DRIs are a set of scientifically based nutrient reference values used for planning and assessing the nutrient intakes of individual and population groups which vary by age and sex.

Further details can be found in the Statistics Canada, CCHS 2004 User Guide for the Public Use Microdata File.¹³⁰

Sampling of households was based on four different sample frames: the Labour Force Survey (LFS) area frame (an area frame), a list of CCHS 2.1 dwellings, and the P.E.I and Manitoba healthcare registries. The household sample from the LFS area frame was selected under a multistage stratified cluster design where the dwelling is the final sampling unit. In brief, sampling from this frame was based on the formation of homogeneous strata from which independent samples of clusters were selected from each stratum. Based on each selected cluster, dwelling lists were created from which dwellings, or households were selected. The original homogeneous strata were formed based on urban-rural characteristics as well other geographic and socioeconomic information. The sample of clusters within each stratum was created from census enumeration areas (the primary sampling units or PSUs) and was chosen by a random sampling method known as “probability proportionate to size” (PPS) where size refers to the number of households in the cluster. From the sampled clusters, systematic sampling was used to select dwellings, or households.

The area frame (LFS) was supplemented by a secondary frame in all provinces, except Manitoba and P.E.I., to increase the probability of sampling households with respondents aged 18 years of age or less. The secondary frame was created based on household information of respondents from the regional component of the CCHS cycle 2.1. The data from the CCHS 2.1 was used to create a list of dwellings in which there was at least one individual under the age of 18 years (or, in Ontario, at least one individual over 71 years). This list was subsequently stratified by province and urban/rural zone from which a sample of municipalities and/or cities was selected based on the PPS method; from this, a

sample of dwellings was selected based on systematic sampling. The data from the CCHS 2.1 was also used to create a list of dwellings where the selected respondent reported being Aboriginal. This list was used to meet the buy-in objectives of Health Canada: to obtain a larger sample of off-reserve Aboriginals.

To meet the buy-in objectives of P.E.I. and Manitoba, healthcare registries had to be used as supplemental sampling frames to the area frame rather than the list frame of CCHS 2.1 dwellings, which did not provide sufficient numbers in the younger age groups. These provinces provided Statistics Canada with a list of dwellings based on health care insurance cardholders, along with the household composition of these dwelling from which point the sampling method followed that of the list frame of the CCHS 2.1 dwellings. It is estimated that the sampling frames used for this survey covered 98% of the population residing in the provinces.

From the sampled households, selection of one individual respondent was based on a sampling strategy designed to meet specific requirements with regards to key areas of interest per province; probabilities of selection varied by age and by sampling frame. An optimal approach to individual respondent selection, one that would meet sample size requirements for all areas of interest for each respective province (for example, with DRI groupings in each province), was formulated from several scenarios using various parameter simulations to prevent extreme final sampling weights.

Trained Statistics Canada interviewers collected the majority of the data on a voluntary basis directly from survey respondents in person using a computer-assisted interviewing method. Initially, the interviewers gathered general household and demographic information from all selected dwellings after which only one household

member was randomly selected (as previously described) to be the survey respondent. Proxy reporting was only used when the selected respondent was under the age of eleven.

Overall, the survey achieved a 76.5% response rate over a 12-month data collection period spanning from January to December 2004 inclusively. Previous CCHS cycles have only collected self-reported height and weight whereas the survey cycle under investigation for this thesis attempted to take actual measurements for height and weight. A detailed description of the protocol used to ascertain these measurements can be found in the CCHS 2004 User Guide for the Public Use Microdata File (p. 26).¹³⁰ Despite the efforts of Statistics Canada, only 63% of respondents had their height and weight measured by interviewers; reasons for non-response varied and included: refusal, respondent not available, respondent too tall for the interviewer to measure, equipment problems and interview conducted over the telephone. To minimize the potential for non-response bias a special weight has been developed to be used with the measured height and weight information. This issue is discussed further in section 5.3.1.1.

For the purposes of these analyses a final sample derived from the CCHS 2.2 was generated to meet the following criteria: ≥ 18 years of age, measured height and weight data available, food security status data available, no missing data on all other key independent variables of interest and non-pregnant (please see survey measures section 5.2.2).

5.2.2 Survey measures

The variables to be examined in the analyses are of interest because of their hypothesized relationships to BMI or food insecurity, and are based on the adapted conceptual model presented earlier in this thesis (Chapter 4).

5.2.2.1 *Primary independent variable of interest:*

The measure of **Household food security status** used in this thesis is a derived variable based on a set of 18 questions which indicate whether households both with and without children were able to afford the food they needed in the previous 12 months; it captures 4 types of situations:

- 1- **Food secure:** Household members show no or minimal evidence of food insecurity.
- 2- **Food insecure without hunger:** Household members feel anxious about running out of food or compromise on the quality of foods they eat by choosing less expensive options. Little or no reduction in the household members' food intake is reported.
- 3- **Food insecure with MODERATE hunger:** Food intake for adults in the household has been reduced to an extent that implies that adults have repeatedly experienced the physical sensation of hunger. In most (but not all) food insecure households with children, such reductions are not observed at this stage for children.
- 4- **Food insecure with SEVERE hunger:** At this level, all households with children have reduced the children's food intake to an extent indicating that the children have experienced hunger. Adults in households with and without children have repeatedly experienced more extensive reductions in food intake.

The model for “household food security status levels” employed in this survey was adopted from the U.S. model of food security scale published by U.S. Department of Agriculture.¹⁸ The final set of 18 questions provide the indicator variables that underlie the standard measurement scale for severity of U.S. food insecurity and hunger; these 18 questions were selected based on extensive exploratory analyses, tests, validations, goodness-of-fit analyses and other properties needed in a reliable measurement scale.¹⁸ (Refer to section 1.6 for details on how food insecurity is measured).

For the purposes of the analyses presented in this thesis, the last two categories of food security status (food insecure with moderate and severe hunger) were collapsed due to small cell counts in accordance with Statistics Canada confidentiality and disclosure

regulations. Thus, three categories were analyzed here: Food secure, Food insecure without hunger and Food insecure with hunger (moderate and severe).

5.2.2.2 *Dependent variable of interest:*

The outcome of interest in this thesis was **Overweight and/or Obesity** and was based on **Measured Body Mass Index**. The **Measured Body Mass Index** was based on measured height and weight data and was derived by Statistics Canada, by dividing weight in kilograms by height squared in metres squared ($BMI = \text{kg}/\text{m}^2$), for respondents aged 18 and over, excluding pregnant women. From the BMI classification, the following categories were derived: underweight ($BMI < 18.5 \text{ kg}/\text{m}^2$), acceptable weight ($18.5 \leq BMI < 25.0 \text{ kg}/\text{m}^2$), overweight ($25.0 \leq BMI < 30.0 \text{ kg}/\text{m}^2$), or obese ($BMI \geq 30.0 \text{ kg}/\text{m}^2$). These BMI categories are based on those recommended by Health Canada and the World Health Organization.

Since the focus of this thesis was on the relationship between food insecurity and overweight/obesity, BMI was collapsed into two categories for the analyses: underweight/normal weight ($BMI < 25.0 \text{ kg}/\text{m}^2$) and overweight/obese ($BMI \geq 25.0 \text{ kg}/\text{m}^2$). This approach is consistent with other studies in this area of research (i.e. setting various cut-points depending on the exact relationship of interest).^{83, 85, 86, 95, 102}

5.2.2.3 *Independent variables used for sub-analysis:*

- **Sex** [male, female]
- **Family Type**

The derived variable, **Living/family arrangement of selected respondent-grouped** was used to create a “**Family Type**” variable to examine the relationship between family type (i.e one’s role in the household), food insecurity and BMI. The **Living/family**

arrangement variable identifies the family relationship between the selected respondent and the rest of the household as:

- Unattached individual living alone
- Unattached individual living with others
- Spouse/partner living with spouse/partner
- Parent living with spouse/partner and children
- Single parent living with children
- Various classifications for children

“**Family type**” categories were created for the purpose of these analyses by collapsing the 6 living/family arrangement categories available in the CCHS 2.2 into 3

“**Family Type**” suitable categories:

- Parent living with spouse/partner and children
- Single parent living with children
- Other (=Unattached individual living alone or with others or Spouse/partner living with spouse/partner)

These categories were created in attempt to explore whether or not one’s position in the household (single parent vs. other parent vs. all others) modified the relationship between food security and overweight/obesity.

5.2.2.4 *Other independent variables:*

- **Age** (18-24, 25-34, 35-44, 45-54, 55-64, and 65 years of age or older)
- **Cultural or Racial Origin**

This variable was based on a variable derived from a question asking respondents to indicate their cultural or racial origin. Using this derived variable, the following categories were created for analysis in this study: White, Black, Southeast/East Asian (Includes: Chinese, Filipino, Southeast Asian [e.g. Cambodian, Indonesian, Laotian, Vietnamese], Japanese and Korean); off-reserve Aboriginal (Aboriginal peoples of North America); and Other (South Asian [e.g. East Indian, Pakistani, Sri Lanka, Latin American, Arab, West

Asian [e.g. Afghan, Iranian] and other). Multiple responses across the categories defined here were coded to “Other.” These categories were created based on the literature review findings (chapter 2) and for comparison purposes with other studies of the CCHS 2.2 on obesity.²⁵

- **Education**

This variable was based on the derived variable **Highest Level of Education** which indicates the highest level of education attained by the respondent. Categories included: Less than secondary school graduation, secondary school graduation, some post-secondary and post-secondary graduation (includes college diploma, trade certificates and university).

- **Household Income**

This standard Statistics Canada derived variable classified the respondent’s total household income into five categories using information on total household income and the number of individuals living in the household (please see Appendix G for details): Lowest income, Lower middle income, Middle income, Upper middle income, Highest income.

- **Physical Activity Index**

Physical activity was measured by a CCHS 2.2 derived variable that categorized respondents as being “active”, “moderate” or “inactive” based on their total daily energy expenditure values (kcal/kg/day). Based on a series of detailed questions about respondents usual activities, energy expenditure during leisure time activities in the past three months was calculated using the frequency and duration per session of the physical activity as well as the metabolic equivalents (MET) value of the activity. The MET value of metabolic energy cost represents a multiple of the resting metabolic rate. While MET values are often expressed in three intensity levels, the CCHS did not ask respondents to specify intensity,

therefore, all MET values adopted correspond to the low intensity level.^e MET values are expressed in kilocalories per kilogram body weight per day (KKD). Based on these values, the following categories were created by Statistics Canada: inactive (<1.5KKD), moderate (1.5 - 2.9 KKD) and active (≥ 3.0 KKD).

5.3 Data analysis

Prior to discussing the data analysis strategy used in this study, several issues regarding the analysis of complex surveys first need to be addressed such as the importance of weighting and alternate methods of variance estimation.

5.3.1 Complex survey designs: implications for data analysis

Any survey sampling method that deviates from the use of simple random sampling with replacement (SRSWR), such as the CCHS 2.2, is considered to have a complex survey design.¹³¹ Analyzing complex survey data requires special analytic considerations because unlike SRSWR, the inclusion probability for the elements in a complex survey design may be unequal and the sampling unit can be different from the population element of interest.¹³¹ These differences complicate normal methods of estimation and variance calculation, and should be accounted for in the analyses to minimize bias in estimation and statistical tests.¹³¹ In particular, two main issues require consideration in the analysis of complex surveys: the need for sampling weights to account for differential selection probabilities and non-response, and the influence of the design and weighting adjustments on the variance measures for survey estimates.¹³²

^e This decision was adopted from the Canadian Fitness and Lifestyle Research Institute as evidence indicates that respondents tend to overestimate the intensity, frequency, and duration of their activities.

5.3.1.1 *Weighting: Adjusting for differential representation*

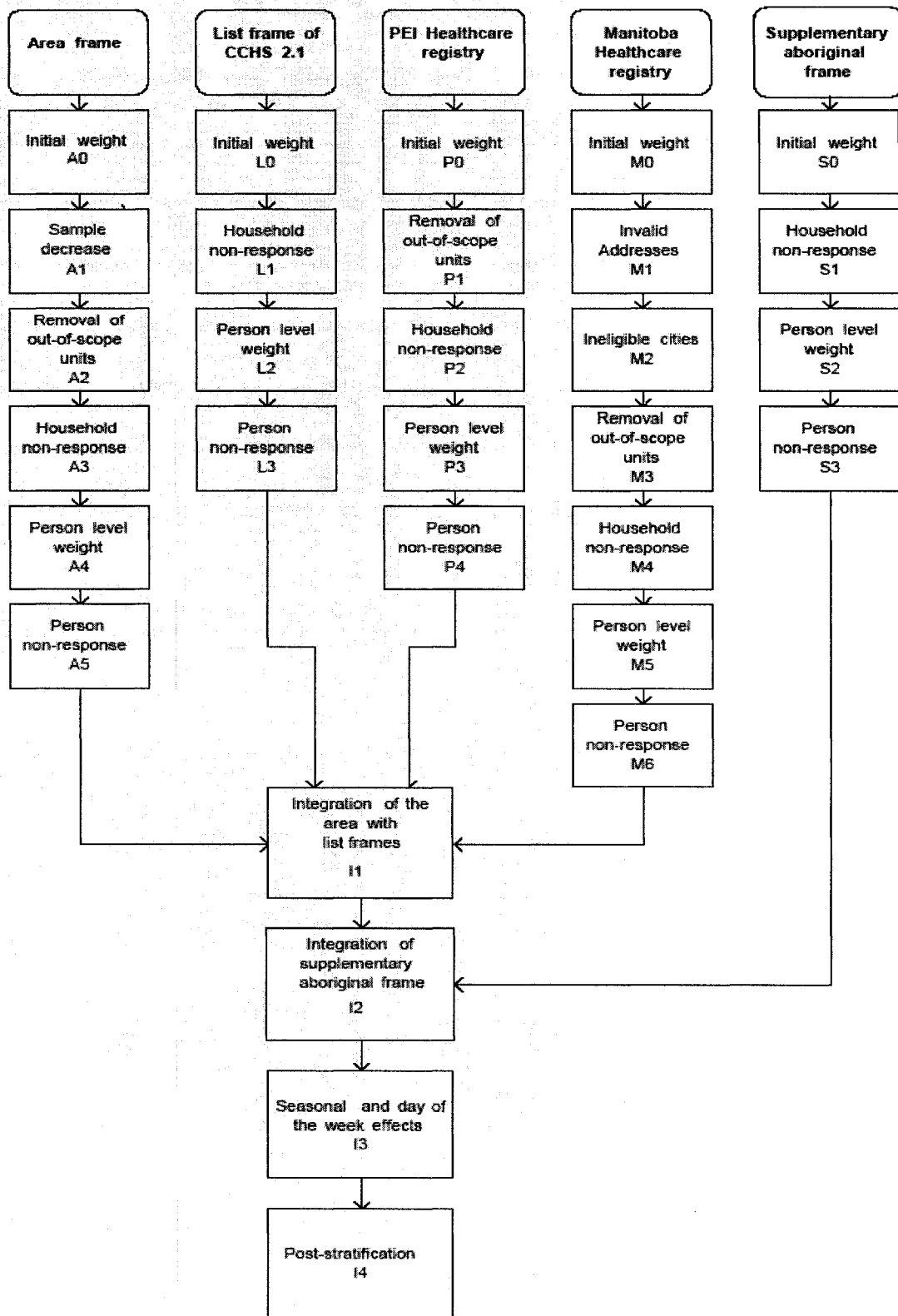
Sampling weights are used to reflect the fact that some members of the population are more likely to be sampled than others as survey respondents¹³¹; and thus, in order for the analyses to represent the target population and not just the sample itself, appropriate survey weights must be used in the analyses. The sample weight is the reciprocal of the respondent's selection probability.¹³¹ In the case of multi-stage sampling, a respondent's selection probability is obtained by multiplying the probabilities of selection at each stage.¹³³ This assumes the selection is independent at each stage and produces the same response rate. The sampling weight obtained is referred to as the base weight¹³³ or the expansion weight.¹³¹ The expansion weight can be further adjusted to correct for differential response rates within classes of the sample and to make post-stratification adjustments to improve the degree to which the distribution of demographic variables represents the known population of interest's distributions.^{131, 133}

Because extreme weights may greatly increase variance, the necessity of weighted analysis has been questioned by some authors.¹³² Korn and Graubard (1999) recommend assessing the impact of weighting on model efficiency; if the weighted analysis significantly increases the variance, it may be more appropriate to conduct an unweighted analysis incorporating design variables into the analysis instead.¹³³ However, due to the complexity of the CCHS, design variables are not available to analysts and therefore, survey weights must be used in the analysis, otherwise the analysis will result in biased parameter estimates.¹³²

In the case of the CCHS 2.2, the weight for each respondent is provided in the microdata file and it is highly recommended that it be used to derive accurate estimates from

the survey.¹³⁰ As previously described, several sampling frames were used to select respondents for the CCHS 2.2: an area frame (LFS), three list frames (Ontario, Manitoba, P.E.I), and a supplementary frame to reach more off-reserve Aboriginals.¹³⁰ It should be noted that for any given province only one list frame could be used. For weighting purposes, each frame was treated independently; weights for each frame were assigned based on the respondent's probability of selection into the survey; the survey weights were subsequently combined through "integration" and after post-stratification, resulted in the final weights.¹³⁰ During the integration phase, an adjustment factor was assigned to each sample based on the relative importance of that sample in the total sample. Adjustment factors ranged from 0 to 1 and were based on sample size and the design effect.¹³⁰ The value of the adjustment factor was directly related to the proportion a sample represented from the total sample and inversely related to the design effect (or variance).¹³⁰ Post-stratification was based on population estimates from the 2001 Census. The weighting scheme and calculations were extensive and complex and thus, details will not be presented here. A diagram of the overall weighting strategy provided by Statistics Canada is presented in Figure 5.1; further details on the weighting process can be found in the CCHS 2.2, User Guide for the Public Microdata File.¹³⁰

Figure 5.1 Weighting Strategy Overview



Given that this thesis uses BMI based on measured height and weight vs. self-reported measures, a more detailed discussion of the special weight assigned to this outcome variable is necessary. While the intent of this survey was to measure the height and weight of all selected respondents, as previously noted, several issues arose making this possible in only 63% of survey respondents. In order to account for the high non-response in this particular variable, a special weight was created for the sub-sample of respondents for whom measures were taken.¹³⁰ The weighting strategy for the measured height and weight variables is identical to that discussed above until step I3 in Figure 5.1; the weight here has been denoted as MHW0 (Initial Weight). At this point, respondents lacking measured height and weight data are temporarily removed and their respective sampling weights are redistributed to the respondents where measured data are available. To reduce the bias introduced by the removal of respondents without height and weight measurements, the sampling weights are redistributed within homogeneous respondent classes based on the probability of having the measurements or not. The CHAID (Chi-square Automatic Interaction Detector) algorithm, available in Knowledge seeker, was used to identify the best variables to create the homogeneous classes. The most common variables used in the creation of the classes were age, sex, income, education level and food intake patterns from the 24-hour dietary recall component of the survey; other variables associated with BMI were also used. Classes were created independently in each province except in Ontario and Manitoba, where they were created for the regions. An adjustment factor, equivalent to the ratio of the sum of weights MHW0 for all respondents to the sum of weights MHW0 for all respondents with body measurements, was then computed for each class. The MHW0 weight for each respondent with body measurements was multiplied by the resulting

adjustment factor to produce a new weight, MHW1 (weights for measures of height and weight). MHW1 was subsequently post-stratified using the same procedure described in the initial weighting procedure producing the final weights for respondents with body measures, MHW2. This was the final weight to be used in any analyses involving the measured height and weight BMI variables.¹³⁰

5.3.1.2 *Variance estimation: Adjusting for the design effect*

While the use of sampling weights in the analysis of complex survey data can yield unbiased estimates of population parameters, they often create inaccuracies in other statistical measures such as the variance estimates for the statistical parameters.¹³¹ Inaccuracies in the variance estimates for other statistical parameters will arise for two reasons.¹³⁴ First, when the expansion weight is used, the sample size will be inflated as it will be equal to the sum of weights.^{131, 134} To address this, the expansion weight can be rescaled (down) to produce the relative weight; this is obtained by dividing the expansion weight by the mean of the expansion weights.¹³¹ This method is discussed in the User Guide for the CCHS 2.2 under guidelines for statistical analysis¹³⁰ and provides a way of adjusting the sampling weights to ensure that when the relative sampling weights are incorporated, the sample size represents the true sample size of the survey.¹³¹

Second, the usual statistical methods estimate parameter variances based on the assumption that the observations under investigation are independent of one another; this is not the case in surveys based on cluster sampling. Individuals within clusters tend to be more similar to one another than individuals randomly selected from the population.^{131, 133} The intraclass correlation coefficient (ICC) measures the degree of correlation between individuals within a cluster and differs for different variables.¹³¹ The ICC would be equal to

zero if the variables within a cluster were truly random; whereas if all individuals within the cluster have the same value for each variable the ICC equals 1.¹³¹ In community and social surveys the ICC tends to be greater than zero for most variables, and is usually larger for SES variables in comparison to other variables. As a result, cluster sampling usually leads to larger sampling variances than would result from simple random sampling. The resulting loss (or gain) in precision due to the complex sample scheme must be considered and accounted for in the analyses.¹³¹ To do so, the *design effect* for any particular statistic, defined as the ratio comparing the variance of a statistic from the complex survey design to that of the statistic under SRSWR, must be considered.¹³¹

In the case of the CCHS, and other complex surveys, “the computation of exact coefficients of variation is not a straightforward task since there is no simple mathematical formula that would account for all CCHS sampling frames and weighting aspects” (p. 63) and therefore, other methods, based on resampling are advised to obtain meaningful estimates of measures of precision.¹³⁰

Several strategies are available for estimating the variance with complex survey data. The general techniques include *linearization* (the Taylor series method) and *replication or resampling*, which includes replicated sampling, balanced repeated replication (BRR), jackknife-repeated replication (JRR), and the bootstrap method.^{131, 133} The overall goal of the *replication* or *resampling* method is to facilitate the estimation of variances of parameter estimates¹³¹ and it generally involves calculating the parameter estimators repeatedly on different subsets of the data.¹³³ For each subset selected, an estimate of the variance is calculated.¹³¹ An estimate of the overall variance can be estimated from the variability of

each subset provided that the subsets were selected independently with equal probability of selection.¹³¹

In the case of the CCHS 2.2, Statistics Canada has recommended the bootstrap replication method for the computation of variance estimates.¹³⁰ In the bootstrap method, several replicate samples (or artificial data sets or subsamples), of the same size and structure as the original design, are selected by repeatedly resampling the PSUs from the original data set.^{131, 133} For data based on stratified multistage sampling, simple random samples (replicates) are generated by independently resampling the PSU with replacement from each stratum; this is the case with the resampling of the CCHS.^{128, 133} The number of PSUs sampled from each stratum is equal to one fewer than the number in the original sample.¹²⁸ The bootstrap method used by Statistics Canada adheres to the recommendation that sampling be repeated a minimum of 200 times (denoted as B);¹³¹ for the CCHS 2.2, B is equal to 500, producing 500 sets of bootstrap weights.¹²⁸

For each replicate, the survey weight is then recalculated for each respondent in each of the sampled PSUs.¹²⁸ Survey weights are then post-stratified following the same post-stratification procedure used to generate the sampling design weight resulting in the final bootstrap weights.¹²⁸ Based on these sampling weights, an estimate of the parameter of interest is calculated as is the variance among the replicate estimates resulting in the bootstrap variance estimate for the parameter from the original sample.¹²⁸ Researchers with access to the Carleton Ottawa Outaouais Local Research Data Centre (COOL RDC) are able to use a Statistics Canada Bootvar program that can perform all of these calculations by automatically applying the 500 sets of bootstrap replicate weights to obtain an estimate of the variance for each statistical parameter of interest.¹²⁸

5.3.2 Approaches to data analysis

All analyses involving the CCHS 2.2 in this thesis were carried out at the COOL RDC using the statistical software program SAS, version 9.1. Before describing the data analyses, several definitions are worth outlining as some may have alternate interpretations. In this document, the term “univariate” refers to the analysis of the distribution of 1 variable¹³⁵, the term “bivariate” refers to the analysis of the relationship between 2 variables¹³⁶ and the term “multivariate” refers to the analysis of the relationship between more than 2 variables.¹³⁵ With respect to regression analysis, in this document, the term “univariable logistic regression” refers to logistic regression analysis with 1 independent variable¹³⁷ and thus, is considered to be one specific type of “bivariate” analysis; whereas “multivariable logistic regression” refers to logistic regression involving 1 dependent variable and multiple independent variables.¹³⁵

5.3.2.1 Univariate analysis

The first step in analysing the CCHS 2.2 was to create the appropriate data set by drawing out the variables and sample of interest, after which, the univariate distribution of all of the variables being considered was examined. All of the variables being investigated in this thesis were either categorical or converted into categorical variables. Unweighted counts and proportions were generated for all of the variables under investigation and where necessary, categories were further collapsed if too small a number of respondents were included in any given category (collapsing of categories is described, where applicable, in Chapter 6). According to the release guidelines of the CCHS 2.2, and the research data analyst at the COOL RDC, unweighted cell counts of less than 5 must be suppressed and cell counts of less than 30 may be statistically unreliable and users are advised to verify the

sampling variability guidelines for release.¹³⁰ All of the Statistics Canada guidelines have been adhered to in this thesis. Once the unweighted counts and proportions were examined, weighted proportions were generated along with their 95% confidence intervals using the bootstrap replicate weights. The distribution of the outcome, overweight/obesity, was also explored at this stage independently for women and men. The proportion of missing values was also assessed at this stage and sensitivity analysis was conducted to determine the impact of removing respondents lacking data on the household income variable.

5.3.2.2 *Bivariate analysis*

Because the outcome of interest in this thesis, overweight/obesity, has been dichotomized and all of the independent variables of interest were categorical, the first step at the bivariate stage was to generate unweighted contingency tables, whereby the proportion of respondents with the outcome of interest was examined for the primary independent variable of interest, food security status, and for each additional independent variable. Again, where necessary, categories were further collapsed due to small cell counts. The proportions were also viewed graphically. Weighted contingency tables and graphs were subsequently explored and 95% confidence intervals were generated around these proportions using the bootstrap replicate weights.

To better understand the data set, unweighted and weighted contingency tables (here using the rescaled weight, refer to section 5.3.1.1) were also tabulated to explore the bivariate associations between food security status and other predictor variables including: Family type, Household Income and Education. Variance estimates are not presented for these analyses as its purpose was to explore the data rather than to test hypotheses.

As previously mentioned, the outcome of interest for this thesis was dichotomous. Binary logistic regression is a form of regression which can be used when the dependent variable is a dichotomy and the independents are either continuous or categorical.¹³⁷ Once a logit transformation of the expected value is calculated, such that the outcome is given by the log odds, $\ln[p(x)/(1-p(x))]$, where $p(x)$ represents the outcome value probability, maximum likelihood estimation is used to estimate the probability of a certain event occurring.¹³⁷ Thus, logistic regression calculates changes in the log odds of the dependent variable, not changes in the dependent variable itself as in linear regression. The assumptions of the logistic regression model include: correct model specification (inclusion of all relevant variables, measured without error and exclusion of all irrelevant variables), independence of observations, and that continuous predictors are linear in the logit outcome.¹³⁷

Thus, to further explore the bivariate associations, univariable logistic regression analysis was used. First the outcome of interest was regressed on each of the predictors in unweighted models; the same models were then explored with the sampling weights incorporated. Variance estimates around the calculated odds ratios (weighted) were generated using the bootstrap replicate weights. All bivariate analyses were conducted for the full sample and then stratified by sex. It became apparent at this stage in the analysis that the relationship between food security status and overweight/obesity differed between men and women. Thus, because of this and because exploring sex differences was an objective of the study, all of the subsequent analyses were carried out independently for women and men and are presented as such.

5.3.2.3 *Multivariate analysis: exploring family type*

As part of objective 1 for this thesis (section 4.3.1), in addition to examining whether or not the prevalence of overweight/obesity differed based on food security status, we also sought to determine whether or not this relationship was modified by “family type”. As a preliminary step, the unweighted and weighted proportion of respondents who were overweight/obese in each food security status category was examined across “family types”. Where necessary, in the unweighted analyses, categories were further collapsed due to small cell counts. Sampling weights were subsequently incorporated and variance estimates were adjusted to account for the complex sampling design.

5.3.2.4 *Multivariable logistic regression*

Multivariable logistic regression analysis was used to examine whether or not food security status predicts overweight/obesity after adjusting for other important variables. As this was not an exercise in model building (i.e. not an exploratory analysis), all of the variables from the conceptual model (presented in section 4.4) were entered into the multivariable models, regardless of whether or not they were found to be significant at the univariable logistic regression stage. Since all of the covariates were categorical, dummy or indicator variables were created for all of the variables in the multivariable logistic regression model. As previously described, analyses were conducted independently for women and men.

As discussed in Chapter 2, food security and income are closely related. As such, two separate models were explored at this stage: one adjusting for all of the independent variables examined at the bivariate stage and one excluding only the income variable; we

wished to examine how including and excluding income might alter the relationship under study in this thesis.

During preliminary multivariable logistic regression analyses, unweighted and weighted models (based on the rescaled weights) were examined. Bootstrapping was used for all final weighted models to account for the complex survey design. Adjusted odds ratios, 95% confidence intervals, standard errors and p-values are presented.

5.3.2.5 Regression diagnostics, handling of outliers and goodness of fit in weighted multivariable regression analysis

Because a complex sampling design was used, to create the national cross-sectional sample for the CCHS 2.2, probability of selection into the sample, and thus sampling weights, had the potential to differ substantially across respondents, particularly at the provincial level. As described in section 5.3.1.1, sampling weights are used to reflect the fact that some members of the population are more likely to be sampled than others; to account for this and to improve the degree to which the sample represents the target population, sampling weights must be incorporated into the analyses. However, because these sampling weights can be wide ranging and highly skewed, a small number of respondents with very high sampling weights may have the potential to have a large influence on parameter estimates in statistical models.

To analyze and minimize the potential bias in regression coefficients resulting from influential outliers with large sampling weights, logistic regression diagnostics were used in all multivariable logistic regression models. The diagnostic statistics used here to identify influential outliers were *dfbeta* and *c*.¹³⁸ In this document, *dfbeta* refers to a measure of influence on a single regression coefficient whereas *c* refers to a measure of influence that

an observation has on the overall model. Influential observations have higher absolute values of *dfbeta* and higher values of *c*.¹³⁸

Determining whether an observation is an influential outlier usually involves comparing the relative value of the diagnostic statistic for an observation with other observations in the sample (based on graphical analysis) and/or consideration of the actual value of diagnostic statistic by comparing it to a pre-defined cut-point.¹³⁴ Because exploring regression diagnostics involves analyzing individual observations within the data set, much of the relevant analysis can not be presented in this thesis due to Statistics Canada disclosure regulations. While values of *c* were plotted to examine relative influence they cannot be presented and thus, to be as transparent as possible, and so that methods for identifying influential outliers remained consistent and reproducible, regression diagnostics were based on the actual values of the diagnostic statistics vs. their relative value in the sample. Absolute values of *dfbeta* near 1.0 and values of *c* >1.0 have been identified as influential; thus absolute values of *dfbeta*>1.0 and values of *c*>1.0 were used as the cut-point here.^{137,138} Observations with values above these cut-points were identified, inspected (in terms of their covariate pattern and sampling weight) and were subsequently temporarily removed from the multivariable model. Once these observations were removed from the model, the model was re-run and influential observations were once again identified, analyzed and temporarily removed. This process was carried out until no more potentially influential observations remained in the model.

SAS generates influence statistics based on individual observations but it is usually recommended that they be calculated based on covariate patterns.¹³⁷ However, in this study, calculating influence statistics based on individual observations may have been more

appropriate as we anticipated, based on others' work,¹³⁴ that observations would be more likely to be influential as a result of a high sampling weight, sometimes coupled with an unusual covariate pattern.

The models, with potentially influential outliers removed, were then compared to the corresponding model that included all observations (i.e. no observations removed), to explore whether or not the observations identified as influential outliers were in fact influencing the parameter estimates in the models. When the outliers appeared to be influencing the parameter estimates, we investigated the covariate patterns of these observations for any unusual characteristics; based on this inspection, we decided whether or not to remove these observations.

The Hosmer and Lemeshow Goodness of fit test was used to explore the fit of all final models. Using the Hosmer and Lemeshow Goodness of Fit test on weighted data has been problematic when working with a data set with highly skewed and wide ranging sampling weights¹³⁴, which was expected in the present study. Thus, we used the test but in light of these findings, and because the distributional properties of the Hosmer and Lemeshow statistic were not established based on weighted data, the test was not relied upon for the weighted multivariable regression models. Rather, we verified the fit of each corresponding unweighted model using the Hosmer and Lemeshow Goodness of fit test.

5.4 An environmental scan of policies, programs and initiatives targeting food insecurity in Canada

To place our analyses of the CCHS 2.2 (2004) into an applied context, the final component of this research project entailed scoping and assembling key policy information broadly related to food insecurity with some specific discussion around its relationship to

healthy weights. The purpose of this environmental scan was to synthesize existing policy and program information on the topic of food insecurity and healthy weights rather than to provide a systematic review of the political climate.

5.4.1 Eligibility criteria

Published documents eligible for inclusion in the environmental scan were those that included some discussion of policies related to food insecurity within Canada. Documents from both the peer-reviewed and grey literature were considered. To focus on the current Canadian policy context, we relied on documents published in Canada since 2000, making limited exceptions for international documents and dated Canadian documents considered to be particularly relevant. Because the environmental scan was not intended to be an exhaustive review of the literature, we further narrowed our analysis to focus on what we deemed to be key publications and we placed a priority on review articles.

5.4.2 Search strategy

We used a variety of approaches to identify relevant documents, including scanning the peer-reviewed literature, searching the grey literature (including government websites and non-governmental websites) and corresponding by email with content experts in food security. All searches were conducted in March 2007.

5.4.2.1 *Academic publications and documents*

A broad search was conducted to identify relevant publications regardless of publication type. Two electronic databases were searched using the OVID search interface: MEDLINE (1996 to March week 2 2007), and Health Star (1999 to Feb 2007). A detailed search strategy was developed for use in MEDLINE and then adapted for Health Star.

Overall, little research has been done examining the relationship between food insecurity and health outcomes,⁹¹ which likely explains why there were no index terms for food security available in the electronic databases, as was mentioned in Chapter 3. Because research in this field is in the early stage of development, several terms to describe the concept of food insecurity are used interchangeably (e.g. food poverty, food insufficiency, and hunger-the most severe form of food insecurity). Thus, these broad search terms were used to capture food insecurity and these were combined with terms relevant to policy (including policy, programs and initiatives). The search was limited to the English language. A detailed description of the MEDLINE database search strategy is presented in Appendix H. In addition, the reference lists of all relevant articles (including reviews) were examined for reports of additional studies and study authors were contacted to retrieve grey literature when necessary.

5.4.2.2 Government documents

At the federal level, we searched the websites of Health Canada, the Public Health Agency of Canada (PHAC), the department of Human Resources and Social Development Canada (HRSDC), including the National Council of Welfare, and Agriculture Canada. We looked for relevant federal level policy documents using similar terms to those outlined above in section 5.4.2.1 and via general website scanning. At the provincial and territorial level, the websites of all ministries of health were also searched using the same combination of key words as well through general website scanning.

5.4.2.3 Non-governmental organization (NGO) documents

The websites of the following organizations were searched using the same search strategy outlined above:

Canadian organizations:

- Canadian Policy Research Network (CPRN)
- Canadian Public Health Association (CPHA)
- Canadian Consortium for Health Promotion Research (CCHPR)
- Conference Board of Canada
- Canadian Population Health Initiative (CPHI)
- Chronic Disease Prevention Alliance of Canada (CDPAC)
- Canadian Centre for Policy Alternatives
- Canadian Association of Food Banks
- Caledon Institute of Social Policy
- Food Secure Canada

5.4.2.3 Contact with content experts

Finally we emailed five content experts (Dr. Lynn McIntyre, Dr. Elaine Powers, Dr. Valerie Tarasuk, Dr. Danielle Brule, and Dr. Martine Pageau) to identify additional key documents and unpublished or ongoing studies. However, only one additional document was identified in this step.

5.4.3 Document selection

All relevant citations, including titles and abstracts, were imported or manually entered into a reference database (Reference Manager 11). In the initial broad screen, a single reviewer (MM) independently screened all titles and abstracts of citations for overall non-relevance. Specifically, the reviewer (MM) screened the list of citations to identify and retain publications for further review which were directly related to food insecurity and policy.

Full reports for those studies screened in after this initial broad screen were collected via the University of Ottawa Library, internet searching and through contact with authors. As previously described, not all articles considered eligible after the full-text review were

included in the final set of documents for this environmental scan and given the objectives and scope of this scan, reasons for exclusion were not documented.

Chapter 6: RESULTS-ANALYSES OF THE CANADIAN COMMUNITY HEALTH SURVEY 2.2 (2004)

6.1 Overview of Chapter 6

Chapter 6 summarizes the results of the analyses of the Canadian Community Health Survey 2.2 (2004). In section 6.2 we provide descriptive data. Presentation of the preliminary results obtained concerning the relationship between food security status and overweight/obesity follows in section 6.3, where results from the bivariate analysis are presented (section 6.3.1) as are results from the analyses which explored the relationship between food security and overweight/obesity by family type (section 6.3.2).

In the final section of this chapter, multivariable models are discussed (section 6.4). This section briefly discusses regression diagnostics, handling of outliers and goodness of fit tests (section 6.4.1) and presents the final multivariable models obtained in these analyses (section 6.4.2).

Please note that all of the data presented in the main body of this chapter is based on the weighted analysis; the corresponding results from the unweighted analysis can be found in Appendix I.

6.2 Descriptive data

6.2.1 Description of the sample

There were 21160 individuals over the age of 18 in the sample who technically formed the eligible group for the analyses of interest. However, of these 21160 respondents, only 12428 had valid data for measured height and weight (58.7%). Because one of the objectives (objective 1) of this thesis was to focus the analyses on respondents with measured height and weight data, the respondents missing this information (approximately 41%) were excluded at this point. In order to account for the high non-response in this

particular variable, a special weight was created by Statistics Canada methodologists to be used with the sub-sample of individuals with measured height and weight (see section 5.3.1.1).

Aside from body weight measurements, there were very few missing data for all other variables of interest (all less than 2%) with the exception of income. After excluding respondents with missing data on food security status, family type, education, ethnicity, and physical activity (n=261) the sample was further reduced to 12167 (decrease of 2.10%). A more substantial proportion of respondents were missing data on household income (n=2378, approximately 11%). After excluding respondents with missing data on the household income variable, the final sample size for analysis was further reduced to 11162.

Descriptive data on overweight/obesity and food security status along with information on other relevant sociodemographic variables is presented in Table 6.1 for the full sample and in Table 6.2 stratified by sex. Because the proportion of respondents with missing data on household income was considerable, Table 6.1 also provides a comparison of the characteristics of respondents in the final sample and the sample including respondents missing data on the income variable. Although there are some differences between the two samples, they appear to be quite small and are likely negligible in terms of bias. Therefore, all remaining analyses were based on the final analytic sample of 11162.

The majority of the sample was overweight/obese (60%) and food secure (92.8%) (Table 6.1). The proportions of the sample that were food insecure **without hunger** and food insecure **with hunger** were 4.9% and 2.3% respectively (Table 6.1).

The final sample consisted of 49.9% males and 50.1% females (Table 6.1). The highest proportion of respondents were between the ages of 35-44 (21.4%) or 45-54 (20.3%)

years of age with fewer individuals aged 18-24 (12.1%), 25-34 (16.7%), 55-64 (14.3%), and 65 or older (15.2%) (Table 6.1). A substantial proportion of respondents classified themselves as a parent living with their spouse/partner and children (30.2%) where as only 4.9% of the sample identified as a single parent; the rest of the sample was classified as belonging to “all other family types” (64.8%) (Table 6.1). Over 80% of the sample identified their cultural or racial origin as White (83.3%) and just over 70% of the sample had completed some form of a post-secondary degree (Table 6.1). With respect to household income adequacy, almost 70% of the sample was classified as belonging to an upper middle (36.4%) or highest income (33.4%) household; still nearly 10% of the sample was categorized as a lowest (3.1%) or lower middle income (6.2%) household (Table 6.1). Finally, the majority of the sample (57.3%) was classified as inactive based on the physical activity index (Table 6.1).

Because one of the main objectives of this thesis was to explore the relationship between food security status and overweight/obesity by sex, Table 6.2 also presents descriptive data for the final analytic sample stratified by sex. The proportion of women classified as overweight/obese was 53.8% whereas in men it was 66.2% (Table 6.2). However, of those women who were overweight/obese ($BMI \geq 25.0 \text{ kg/m}^2$), 55.7% were overweight ($25.0 \text{ kg/m}^2 \leq BMI \leq 29.9 \text{ kg/m}^2$) and 44.3% were obese ($BMI \geq 30.0 \text{ kg/m}^2$) (Data not shown in table). In contrast, in men who were overweight/obese, 63.5% were overweight and 36.5% were obese (Data not shown in table). Although no formal statistical tests were carried out here, food security status appeared to differ slightly by sex, with fewer women reporting food security than men (91.8% vs. 93.7%) and in turn, more women reporting food insecurity **without** and **with hunger** than men (5.4% vs. 4.5% and 2.8% vs.

1.9% respectively) (Table 6.2). Finally, when the family type variable was explored by sex, the proportion of respondents in the sample who identified themselves as a parent living with their spouse/partner and children was similar between men and women, whereas the proportion of women who identified themselves as a single parent was 7.5%, compared with 2.3 % of men (Table 6.2).

The weighted distribution of respondents by cultural or racial origin and by education level achieved was similar for men and women. Women were somewhat overrepresented in the lowest income household category and underrepresented in the highest income household categories (3.9% of women vs. 2.2% of men were in the lowest income household category; and 31.3% of women versus 35.6% of men were in the highest income household category). A slightly higher proportion of women were inactive (59.9%) compared with men (54.7%) (Table 6.2).

Table 6.1 Description of final analytical sample compared to sample with data missing on income variables (weighted)

Characteristic (number of subjects with missing variable)	Final Sample of respondents with measured BMI. Proportion (%) [Unwtd n=11162]	95% CI	Sample including respondents with missing data on income variable [Unwtd n=12167]	95% CI
BMI classification (kg/m²) (N/A)				
Underweight or Normal Weight (<25.0)	40.0	(38.2, 41.9)	40.7	(38.9, 42.4)
Overweight or Obese (>=25.0)	60.0	(58.2, 61.8)	59.3	(57.6, 61.1)
Food Security Status (92)				
Food Secure	92.8	(91.8, 93.7)	93.1	(92.2, 94.0)
Food Insecure without hunger	4.9	(4.1, 5.8)	a	
Food Insecure with hunger	2.3	(1.8, 2.8)	a	
Sex (0)				
Male	49.9	(47.5, 52.2)	49.4	(49.0, 49.8)
Female	50.1	(47.8, 52.5)	50.6	(50.2, 51.0)
Age (0)				
18-24	12.1	(11.3, 13.0)	13.1	(12.3, 13.9)
25-34	16.7	(15.4, 18.1)	16.1	(14.8, 17.4)
35-44	21.4	(20.0, 22.9)	21.0	(19.7, 22.4)
45-54	20.3	(18.7, 21.9)	19.8	(18.3, 21.4)
55-64	14.3	(13.3, 15.2)	14.0	(13.1, 14.9)
65 or older	15.2	(14.5, 15.8)	16.0	(15.4, 16.6)
Family Type (69)				
Parent w/ spouse/partner and children	30.2	(28.6, 31.9)	29.5	(30.0, 31.0)
Single Parent w/child	4.9	(4.1, 5.8)	4.9	(4.1, 5.7)
All other family types	64.8	(63.2, 66.5)	65.6	(64.1, 67.2)
Cultural or Racial Origin (18)				
White	83.3	(81.7, 84.8)	83.0	(81.5, 84.5)
Black	1.6	(1.0, 2.2) E	1.6	(1.0, 2.1)E
Southeast/East Asian	6.0	(4.9, 7.2)	6.3	(5.2, 7.4)
Off-reserve Aboriginal	1.1	(0.8, 1.4)	1.0	(0.8, 1.3)
Other	8.0	(6.8, 9.2)	8.1	(7.0, 9.2)
Education (364)				
Less than secondary school graduation	10.4	(9.5, 11.2)	10.5	(9.7, 11.3)
Secondary school graduation	10.9	(9.7, 12.0)	10.9	(9.8, 12.0)
Some post-secondary	7.3	(6.3, 8.3)	7.3	(6.3, 8.2)
Post-secondary graduation	71.5	(69.8, 73.1)	71.3	(69.8, 72.9)
Household Income (2378)				
Lowest income	3.1	(2.4, 3.7)	2.8	(2.2, 3.5)
Lower middle income	6.2	(5.3, 7.1)	5.7	(4.9, 6.6)
Middle income	20.9	(19.4, 22.4)	19.3	(17.9, 20.7)
Upper middle income	36.4	(34.5, 38.2)	33.5	(31.8, 35.2)
Highest income	33.4	(31.5, 35.4)	30.8	(30.0, 32.7)
Not stated/missing	N/A	N/A	7.8	(6.9, 8.7)
Physical Activity Index (6)				
Active	18.0	(16.6, 19.4)	18.0	(16.7, 19.3)
Moderate	24.7	(23.1, 26.3)	24.8	(23.3, 26.4)
Inactive	57.3	(55.4, 59.2)	57.2	(55.4, 59.0)

CI=Confidence Interval, Unwtd=unweighted

E=16.6 < CV <= 33.3; Interpret with Caution-high sampling variability associated with this estimate.

a= Data cannot be presented based on Statistics Canada confidentiality regulations due to risk of residual disclosure.

Table 6.2 Description of final analytic sample by sex (weighted)

Characteristic	WOMEN		MEN	
	Proportion (%) (95% CI) [Unwtd n=6373]		Proportion (%) (95% CI) [Unwtd n=4789]	
BMI classification (kg/m²)				
Underweight or Normal Weight (<25.0)	46.2	(43.7, 48.7)	33.8	(31.2, 36.4)
Overweight or Obese (>=25.0)	53.8	(51.3, 56.3)	66.2	(63.6, 68.8)
Food Security Status				
Food Secure	91.8	(90.5, 93.1)	93.7	(92.2, 95.1)
Food Insecure without hunger	5.4	(4.2, 6.6)	4.5	(3.1, 5.8)
Food Insecure with hunger	2.8	(2.1, 3.5)	1.9	(1.2, 2.6)E
Age				
18-24	11.4	(10.3, 12.4)	13.0	(11.7, 14.2)
25-34	16.7	(14.8, 18.5)	16.8	(14.8, 18.8)
35-44	21.7	(19.6, 23.7)	21.2	(19.1, 23.2)
45-54	20.4	(18.2, 22.7)	20.1	(17.9, 22.4)
55-64	14.1	(12.8, 15.3)	14.4	(13.0, 15.8)
65 or older	15.8	(15.0, 16.7)	14.5	(13.5, 15.5)
Family Type				
Parent w/ spouse/partner and children	30.0	(27.6, 32.4)	30.5	(27.9, 33.1)
Single Parent w/child	7.5	(6.1, 9.0)	2.3	(1.4, 3.3)E
All other family types	62.5	(60.0, 65.0)	67.2	(64.5, 69.8)
Cultural or Racial Origin				
White	83.3	(81.3, 85.3)	83.3	(81.0, 85.6)
Black	1.9	(1.0, 2.8)E	1.3	(0.6, 2.0)E
Southeast/East Asian	5.6	(4.1, 7.2)	6.5	(4.9, 8.0)
Off-reserve Aboriginal	1.4	(1.0, 1.8)	0.8	(0.5, 1.1) E
Other	7.8	(6.2, 9.3)	8.2	(6.4, 10.0)
Education				
Less than secondary school graduation	10.7	(9.7, 11.7)	10.1	(8.7, 11.4)
Secondary school graduation	10.5	(9.1, 12.0)	11.2	(9.5, 12.9)
Some post-secondary	7.2	(5.8, 8.5)	7.5	(6.0, 9.0)
Post-secondary graduation	71.6	(69.6, 73.5)	71.3	(68.8, 73.7)
Household Income				
Lowest income	3.9	(3.0, 4.9)	2.2	(1.5, 3.0) E
Lower middle income	7.6	(5.5, 8.7)	4.8	(3.4, 6.2)
Middle income	22.8	(20.9, 24.6)	19.1	(16.8, 21.4)
Upper middle income	34.4	(32.0, 36.7)	38.4	(35.5, 41.2)
Highest income	31.3	(28.6, 34.0)	35.6	(32.8, 38.4)
Physical Activity Index				
Active	16.4	(14.6, 18.3)	19.5	(17.5, 21.6)
Moderate	23.7	(21.6, 25.8)	25.8	(23.3, 28.2)
Inactive	59.9	(57.5, 62.3)	54.7	(52.1, 57.4)

CI=Confidence Interval, Unwtd=unweighted

E=16.6 < CV <= 33.3. Interpret with Caution-high sampling variability associated with this estimate.

6.3 The relationship between food security status and overweight/obesity

6.3.1 Bivariate analysis

6.3.1.1 Food security status and overweight/obesity

The prevalence of overweight/obesity by food security status is presented for women and men in Table 6.3 and Figures 6.1 and 6.2 respectively. While 53.5% of food secure women and 50.6% of women who were food insecure **without hunger** were overweight/obese, nearly 70% of women who were food insecure **with hunger** were overweight/obese (Table 6.3, Fig 6.1). In univariable logistic regression analysis, women who were food insecure **with hunger** were significantly more likely than food secure women to be overweight or obese [OR=2.0, CI=1.2, 3.3] (Table 6.4).

In contrast, among men, those who were food secure had the highest prevalence of overweight/obesity (67.5%). For men who were food insecure **without hunger** and food insecure **with hunger**, 44.7% and 51.4% were overweight/obese respectively (Table 6.3, Fig 6.2). In univariable logistic regression analysis, men who were food insecure **without hunger** were significantly less likely to be overweight/obese compared to those who were food secure [OR=0.4, CI=0.2, 0.8] (Table 6.4). No other significant differences were noted.

Table 6.3 Prevalence of overweight/obesity by food security status for women and men (weighted)

	Overweight/Obesity (%) (95% CI)	
	Women [Unwtd n=3761]	Men [Unwtd n=3246]
TOTAL POPULATION	53.8 (51.3, 56.3)	66.2 (63.6, 68.8)
<i>Food Security Status</i>		
Food Secure	53.5 (50.9, 56.1)	67.5 (64.9, 70.2)
Food.Insecure without hunger	50.6 (38.8, 62.3)	44.7 (27.8, 61.7) E
Food Insecure with hunger	69.6 (59.2, 80.0)	51.4 (33.7, 69.1) E

E=16.6 < CV <= 33.3. Interpret with Caution-high sampling variability associated with this estimate.

Figure 6.1 Prevalence of overweight/obesity by food security status in *women* (weighted)

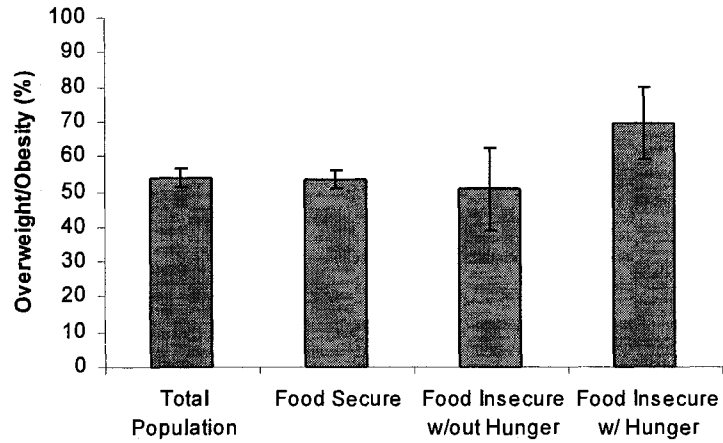
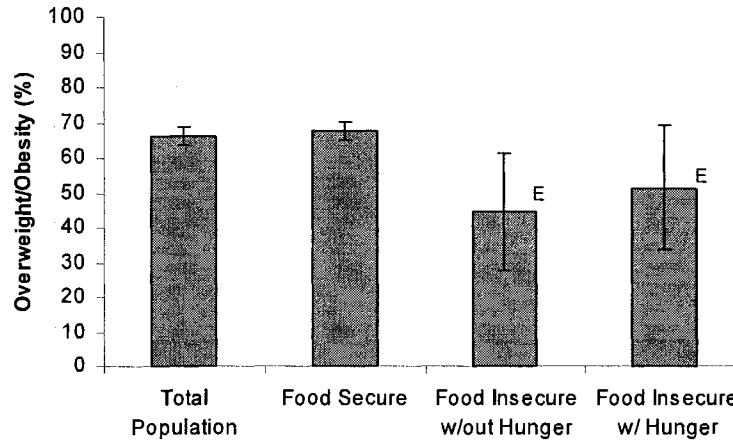


Figure 6.2 Prevalence of overweight/obesity by food security status in *men* (weighted)



E=16.6 <CV<=33.3. Interpret with caution. High sampling variability associated with this estimate

Table 6.4 Univariable regression model predicting overweight/obesity by food security status (weighted)

	WOMEN [Unwtd N=6373]	MEN [Unwtd N=4789]
	OR (95% CI)	OR (95% CI)
<i>Food Security Status</i>		
Food Secure [REF]	1.0	1.0
Food Insecure without hunger	0.9 (0.5, 1.5)	0.4 (0.2, 0.8)
Food Insecure with hunger	2.0 (1.2, 3.3)	0.5 (0.2, 1.1)

OR=odds ratio; CI=confidence interval; REF=reference category

6.3.1.2 *Other variables predicting overweight/obesity*

Prevalence of overweight/obesity is shown across other independent variables of interest by sex in Table 6.5. In univariable regression analysis, age was significantly associated with overweight/obesity among both men and women, with middle aged and older age respondents being significantly more likely to be overweight/obese compared to the younger respondents (Table 6.6). Family type was not a significant predictor of overweight/obesity in women, but in men, those who were parents living with a spouse/partner and children were significantly more likely to be overweight/obese than those belonging to “all other family types” [OR=1.4, CI=1.1, 1.9] (Table 6.5).

Cultural or racial origin was also a significant predictor of overweight/obesity in both women and men. Women who identified as Southeast/East Asian were significantly less likely to be overweight/obese compared to their White counterparts [OR=0.4, CI=0.2, 0.8] whereas women who were Off-reserve Aboriginal were significantly more likely to be overweight/obese compared to women who were White [OR=2.1, CI=1.2,3.7] (Table 6.5). Men who were Southeast/East Asian were significantly less likely to be overweight/obese compared to men who were White [OR=0.3, CI=0.1,0.5] as were men classified as belonging to “other” racial or cultural origins [OR=0.4, CI=0.2,0.7] (Table 6.6).

With respect to education, women with post-secondary education were significantly less likely to be overweight/obese than those who hadn't completed secondary school [OR=0.5, CI=0.4, 0.7] and men with some post-secondary education were significantly less likely to be overweight/obese compared to those who hadn't completed secondary school [OR=0.5, CI=0.3, 0.8] (Table 6.5).

Income was not a significant predictor of overweight/obesity with the exception of men in the highest household income category; they were significantly more likely to be overweight/obese than men in the lowest income household category [OR=2.1, CI=1.1, 3.9].

Interestingly, physical activity was only a significant predictor of overweight/obesity among women. Both women who were moderately active and those who were inactive were significantly more likely to be overweight/obese than women who were active [OR=1.7, CI=1.2, 2.3 and OR=2.0, CI=1.5, 2.7 respectively] (Table 6.6).

Table 6.5 Overweight prevalence according to selected demographic, socio-demographic, health and lifestyle variables (weighted)

	Overweight/Obesity (%) (95% CI)	
	WOMEN [Unwtd n=3761]	MEN [Unwtd n=3246]
TOTAL POPULATION	53.8 (51.3, 56.3)	66.2 (63.6, 68.8)
<i>Age</i>		
18-24	34.7 (28.6, 40.7)	39.7 (33.2, 46.2)
25-34	43.7 (36.7, 50.7)	63.7 (57.5, 69.9)
35-44	48.0 (41.6, 54.5)	68.5 (62.0, 75.0)
45-54	64.1 (57.7, 70.4)	71.1 (64.6, 77.6)
55-64	63.1 (57.5, 68.7)	75.0 (68.8, 81.2)
65 or older	64.3 (60.2, 68.5)	74.0 (70.2, 77.9)
<i>Family Type</i>		
Parent w/ spouse/partner and children	53.1 (46.7, 59.4)	71.3 (65.9, 76.8)
Single Parent with child	58.8 (49.0, 68.7)	81.1 (66.9, 95.3)
All other family types	53.5 (50.8, 56.2)	63.4 (60.5, 66.2)
<i>Cultural or Racial Origin</i>		
White	54.9 (52.3, 57.5)	70.3 (67.6, 73.0)
Black	62.7 (36.5, 89.0) E	48.6 (21.2, 76.1) E
Southeast/East Asian	31.4 (19.1, 43.7) E	37.8 (23.2, 52.4) E
Off-reserve Aboriginal	71.9 (60.3, 83.5)	65.5 (50.4, 80.7)
Other	52.1 (39.6, 64.4)	49.5 (37.6, 61.5)
<i>Education</i>		
Less than secondary school graduation	65.7 (60.8, 70.2)	72.2 (65.9, 78.4)
Secondary school graduation	58.8 (52.9, 64.8)	66.9 (59.7, 74.0)
Some post-secondary	67.0 (58.5, 75.4)	55.7 (45.0, 66.4)
Post-secondary graduation	50.0 (46.8, 53.1)	66.4 (63.1, 69.6)
<i>Household Income</i>		
Lowest income	47.4 (35.1, 59.7)	55.9 (41.0, 70.9)
Lower middle income	55.4 (47.8, 63.0)	59.8 (44.4, 75.1)
Middle income	59.4 (54.5, 64.3)	62.0 (55.8, 68.1)
Upper middle income	53.2 (49.1, 57.3)	64.2 (59.6, 68.7)
Highest income	50.8 (45.9, 55.7)	72.2 (67.9, 76.5)
<i>Physical activity index</i>		
Active	40.4 (34.5, 46.2)	67.9 (62.8, 73.0)
Moderate	52.8 (47.8, 57.8)	62.6 (57.4, 67.9)
Inactive	57.9 (54.4, 61.3)	67.3 (63.6, 71.0)

E=16.6 < CV <= 33.3. Interpret with Caution-high sampling variability associated with this estimate.

Table 6.6 Univariable regression models predicting overweight/obesity by selected sociodemographic and lifestyle variables (weighted)

Sociodemographic and lifestyle variables	WOMEN	MEN
	[Unwtd N=6373]	[Unwtd N=4789]
	OR (95% CI)	OR (95 % CI)
Age		
18-24 [REF]	1.0	1.0
25-34	1.5 (1.0, 2.2)	2.7 (1.8, 3.9)
35-44	1.7 (1.2, 2.5)	3.3 (2.2, 4.9)
45-54	3.4 (2.3,4.9)	3.8 (2.5, 5.6)
55-64	3.2 (2.3, 4.6)	4.6 (2.9, 7.1)
65 or older	3.4 (2.5, 4.7)	4.3 (3.1, 6.0)
Family Type		
Parent w/ spouse/partner and children	1.0 (0.7,1.3)	1.4 (1.1, 1.9)
Single Parent with child	1.2 (0.8, 1.9)	2.5 (0.9, 7.0)
All other family types [REF]	1.0	1.0
Cultural or Racial Origin		
White [REF]	1.0	1.0
Black	1.4 (0.4, 4.8)	0.4 (0.1, 1.3)
Southeast/East Asian	0.4 (0.2, 0.8)	0.3 (0.1, 0.5)
Off-reserve Aboriginal	2.1 (1.2, 3.7)	0.8 (0.4, 1.6)
Other	0.9 (0.4, 1.8)	0.4 (0.2, 0.7)
Education		
Less than secondary school graduation [REF]	1.0	1.0
Secondary school graduation	0.8 (0.5, 1.0)	0.8 (0.5, 1.2)
Some post-secondary	1.1 (0.7,1.6)	0.5 (0.3, 0.8)
Post-secondary graduation	0.5 (0.4, 0.7)	0.8 (0.5, 1.1)
Household Income		
Lowest income [REF]	1.0	1.0
Lower middle income	1.4 (0.8, 2.4)	1.2 (0.5, 2.8)
Middle income	1.6 (0.9, 2.8)	1.3 (0.7, 2.5)
Upper middle income	1.3 (0.7, 2.1)	1.4 (0.7, 2.7)
Highest income	1.1 (0.7, 2.0)	2.1 (1.1, 3.9)
Physical activity index		
Active [REF]	1.0	1.0
Moderate	1.7 (1.2, 2.3)	0.8 (0.6, 1.1)
Inactive	2.0 (1.5, 2.7)	1.0 (0.7, 1.3)

OR=odds ratio; CI=confidence interval; REF=reference category

6.3.2 Food security and overweight/obesity by family type

In addition to exploring how the relationship between food security status and overweight/obesity might differ by sex, one of the objectives of this thesis was also to

explore whether or not this relationship differs by family type (essentially, by one’s role in the household). To explore this potential relationship, the proportion of overweight/obese respondents was tabulated by food security status and family type for women and men. Inadequate sample sizes, particularly among men, precluded specific hypothesis testing, but preliminary analyses based on visual inspection alone in both women and men suggested that family type does not likely modify the relationship between food security status and overweight/obesity. Table 6.7 presents these preliminary cross-tabulations for women; however, due to Statistics Canada confidentiality regulations related to small cell counts, the results for men could not be released.

Table 6.7 Proportion of Overweight/Obese women by Food Security Status according to Family Type (Weighted)

	% Overweight/Obese (95% CI)
Total population	54.0
Food Security Status	
<i>Food Secure</i>	
Parent with spouse and children	53.2 (46.8, 59.7)
Single Parent with child	58.3 (46.8, 69.7)
All other	53.1 (50.3, 55.9)
<i>Food Insecure without hunger</i>	
Parent with spouse and children	46.8 (15.9, 77.7) E
Single Parent with child	56.3 (30.0, 82.6) E
All other	50.9 (39.1, 62.7)
<i>Food Insecure with Hunger</i>	
Parent with spouse and children	72.2 (32.9, 100) E
Single Parent with child	70.8 (48.9, 92.6)
All other	69.0 (56.7, 81.3)

CI=confidence interval;

E=16.6 < CV <= 33.3. Interpret with Caution-high sampling variability associated with this estimate.

6.4 Multivariable regression analysis

The objective of these analyses was to examine the relationship between food security status and overweight/obesity, rather than to create a “best model” for predicting overweight/obesity. Thus, all of the variables believed to be potentially important

confounders from the conceptual framework were entered into the multivariable logistic regression models regardless of whether or not they were found to be significant independent predictors of overweight/obesity at the univariable logistic modelling stage. In addition, because income and food security have been found to be highly correlated in previous studies,⁶²⁻⁶⁶ we explored this relationship here before proceeding to the multivariable models, using cross-tabulations and visual inspection. Table 6.8 presents the results of cross-tabulations of food security status by household income category for women only; due to small cell counts, the data for men have been suppressed in accordance with Statistics Canada's disclosure regulations.

Table 6.8 Food Security Status by Household Income for Women-Weighted

	Food Secure (%) (Unwtd n=5837)	Food Insecure without hunger (%) (Unwtd n=315)	Food Insecure with hunger (%) (Unwtd n=221)
TOTAL	91.8	5.4	2.8
<i>Household Income</i>			
Lowest income	54.5	24.9	20.5
Lower middle income	73.4	16.2	10.4
Middle income, Upper middle and Highest income ^c	95.1	3.6	1.3

Unwtd= unweighted; c= Collapsed due to small cell count in unweighted analyses

Consistent with the literature, visual inspection alone revealed trends in the relationship between household income and food security status. As expected, the proportion of respondents who were food insecure was highest among the lowest income households and lowest in the middle, upper middle and highest income households (Table 6.8). The cross-tabulations were very similar among men (data not presented here due to small cell counts).

Because income and food security are known to be associated, and appeared to be correlated in this data set as well, two models were created for women and men, one including income as a potential confounder and one without to explore the impact of income

on the food security/overweight/obesity relationship with other predictors included in the model. Because both models provided support for the same inference regarding the relationship between food security status and overweight/obesity, and considering that collinearity was not identified as a problem with both income and food insecurity in the model (there were no large differences in standard errors between the two models), only the model including income is presented here (Table 6.9 [women] and Table 6.10 [men]). Results from “first alternate models” (without adjusting for income) can be found in Appendix I, in Tables 6.11A and 6.12A.

6.4.1 Regression diagnostics, handling of outliers in weighted multivariable analyses and goodness of fit

As discussed in the data analysis section 5.3.2.5, at the multivariable modelling stage, logistic regression diagnostics were used to identify any influential outliers; this was carried out to analyze and minimize any potential bias in regression coefficients resulting from influential outliers with large sampling weights. Based on the criteria established in Chapter 5 (influential observations = absolute value of $dfbeta > 1.0$ and/or $c > 1.0$) influential observations were identified, examined and temporarily removed from one set of the multivariable models.

In all of the multivariable models explored at this stage (those with potential influential outliers removed), less than 0.5% of the total sample was removed. Moreover, all influential observations identified and removed had sampling weights that exceeded the 90th percentile of sampling weights and in most cases they exceeded the 95th percentile of sampling weights. Similar to other analyses based on large multi-stage cluster designs, this suggests that the large sampling weight relative to the other sampling weights in the sample,

coupled perhaps in some cases with a somewhat unusual covariate pattern, was the primary reason for the influence of these observations.¹³⁴

These models (with potential influential outliers removed) were then compared to the corresponding models that included all of the observations. Because both sets of models (those with and without all of the observations) had highly similar parameter estimates and provided support for the same inferences, all of the final models presented here include all of the originally eligible respondents. The “second alternate models” explored (with potential influential outliers removed) can be found in Appendix I, in Tables 6.13A and 6.14A for women and men respectively.

The Hosmer and Lemeshow Goodness of Fit Statistic was used to explore the fit of all final multivariable models. All of the final unweighted models showed adequate fit ($p > 0.05$) but only one of the final weighted multivariable models did (Final Model: Multivariable regression model predicting overweight/obesity by food security status in Men, $p=0.3414$) (Table 6.10). As discussed in Chapter 5, using the Hosmer and Lemeshow Goodness of Fit test on weighted data has previously been found to be problematic when working with a data set with highly skewed and wide ranging sampling weights,¹³⁴ as was the case with the CCHS 2.2 (2004). The range of the sampling weights used here with the final analytic sample was 68 028 (90th percentile= 4630, 95th percentile = 7595) and the sampling weights were highly positively skewed (Skewness = 5.60).

6.4.2 Final multivariable models

In the final multivariable model for women, women at the intercept had the following characteristics: food secure, aged 18-24, categorized as belonging to all other family types, white, less than secondary school graduation, lowest income household and

active (Table 6.9). After adjusting for all of the sociodemographic and lifestyle characteristics believed to be important, including income, food insecure women **with hunger** were still significantly more likely than food secure women to be overweight/obese [OR=2.3, CI=1.2, 4.3] (Table 6.9). Thus, in women, food insecurity **with hunger** was associated with overweight/obesity over and above the effect of income. The odds of being overweight/obese in women who reported food insecurity **without hunger** were not significantly different ($p>0.05$) than among their food secure counterparts [OR=1.0, CI=0.6, 1.6] (Table 6.9).

Other significant predictors of overweight/obesity in women included age, racial or cultural origin, education, income, and physical activity. Women who were middle aged and older were significantly more likely to be overweight/obese than younger women (Table 6.9). Women who were Southeast/East Asians remained significantly less likely to be overweight/obese relative to women who were White [OR=0.4, CI=0.2, 0.7] while women who were Off-reserve Aboriginal were significantly more likely to be overweight/obese relative to women who were White [OR=2.4, CI=1.3, 4.5] (Table 6.9). Women with some post-secondary education were significantly more likely to be overweight/obese compared to women with less than secondary education [OR=1.6, CI=1.0, 2.5] as were women in middle income households compared to women in the lowest income households [OR=1.8, CI=1.0, 3.3] (Table 6.9). Women who were moderately active and inactive were significantly more likely to be overweight/obese than active women [OR=1.5, CI=1.1, 2.2; OR=2.0, CI=1.4, 2.7 respectively] (Table 6.9).

Table 6.9 Final Model: Multivariable regression model predicting overweight/obesity by food security status in Women (weighted; n=6373)^{d, e}

	SE	Adjusted OR	95% CI	p-value
<i>Food security status</i>				
Food Secure (Ref)				
Food Insecure without hunger	0.3	1.0	0.6, 1.6	0.9201
Food Insecure with hunger	0.3	2.3	1.2, 4.3	0.0082
<i>Age</i>				
18-24 (Ref)				
25-34	0.2	1.4	0.9, 2.2	0.1201
35-44	0.2	1.7	1.2, 2.6	0.0082
45-54	0.2	3.5	2.4, 5.1	0.0000
55-64	0.2	3.6	2.5, 5.1	0.0000
65 or older	0.2	3.4	2.3, 4.8	0.0000
<i>Family Type</i>				
Other (Ref)				
Parent w/ spouse/partner and children	0.2	1.2	0.9, 1.6	0.2832
Single Parent with child	0.2	1.0	0.7, 1.6	0.8701
<i>Cultural or Racial Origin</i>				
White (Ref)				
Black	0.7	1.8	0.5, 7.2	0.4017
Southeast/East Asian	0.3	0.4	0.2, 0.7	0.0008
Off-reserve Aboriginal (4)	0.3	2.4	1.3, 4.5	0.0074
Other (5)	0.3	1.1	0.7, 1.9	0.6794
<i>Education</i>				
Less than secondary school graduation (Ref)				
Secondary school graduation	0.2	1.0	0.7, 1.4	0.9343
Some post-secondary	0.2	1.6	1.0, 2.5	0.0429
Post-secondary graduation	0.2	0.9	0.6, 1.1	0.2780
<i>Household Income</i>				
Lowest income (Ref)				
Lower middle income	0.3	1.4	0.7, 2.6	0.3194
Middle income	0.3	1.8	1.0, 3.3	0.0475
Upper middle income	0.3	1.5	0.8, 2.7	0.1746
Highest income	0.3	1.4	0.8, 2.6	0.2678
<i>Physical Activity Index</i>				
Active (Ref)				
Moderate	0.2	1.5	1.1, 2.2	0.0221
Inactive	0.2	2.0	1.4, 2.7	0.0000

OR=odds ratio; CI=confidence interval; REF=reference category; SE=Standard Error; Unwtd=unweighted
d= The reference Woman is White and Food secure with the following other characteristics: Aged 18-24, categorized as belonging to all other family types, less than secondary school graduation, lowest income and active.

e= HL goodness of fit [p< 0.001] but for Unweighted model [p=0.6873]

Men at the intercept had the following characteristics: food secure, aged 18-24, categorized as belonging to all other family types, white, less than secondary school graduation, lowest income household and active (Table 6.10). With respect to food security status and overweight/obesity, consistent with the univariable logistic regression results, the opposite relationship emerged in men compared to women in the multivariable analysis; however the results were not significant after adjusting for other potential predictors of overweight/obesity.

Significant predictors of overweight/obesity in men included age and cultural or racial origin. Men in all age categories were significantly more likely to be overweight/obese compared to men in the reference category (18-24 years of age). Southeast/East Asian men and men with a cultural or racial origin classified as 'other' were significantly less likely to be overweight/obese compared to men who were white [OR=0.2, CI=0.1, 0.5; OR=0.5, CI=0.3, 1.0 respectively] (Table 6.10).

Table 6.10 Final Model: Multivariable regression model predicting overweight/obesity by food security status in Men (weighted; n=4789) ^{d,e}

	SE	Adjusted OR	95% CI	p-value
<i>Food security status</i>				
Food Secure (Ref)				
Food Insecure without hunger	0.4	0.5	0.2, 1.0	0.0594
Food Insecure with hunger	0.4	0.6	0.2, 1.3	0.1568
<i>Age</i>				
18-24 (Ref)				
25-34	0.2	2.6	1.7, 4.0	0.0000
35-44	0.2	2.9	1.9, 4.5	0.0000
45-54	0.2	3.0	1.9, 4.7	0.0000
55-64	0.2	4.0	2.5, 6.1	0.0000
65 or older	0.2	4.0	2.8, 5.6	0.0000
<i>Family Type</i>				
Other (Ref)				
Parent w/ spouse/partner and children	0.2	1.4	1.0, 2.0	0.0589
Single Parent with child	0.5	2.0	0.7, 5.5	0.2212
<i>Cultural or Racial Origin</i>				
White (Ref)				
Black	0.6	0.4	0.1, 1.6	0.2020
Southeast/East Asian	0.3	0.2	0.1, 0.5	0.0000
Off-reserve Aboriginal (4)	0.4	1.2	0.5, 2.6	0.7116
Other (5)	0.3	0.5	0.3, 1.0	0.0298
<i>Education</i>				
Less than secondary school graduation (Ref)				
Secondary school graduation	0.2	1.0	0.6, 1.7	0.9339
Some post-secondary	0.3	0.6	0.3, 1.2	0.1496
Post-secondary graduation	0.2	0.9	0.6, 1.3	0.4946
<i>Household Income</i>				
Lowest income (Ref)				
Lower middle income	0.5	1.4	0.6, 3.7	0.4596
Middle income	0.4	1.2	0.6, 2.5	0.6179
Upper middle income	0.4	1.3	0.6, 2.7	0.4475
Highest income	0.4	1.7	0.8, 3.6	0.1307
<i>Physical Activity Index</i>				
Active (Ref)				
Moderate	0.2	0.8	0.6, 1.1	0.1917
Inactive	0.2	0.9	0.7, 1.3	0.6662

OR=odds ratio; CI=confidence interval; REF=reference category; SE=Standard Error; Unwtd=unweighted
d= The reference Man is White and Food secure with the following other characteristics: Aged 18-24, categorized as belonging to all other family types, less than secondary school graduation, lowest income and active.

e= HL goodness of fit [p=0.3111] but for Unweighted model [p=0.3414]

Chapter 7 RESULTS: ENVIRONMENTAL SCAN OF POLICIES, PROGRAMS AND INITIATIVES TARGETING FOOD INSECURITY IN CANADA

7.1 Overview of Chapter 7

In this chapter we present the results of an environment scan of policies, programs and initiatives targeting food security, and where possible, food security and healthy weights in Canada. Specifically, this chapter draws together ideas from the peer-reviewed literature and grey literature to provide a broad summary of current discussions and policy recommendations to address food insecurity in Canada.

This chapter opens with a review of the purpose and objectives of this scan as well as a brief description of the policy issue under investigation (section 7.2). The following section, section 7.3, summarizes the results of this environmental scan. In section 7.3.1 we provide a background on traditional responses to individual and household level food security. In section 7.3.2, we provide a synthesis of on-going and recommended policies, programs and initiatives targeting food insecurity based on our scan of government websites, documents and the peer-reviewed and grey literature. Specifically, section 7.3.2.1 describes results from our scan of government websites and documents and section 7.3.2.2 discusses results from our scan of the peer-reviewed and grey literature. Finally, this chapter concludes with section 7.3.3 where we focus our discussion on findings from our scan specifically relevant to the association between food insecurity and healthy weights.

7.2 Purpose, policy issue definition and overview of empirical evidence on determinants and impacts of food security

7.2.1 Purpose

As described elsewhere (section 4.3.2), the second objective of this thesis was to synthesize existing information on policies, programs and initiatives targeting food

insecurity in Canada. Specifically, we sought to identify key Canadian articles and documents that discuss policies related to food security, and where possible, food security and healthy weights; to highlight new or existing policies, programs or initiatives in Canada with a stated objective of addressing food security, and where possible, food security and healthy weights; and finally to highlight key points of debate on new or existing policies and programs targeting food security.

As discussed in section 5.4, the purpose of this environmental scan was to initiate a policy discussion on food insecurity rather than to provide a systematic review of the issues. Although we acknowledge that a great deal of work in the policy field has been done in the area of healthy weights, it was beyond the scope of this environmental scan to review policies and programs targeting healthy weights. Rather, we chose to review the issue of food security, a possible determinant of healthy weights, and provide a more focused discussion on policies related to food security and healthy weights in one of the later sections of this chapter.

7.2.2 Policy issue definition and overview of empirical evidence on determinants and impacts of food security

Policy reviews often include a complete description, history and analysis of the issue under investigation; since the issue of food insecurity and its associated health outcomes were discussed at length in Chapters 1 and 2, only particularly relevant information is revisited here.

Food security status can be explored from several perspectives and on multiple levels: individual, household, community, regional, national and global.¹³ The main dimensions of food security can be divided into two central components: one's ability to

reliably *access* food and the *production and supply* of food.¹⁴ This environmental scan focuses on the former dimension of food security: individual and household level food security. The analysis presented in this chapter situates the issue of individual and household food insecurity within the context of socio-economic inequities.

The most important determinant of food security is income; however, other sociodemographic factors and characteristics such as education, race/ethnicity, family composition, housing status and the food environment, particularly the availability of affordable nutritious foods, may also affect food security status.¹⁵ For example, lone-parent families, especially those headed by women, Aboriginals, residents of more remote areas such as the Canadian territories, and students, are at an increased risk of food insecurity.^{62, 65, 67, 68}

Insufficient food, either in quality or quantity, has been associated with an increased risk of nutritional deficiency and poorer overall health.^{69-72, 74, 139} For example, food insecure individuals are at increased risk of reporting psychological distress, poor functional status, and multiple chronic conditions including overweight and obesity.^{70, 76, 83, 90} The latter association is consistent with the findings of this thesis in relation to women with food insecurity **with hunger**, as presented in Chapter 6.

7.3 Environmental scan results

Through our search of government websites we identified 20 potentially relevant documents, of which 18 are summarized here (not including Hansard recordings and website materials). Through our searches of NGO websites, we identified 8 potentially relevant documents, of which 7 are summarized here. Finally, through our searches of the peer-reviewed literature via Medline and HealthStar we identified 190 potentially relevant

citations, of which 16 are summarized here. As expected, several irrelevant documents were identified in our search; those summarized here were deemed to be “key” documents in this area. Several other relevant documents and materials summarized here were uncovered through reference searching and on websites; however, due to the add-hoc nature of this aspect of the search strategy, these materials were not quantifiable.

7.3.1 Synthesis of traditional strategies to address food security in Canada

On the whole, the most common strategies for addressing food insecurity can be organized along a continuum including: (i) short-term strategies, which provide immediate but temporary relief; (ii) capacity-building strategies, which aim to enhance personal and organizational skills and capacity; and (iii) redesign strategies, which examine social and economic structures influencing food security, often with changes to policy as the main outcome goal (p. 5).¹⁴⁰ In Canada, both the awareness of and responses to food insecurity have originated from community-level organizations, the majority of which focus on the provision of free or subsidized foods; these initiatives tend to fall into categories (i) and (ii) above, and are sometimes administered in part through the use of government funds.^{61, 141}

7.3.1.1 Short-term strategies

One of the most common responses, and still today the primary response, to food insecurity in Canada is the food bank, a charitable organization that collects and distributes donated foods to a portion of the food insecure^{61, 142, 143}; there are 649 food banks across Canada.¹⁴² Food banks rely largely on donations from the public and from producers, processors and retailers to provide food assistance, and therefore the quantity and quality of the foods distributed is contingent upon these donations.^{60, 143} Given the supply-driven nature of food banks, it is not surprising that research has shown that the food available for

distribution is often of poor quality and limited in quantity.^{60, 61, 144} For example, in 2006, 34.5% of Canadian food banks reported difficulty in meeting demand.¹⁴² Moreover, food banks are not necessarily located where needs are highest and hours of operation can sometimes affect access to food.^{73, 145} Food banks were originally construed as a temporary food relief operation, but they continue to proliferate across the country; it is generally agreed upon that they are a “Band-Aid” solution, offering important immediate assistance but not yielding sustainable solutions.^{60, 61, 73}

Thus the adequacy and appropriateness of food banks as a response to food insecurity continues to be heavily criticized.^{14, 61, 73, 141, 143, 144, 146, 147} For example, a critical examination of community-based responses to household food insecurity in Canada notes that the sustained and increasing demand on food banks is linked to high levels of poverty, unemployment and underemployment and to cut-backs in publicly funded social programs in Canada beginning in the early 1980s.⁶¹ Tarasuk (2001) argues that “food banks effectively frame household food insecurity as a *food* problem that can be addressed by giving food” (p. 489).⁶¹ Notwithstanding the good intentions of food banks and the important role they play in terms of acute hunger relief, it has been argued that they perpetuate the erosion of the social welfare system by placing the responsibility of access to adequate food in the hands of charitable organizations rather than focusing on government social policies such as income support programs.^{61, 143, 144} Other examples of short-term strategies include soup kitchens and school-feeding programs, which provide free food to children, adolescents and adults, as an alternative to eating at home but they tend to be smaller in scale relative to food banks.

7.3.1.2 *Capacity-building strategies*

Concern over the appropriateness and adequacy of food banks as a means of addressing food insecurity gave rise to several alternative community-level responses to food insecurity such as field-to-table programs, collective kitchens, community gardens, and consumer education programs.^{73, 141} While most of these programs provide free or subsidized food, some focus on alternative methods of obtaining food (e.g., community gardens, field-to-table programs, 'good food' boxes) and/or on enhancing food preparation and shopping skills (e.g., community kitchens, consumer education programs); most are participatory.^{14, 61, 141, 148-150}

Common to all of these community-based initiatives is the intent to create more sustainable solutions and to foster personal empowerment and community action by way of mutual support strategies. Still, they can vary considerably in terms of structure and goals. Similar to short-term strategies they tend to involve free or low-cost food provision, but differ significantly because they also involve components of nutrition education and social support. Another important distinction between food banks and these community-based programs is their origins. While food banks arose largely in the voluntary and charitable sectors and typically receive minimal government funding¹⁴², community-based programs are more often funded by the government, through the public health and social sectors.⁶¹

While these community approaches may promote self-help and community development as well as deliver valuable social, psychological and community benefits, the effectiveness of such programs in alleviating food insecurity has yet to be demonstrated in systematic and rigorous evaluative research.^{45, 61, 73, 141, 151} There is some empirical research evaluating community kitchens (which consist of small groups of individuals pooling

resources to buy foods and cook together).¹⁵² This research suggests that community kitchens improve household self-reliance in two ways: one, by directly providing more food and two, by helping individuals to develop enhanced shopping and cooking skills, facilitate better management of limited funds.⁶¹ Thus, some community kitchens effectively augment household resources, build skills and foster mutual support.^{61, 151-153}

Tarasuk believes that community-based programs have come under little scrutiny because there was a broad consensus that alternatives to food banks were needed.⁶¹ Despite the fact that these community approaches sought to provide a better alternative to food banks, they maintain a focus largely on food and food behaviours and seek to enable individuals to manage more effectively within current social and economic structures and to better cope with their poverty.⁶¹ While some believe these programs may have a role to play in lessening food insecurity, others question the extent to which food skills can compensate for inadequate income and defend against food insecurity among poor families.^{61, 149, 154, 155} Given budget deficits among the food insecure, Tarasuk argues that the food subsidies and nutrition supplements provided by these programs are likely too small to be meaningful in terms of improved access to nutritious foods.¹⁴⁶ Indeed, since research suggests that people with fewer resources may make food choices based on cost,^{49, 51-53} some have argued that the nutrition education component of these programs may have little impact on diet quality.¹⁴⁶ This argument is supported by a study that found that implementing nutritional recommendations is challenging for low-income individuals, since the types of information given and the education process used are not always relevant for the most vulnerable groups.⁴⁶ In particular, the standard lists of healthy foods provided by nutritionists and educators were often unfamiliar, objectionable or too expensive for the individuals in the

targeted group.⁴⁶ Thus, some authors have argued that community-based programs to address food insecurity would actually be more likely to succeed if participants already had a baseline amount of necessary and basic goods such as a reasonable income, quality housing, training/education and child care.^{73, 141} As Travers has noted, diet inequalities reflect social inequalities and are not merely the result of poor individual life style choices.⁴⁶ Thus, she argues that if we continue to focus on changing individual behaviours without considering the environment in which people live and work, inequalities in nutritional health will only grow.⁴⁶

Additional criticisms of community-based programs are their small-scale nature and ad-hoc structures representing “stop-gap” solutions;⁷³ not all food insecure individuals are comfortable participating in charitable food programs and their locations and operating hours may affect access;¹⁴⁵ and the reach of many programs may be insufficient or incorrectly targeted.⁶¹ In summary, Canadian community-based initiatives build on the model of short-term food provision (i.e., food banks) by adding components of capacity-building in terms of education and social support. These initiatives, though, still cannot overcome the systemic poverty that underlies food insecurity.^{61, 148}

7.3.1.3 Redesign strategies: broad public policy initiatives

Generally, public policy in Canada to address food security has come in the form of income-support programs. Social welfare policies, such as progressive tax systems, social assistance programs and child benefit programs provide examples of higher level policies or redesign strategies influencing food security status.¹⁵⁶ This appears to be the least well-developed means of addressing food insecurity in Canada and is the focus of much critical attention in the food security literature.

7.3.2 Synthesis of on-going and recommended policies, programs and initiatives targeting food insecurity

7.3.2.1 Insights from our scan of government websites and documents

Our searches of government websites and documents revealed widespread recognition of the public health significance of food insecurity and its importance as a determinant of health, but few government policy documents providing specific or actionable recommendations for addressing it. When we did find explicit recommendations, they were often found in reports commissioned on behalf of the government and thus did not necessarily reflect the views of the government. As such, rather than discuss these findings here, we have opted to do so in the following section where we summarize our scan of the peer-reviewed and NGO grey literature.

Examples signalling a new awareness of the importance of food security among policy-makers abound and include: food security as an agenda topic at workshops, conferences and summits (particularly in agricultural departments)^{157, 158}; dedicated sections of some provincial websites to food security¹⁵⁹; discussions related to food security in recent official transcripts of provincial legislative assembly debates^{160, 161}; a growing commitment, in terms of funding, to food security initiatives such as community kitchens, gardens and school based programs, food security case studies, food security working groups, the inclusion of food security in healthy living strategies (for example, in Saskatchewan, Alberta, Quebec and Ontario) and finally the introduction of food security as one teaching focus to high school curricula.¹⁶²⁻¹⁶⁷

Specifically, at the provincial and territorial level, governments have released a host of documents linked to food security and poverty reduction policy over the last few years.

The following few examples are offered as an illustration:

- British Columbia's Framework for Core Functions in Public Health, which identifies food security as a core public health function;^{168, 169}
- Alberta's Social and Health Equities Network, a network which brings together practitioners, researchers and policy-makers to work together on issues such as food security and affordable housing;¹⁷⁰
- Saskatchewan's Population Health Promotion Strategy, which addresses the accessibility of nutritious foods;¹⁷¹
- the Manitoba Food Charter and Northern Food Prices Report, which explores strategies to reduce the high cost of food in Northern Manitoba;^{172, 173}
- Quebec's Act to Combat Poverty and Social Exclusion, which includes a section on food security and its Food Security Program which is currently being updated;¹⁷⁴
- Nova Scotia's Strategic Framework Project on Shaping the Future of Continuing Care which includes food security as a key issue under financial/poverty services;¹⁷⁵ and finally,
- Newfoundland and Labrador's Poverty Reduction Strategy, an integrated government wide strategy to alleviate the impacts of poverty.¹⁷⁶

The majority of these reports recognize that the main solution to food insecurity is to reduce poverty; however, most fall short of providing specific recommendations on how to do so; rather, they often summarize current government policies, programs and initiatives in place within their respective jurisdictions with a mandate to reduce poverty, and in turn, food insecurity.

Some of the provincial strategies noted above are particularly comprehensive and warrant further analysis; two Canadian provinces, Quebec (2002) and Newfoundland and Labrador (2005), have introduced anti-poverty strategies. In Quebec, the anti-poverty strategy was the result of a broad based public pressure movement "Le Collectif pour un

Québec sans pauvreté” and resulted in the unanimous adoption of the *Act to Combat Poverty and Social exclusion* by the provincial legislature in 2002.¹⁷⁷ The main objective of this strategy is to achieve, by 2013, one of the lowest poverty rates in the world. The Act includes on-going implementation and evaluation of the strategy by an advisory committee made up of anti-poverty groups and various other sectors of Quebec society. Actions related to enhancing the social environment must be aimed at facilitating dignified access at a reasonable cost for low-income residents to a food supply that is both sufficient and nutritious and to simple education materials enabling those persons to make better dietary choices. The Act also stipulates monitoring, research and discussion around the provision of reliable and objective information on poverty and social exclusion; these goals, targets and initiatives are accompanied by a substantial budget detailed through progress reports.¹⁷⁷

Newfoundland and Labrador’s anti-poverty strategy surfaced as a result of a government election promise, and consultation with various community stakeholders in the design and implementation of the strategy ensued.¹⁷⁶ The overall goal of this province’s strategy is to be the province with the least amount of poverty in the country, and similar to Quebec, monitoring of the strategy through poverty indicators and budgetary allocations, are also instrumental parts of the strategy.¹⁷⁶ While numerous issues related to food security are addressed, such as wage and social assistance levels, as well as affordable housing, food security itself is not specifically highlighted in this poverty reduction strategy.¹⁷⁶

In addition to having an anti-poverty strategy, Quebec also has a specific strategy dedicated to achieving food security in the province: “Programme de subvention en sécurité alimentaire”. The program is currently undergoing revision and the revised program was scheduled to be circulated to the Quebec public health regions for consultation in late April

2007.¹⁷⁴ British Columbia has recently identified food security as a “core program in public health” under the “health improvement core programs”. This is an important development because it places the responsibility of food security within public health departments across the province. It is hoped that these core programs in public health will reduce the burden of disease, disability and injury in B.C and in turn improve overall health in the province. In order to monitor performance in core programs, regional health authorities (RHAs) in B.C (i.e. public health departments) will require performance indicators. In response to B.C’s Framework for Core Functions in Public Health,¹⁶⁹ and in recognition of this need, Rideout and colleagues developed a model for RHAs to operationalize food security and develop indicators for its measurement.¹⁷⁸ To do so, they considered 3 basic questions on which to base their food security indicators for use at the regional level: 1. How will the indicators be used-as passive monitors of public health performance, to measure changes in programming over time, or for cross-regional comparisons? 2. With whom will the indicators be used-the entire population or specific vulnerable groups? 3. What resources and data are available to develop and monitor performance on the indicators?

This process resulted in an effort to balance competing needs among RHAs, including the need for RHAs to work with community stakeholders in addressing food insecurity and the practicality of identifying valid indicators and putting them to use. Five classes of indicators were identified (Direct, Indirect, Consequence, Process and Supra-regional), each with multiple focus levels (e.g. whole population level, vulnerable population level) and corresponding indicators (e.g. incidence of food security as measured by biannual CCHS, income indicators); they vary extensively from direct individual level measures to broader policy level measures outside of RHA jurisdictional boundaries. These

18 indicators are intended to be used in combination and are intended to be generalizable to the whole of Canada. Of note however, is the fact that “underweight” rather than “overweight” is used as an outcome indicator; in light of empirical evidence, both could be included as indicators.

At the federal level, Health Canada’s Food Directorate and the Office for Nutrition Policy and Promotion (ONPP) work with their F/P/T partners on a variety of food related issues, including food security.¹⁷⁹ One of the main responsibilities of ONPP is policy and standard setting; ONPP’s closest working partners include the Federal Provincial Territorial Group on Nutrition (FPTGN) and the Network on Healthy Eating.¹⁸⁰ ONPP policy related work is anchored by a key Canadian report in the area of nutrition: *Nutrition for Health: An Agenda for Action*.¹⁸¹ This report, published in 1996, was intended to support the integration of nutrition considerations into various Canadian policies and programs within the health, agriculture, education, social and economic sectors. Although dated, this report recognized the importance of changing social programs in Canada and the potential impact this would have on the nutritional health of Canadians. While this report did not specifically address food security, the nutritional vulnerability of lower income groups was highlighted and some key actions were articulated with respect to nutritionally vulnerable populations.¹⁸¹

- 1- Work with social policy decision makers to address the nutritional needs of vulnerable people.
- 2- Develop a database to better define the vulnerable populations and to better understand their food and nutrition issues.
- 3- Monitor the cost of a nutritious food basket and use this information in the development of education programs and income support initiatives.
- 4- Strengthen the food and nutrition component of community programs and services for vulnerable groups, including acute and chronically ill people.

- 5- Provide broader and more consistent access to prenatal nutrition programs for vulnerable pregnant women.
- 6- Ensure that families have the supports they need to nourish their children adequately.
- 7- Ensure that nutrition is part of the continuing care programs in the community.
- 8- Support community meal programs to meet the nutritional needs of seniors or those who cannot leave home.

To this author's knowledge, the first federal report specifically addressing food security in Canada was developed in response to the World Food Summit Plan of Action. Canada was one of the key signatories of the World Food Summit and *Canada's Action Plan for Food Security* (1998) underscored our commitment to a multi-sectoral collaborative approach including all levels of government, non-governmental organizations and private institutions.¹⁸² It built upon commitments set forth in previous domestic documents such as *Canada's Nutrition for Health: An Agenda for Action* (1996)¹⁸¹ and on a variety of international commitments affecting food security. It recognized poverty reduction, social justice and sustainable food systems as essential components of any meaningful food security plan.¹⁸² This document was intended to be a work in progress, and was to form the basis for further discussions on the specifics of implementation such as timing, responsibilities and actions.

Canada's Action Plan for Food Security (1998) put forth a set of 10 "highest priority" areas which included:

- 1- the right to food and the clarification of the meaning of this right toward its full and progressive realization;
- 2- the reduction of poverty, based on the notion that having adequate resources is the main determinant of food security;
- 3- the promotion of access to safe and nutritious food for everyone;

- 4- ensuring food safety including actions to ensure safe supplies and the safe handling of foods;
- 5- acknowledgement of traditional food acquisition methods of Aboriginal and coastal communities;
- 6- greater focus on food production, emphasizing the role of research, rural development, and investment in the productivity of the agriculture and agri-food sector;
- 7- emphasizing environmentally sustainable approaches to food production;
- 8- a better understanding of issues surrounding fair trade;
- 9- acknowledgement of peace as a precursor to food security;
- 10- establishing a monitoring system for food security in order to develop appropriate responses and to monitor their effectiveness (p.6-8).¹⁸²

As was previously mentioned, the scope of this environmental scan was, for the most part, limited to individual and household food security in Canada and one's ability to reliably access food. As such, of the 10 priorities outlined above, priority two is of most relevance to the current environmental scan and will be discussed here in greater depth. The goal of priority 2 was to reduce poverty in Canada, and by extension food insecurity.¹⁸² A restructuring of Canada's social programs was acknowledged as a fundamental aspect of this priority because Canada's social programs are administered by all levels of government to help ensure that the basic needs of all Canadians are met; the challenge for governments is to follow a balanced approach of social investments while simultaneously exercising prudent financial management.¹⁸² *Canada's Action Plan for Food Security* also viewed emergency food relief, such as food banks, as a temporary solution and called for four specific actions under priority 2: (i) include the participation of civil society in the current evolution of Canada's social security system, (ii) in partnership with the provinces and territories, help prevent and reduce the depth of child poverty and promote attachment to the work force

through the National Child Benefit system; (iii) increase opportunities for labour force participation of persons with disabilities and Aboriginal people; and (iv) increase employability of young people through targeted scholarships and job creation programs (p. 16).¹⁸²

Since the publication of *Canada's Action Plan on Food Security*, four progress reports have been published. The most recent report, published by Agriculture and Agri-Food Canada in 2006, highlights Canadian initiatives undertaken in the previous two years to achieve the World Food Summit goals.¹⁶⁵ With respect to poverty reduction, the report highlights several important Canadian efforts such as the Youth Employment Strategy, the National Homeless Initiative, the National Child Benefit, Old Age Security, funding of community-based programs to address health disparities, and the subsidization of the transportation of nutritious food to remote communities; these programs are frequently supplemented financially by provincial and territorial governments. Numerous recently completed and/or implemented projects, all very diverse in nature, are also cited.¹⁶⁵ Some federal examples include: a commitment to the development of a National Food Policy Framework, analysis of the CCHS 2.2 (exemplified in this thesis), revision of Canada's Food Guide to Healthy Eating (2007), and adding food security as a core health indicator to Canadian comparable indicator reports. The progress report also highlights many P/T (provincial/territorial) policies, programs and initiatives, some of which were outlined above. For more details on F/P/T (federal/provincial/territorial) policies, strategies and initiatives, interested readers can refer to the 2006 progress report on Canada's national food security plan (p. 15-24).¹⁶⁵

The federal government also recently released *The Integrated Pan-Canadian Healthy Living Strategy* (2005), which includes a component on healthy eating and nutrition; this strategy includes a proposal to monitor the prevalence of food insecurity in Canada as an indicator of healthy eating and seeks to improve access to, and affordability of, healthy food choices.¹⁸³ Further, the Public Health Agency of Canada and Health Canada's Atlantic Regional Offices lead a joint initiative: the Healthier Food, Healthier People Project (2007).¹⁴⁰ The goal of this project was to build capacity to address food security in Atlantic Canada. The main outcome of this project was an inventory of Atlantic Canada food security initiatives and an Atlantic food security forum.¹⁴⁰

It is clear from our scan of government websites and documents that F/P/T officials in numerous portfolios, such as health, agriculture, and social development, have made significant efforts to advance the food security agenda, and have published a number of noteworthy documents linked to food security, such as *Canada's Nutrition for Health: An Agenda for Action* (1996), *Canada's Action Plan for Food Security* (1998), and the *Pan-Canadian Healthy Living Strategy* (2005). It is also clear though that there have been challenges in the implementation of these initiatives, and that there is a lack of coordination among F/P/T, municipal and regional health authorities and community/NGO organizations. To address this issue, the F/P/T ministers of agriculture tasked agricultural officials to provide a national food policy framework that would account for health, social and economic impacts.¹⁶⁸ Although work in this area is believed to be on-going, no updates have been published since 2004.¹⁶⁸

7.3.2.2 Insights from the peer-reviewed and NGO literature

Our searches of the academic literature and NGO websites and our follow-up with key contacts revealed that there are two primary types of organizations addressing food security in Canada (not mutually exclusive): those concerned with providing immediate food assistance, primarily through community-based programs, and those involved in advocacy and the provision of policy recommendations; the latter group includes academics involved in generating policy relevant research. Because community-based programs were discussed in some depth in an earlier section (section 7.3.1.1, 7.3.1.2), the objective here is to synthesize information related to policy and program recommendations from the literature.

From the foregoing synthesis of traditional methods for addressing food insecurity and our scan of government websites and documents, a number of limitations in addressing food insecurity were identified. Thus, it is not surprising that within the academic, research and advocacy communities, considerable attention is currently being given to the need to move beyond community-level responses to food insecurity and to consider substantial restructuring of the Canadian social welfare system. The rationale for this shift in focus from short-term and capacity-building strategies to redesign strategies is based on the arguments presented earlier whereby several authors note that while short-term and capacity-building strategies play an important role in addressing food security in Canada, they do not offer a sustainable solution to the problem nor do they address the main risk factor for food insecurity: poverty.

Compared to our scan of government websites and documents, our scan of the peer-reviewed and NGO literature revealed more specific guidance for addressing food insecurity. Specifically, five broad categories of policy options for addressing food

insecurity were identified (not mutually exclusive): (i) a rise in real incomes for low-income groups, through increases in minimum wages and/or social assistance, (ii) programs to create more affordable housing, (iii) increased access to education and training opportunities, (iv) increased access to affordable child care and finally, (v) policies that protect the cost of food staples.^{61, 141, 143, 148, 184-186}

These policy options speak to the determinants of health and food security collectively and are the subject of extensive policy debate.¹⁴¹ Each option and its underlying rationale are discussed in turn. However, there is no consensus on the most appropriate of these five options, nor is there a consensus on how best to implement them.

The first option, a rise in real incomes for low-income groups, through increases in minimum wages and/or social assistance, is based on the rationale that a clear connection exists between income and food security status.⁶²⁻⁶⁶ Any factor which limits household resources or the amount of money available to be spent on food (such as limited employment opportunities, housing, utilities, child care) may lead to food insecurity. In Canada, welfare incomes have not been indexed to inflation.¹⁴⁶ For example, in the province of British Columbia, welfare rates have reportedly not increased in 12 years.¹⁸⁷ Kerstetter, the former director of the National Council of Welfare, suggests that governments could ensure that welfare rates are adequate to meet basic needs by establishing the actual cost of needed goods and services in the local market place.¹⁸⁷ In addition, because fixed payments, such as rent, are usually due at the beginning of the month, disposable income for food is particularly low at the end of the month, suggesting that social assistance paid out more regularly (for example, twice a month) might be helpful.¹⁵⁶ For the working poor, income

supplements and tax rebates, in addition to being insufficient, may not be issued frequently enough to be helpful.¹⁸⁸

Specifically, the Canadian Association of Food Banks (CAFB) recommends a renewed social transfer as the current Canada social transfer (CST) provides one lump sum of funding to the provinces and territories for post-secondary education, social assistance and social services with few restrictions on how it is to be spent and no monitoring mechanism to measure its effectiveness.¹⁴² CAFB's position is that this block of funding should be divided into two components: one block for education and one for social assistance, to create greater transparency in spending; they also recommend a new funding formula and enforceable spending standards.¹⁴²

Most Canadians who are food insecure are working; two thirds report employment as their main source of income and the CAFB reports that a growing number of food bank users have paid work as their main source of income, an issue they find particularly worrisome.¹⁴² The working poor often do not qualify for employment insurance (EI), are not members of a union and do not receive additional health and dental benefits; the latter issue is reported as a significant disincentive for Canadians wishing to make the transition from welfare to a low-paying job, especially for those with a family.^{142, 189}

While minimum wages continue to rise throughout the provinces, they are still considered insufficient to provide basic necessities; an individual working full-time on minimum wage would still be living below the poverty line (based on at least three poverty measurement scales, including Statistics Canada low-income cut offs).^{142, 189} Calls to move toward a "living wage", a wage at which basic needs can be met and where individuals working full-time would earn an amount equal to the Statistics Canada low-income cut-off

rate, speak directly to this issue.^{190, 191} Because minimum wages fall short of meeting basic needs, including food, and due to an increase in part-time/short-term employment, anti-poverty advocates argue that programs designed to supplement the wages of the working poor are inadequate.^{142, 143, 146}

The second policy option frequently suggested in the literature is to create more affordable housing programs.^{61, 142, 143, 186} The primary rationale for this policy option is that food needs in low-income households often give way to shelter needs; if housing were more affordable, more money would be left over to be spent on food. Housing is considered affordable when households spend 30% or less of their gross income on housing.¹⁹² In response to affordable housing shortages, the federal government developed a federal homelessness strategy in 1999 and established the Affordable Housing Framework Agreement in 2001 (680\$ million for new housing over five years).¹⁸⁶ As part of this agreement, F/P/T governments agreed to build more social housing units.¹⁸⁶ Yet, one year later, outside of Quebec, fewer than 200 new units had reportedly been built.¹⁸⁶ Currently, shelter allowances and social assistance rates fall short of average rental costs,^{142, 193} and waiting lists for social housing remain long.¹⁴² Food security advocates support a national housing strategy where rent is geared to income and capped at affordable rates.¹⁴²

In terms of option three, to increase access to education and training opportunities, the underlying rationale is that education and training programs would likely lead to better paying and more secure and safe employment opportunities.¹⁴⁸ Increased employment opportunities and employment programs would help to assist low-income groups enter the workforce, thereby enabling more individuals to earn their own income.

Likewise, the premise underlying the fourth policy option, to increase access to affordable day care, is based on the argument that the significant cost of child care poses a barrier to employment.^{61, 142} Affordable day care might ease the burden of parents, especially low-income and lone parents, in turn creating more training and employment opportunities for them, and thus, food security. This option is especially relevant for groups vulnerable to food insecurity such as single parents, particularly women. Although the majority of mothers and fathers are in the workforce, in 2006, regulated child care spaces were available for only 15.5% of Canadian children.¹⁴² An historic agreement reached in 2003 among F/P/T governments on child care collapsed with changing parties in the federal government; the newly elected government announced plans to cancel the federal-provincial child care agreement and replaced it with a non-progressive taxable allowance of \$1200 per child per year, payable directly to families.^{142, 189}

Finally, option five recommends protecting the cost of food staples and of nutritious foods.¹⁴¹ Food staples often form the basis of a traditional diet; in Canada, marketing board policies protect the supply of staples but not their affordability.^{141, 155} Programs and policies which focus on providing affordable and accessible food staples may reduce barriers to their consumption.¹⁴¹

These 5 broad policy option categories were often discussed in parallel, and indeed, it was acknowledged that “without an effective social support system, one that meets a combination of interrelated needs, gains in one area will only go so far in making a sustainable difference in people’s lives” (p.39).¹⁴²

7.3.3 Policy synthesis specific to the observed association between food security and healthy weights

In our scan of government websites and documents and the peer-reviewed and NGO grey literature, we found very little information related to the potential association between food insecurity and healthy weights, both in terms of the number of reports discussing the issue and the depth in which it was discussed. This may be because research in this area has only recently emerged, particularly in the Canadian context, and public policy specifically addressing food insecurity is at an early stage of development. Four notable exceptions surfaced in our scan. In Alberta, a government supported environmental scan of food security initiatives and low-cost physical activity options is underway; the goal of this project is to identify and promote effective community approaches to address the factors that influence food security and access to physical activity as related to the prevention of chronic diseases, including healthy weights and diabetes.¹⁶³ Thus, the connection between food insecurity and chronic conditions, such as overweight/obesity, is being explored. In Ontario, the 2004 *Chief Medical Officer of Health Report: Healthy Weights, Healthy Lives*, acknowledges that a low income can compromise one's dietary choices, weight and health.¹⁹⁴ The report states that the association between food insecurity and overweight/obesity requires further study and recommends an investigation of the potential impact of food pricing on consumption patterns, particularly for communities where the cost of healthy foods may be higher.¹⁹⁴ Reports such as these signal awareness among policy-makers of the potential impact of food insecurity on healthy weights. These reports also suggest that policy-makers are becoming aware of the need to consider the economics of food choices when developing policy. One of the key explanations underlying the observed

association between food insecurity and overweight/obesity is that it is mediated in part by the higher costs of healthy eating.⁴⁴

This issue has also surfaced in reports published by NGOs. In their most recent report, the CAFB devoted a section of their report to Health and Low-income, in which they briefly discussed their first-hand experience with the counter-intuitive relationship between food insecurity and overweight/obesity.¹⁴² Of the 447 food banks that responded to their annual survey, approximately 200 indicated that they are making efforts to improve the nutritional quality of the foods their clients acquire and/or are attempting to make direct changes to the foods they distribute.¹⁴²

The most salient Canadian example of this new awareness comes from a recently published case study that profiles a Montreal-based Taskforce's recent efforts to increase awareness about the extent, causes and consequences of food insecurity in Quebec and Canadian society.¹⁴³ The report notes that because the foods available for distribution from charitable organizations, such as food banks, are often limited, staff members have historically paid more attention to supplying sufficient food quantities rather than to the quality of foods supplied. In fact, in the past, public health questions about food distribution at food banks have largely been concerned with storing perishable foods properly, checking vigilantly for spoilage, sanitation and respecting "best before" dates.¹⁴³ This has changed with the establishment of the Taskforce on Hunger and Social Development for Metropolitan Montreal, profiled in the case study.¹⁴³ In noting that chronic conditions such as diabetes and obesity are quite common among disadvantaged groups, the Taskforce struggled to find a balance between the need to provide emergency food supplies and the long term health and social justice implications of the foods supplied. Quite remarkably, the

Taskforce recommended that food banks refrain from distributing certain foods that are known to promote overweight/obesity (e.g candy and sweets, sweetened cereals). While the group recognized that consuming such foods is not always harmful, they argued that the situation is very different when people have no choice but to eat these foods on a regular basis. In short, “adopting a formal policy on unacceptable food redistribution is meant to call attention to inappropriate donation practices, on the part of corporations and also the general public. The bodies of the poor are not to be used, from the Taskforce’s perspective, as so many recycling bins” (p.40).¹⁴³

While this policy scan has thus far been limited to the Canadian context, more attention has been given to this issue in the United States; one report published in the United States is described here given its particular relevance and its generalizability to Canada.⁹² As was mentioned in Chapter 2 of this thesis, a roundtable on *Understanding the Paradox of Hunger and Obesity* was held in 2004 in California; one area of discussion at this conference focused on the development of sensitive and effective policy solutions to this issue.⁹² The policy recommendations put forth at this conference and documented in the conference report were organized according to the four main explanations for a relationship between food insecurity and overweight/obesity presented in Chapter 2 (section 2.4). The recommendations have been adapted here so as to make them more relevant to Canadian public policy (for example, food assistance programs, such as food stamps, are not available in Canada, but we do have social assistance programs which are intended to cover the cost of foods).

If explanation 1, that food insecurity leads to the purchase and consumption of low-cost, energy dense foods that promote weight gain, were to be supported by the empirical

research, the report suggests that the policy recommendations would be complex, but might include requiring food assistance programs to meet minimal nutritional requirements,⁹² a suggestion supported by the Taskforce on Hunger and Social Development for Metropolitan Montreal.¹⁴³ An additional implication would be that more funding is needed for social assistance programs, so that recipients would be able to afford foods of more optimal nutritional quality, and perhaps to tie a physical activity program to assistance programs.⁹²

Should *explanation 2, that hunger is cyclical and leads to weight gain because of cyclical food consumption*, be supported by evidence, the main policy implication would be that social assistance programs should be delivered on a more frequent basis, so that money was spread out more evenly throughout the year,⁹² a recommendation supported by Canadian authors (for example, Rainville and Brink 2001).¹⁵⁶ Even more effective though would again be an increase in assistance rates so that recipients could meet basic living needs with their monthly allowance, a recommendation also cited in Canada.^{141, 142, 146, 148}

If there were support for *explanation 3, that food insecurity and obesity results from the social and economic experience of poverty*, the policy implications would be similar but recommended strategies would be more broadly focused on alleviating poverty at the community and household level to curb both the prevalence of food insecurity and overweight/obesity.⁹²

Finally, the policy implications for *explanation 4, that food insecurity is a stressor that leads to a weight related stress responses*, would include recommended interventions in both areas, food insecurity and mental health.⁹² For example, the provision of publicly funded mental health services targeted towards populations vulnerable to food insecurity might be recommended. Most of these policy recommendations are in line with those

summarized earlier: that economic resources need to be augmented at the household level and more publicly funded services are needed to adequately address food insecurity, and its health consequences, at the population level.

Chapter 8: DISCUSSION AND CONCLUSIONS

8.1 Overview of Chapter 8

In this final chapter, we summarize the findings of this study, discuss our findings in the context of other research in this area and discuss implications for future research and policy practice in the area of food insecurity and healthy weights. Specifically, in section 8.2.1 we summarize the findings from our analyses of the Canadian Community Health Survey 2.2 in relationship to the work of others (section 8.2.1.1), discuss explanations for a potential relationship between food insecurity/overweight/obesity relationship (section 8.2.1.2), and offer some explanations for our findings regarding sex differences, family type and income in relation to the primary relationship under study (sections 8.2.1.3, 8.2.1.4 and 8.2.1.5 respectively). In section 8.2.2 we summarize the findings from our environmental scan of policies, programs and initiatives targeting food insecurity in Canada. Sections 8.3 and 8.4 respectively discuss this study's major strengths and limitations. Finally, in section 8.5, we discuss, based on our findings, implications for future research, policy and practice in the area of food insecurity and healthy weights from which we draw our final conclusions in section 8.6.

8.2 Discussion

This study examined the relationship between food insecurity and overweight/obesity among Canadian adults and subsequently explored whether or not this relationship differed by sex and family type. This study also provided a synthesis of policies, programs and initiatives (both in place and recommended) to address food insecurity in Canada, with some specific discussion around policies, programs and initiatives relevant to food insecurity and healthy weights.

8.2.1 Analyses of the Canadian Community Health Survey 2.2, 2004

8.2.1.1 Summary and comparison with previous research

The results from our analysis of a large national sample indicate that, after adjusting for sociodemographic and lifestyle factors believed to be important, food insecurity **with hunger** is related to overweight/obesity in women but not in men; food insecure women **with hunger** were significantly more likely to be overweight/obese than food secure women. However, in this study, there was little support for a relationship between food insecurity **without hunger** and overweight/obesity; the odds of being overweight/obese in both women and men who reported food insecurity **without hunger** were not significantly different from their food secure counterparts. Our findings support growing cross-sectional evidence, predominantly from the United States, for a positive relationship between food insecurity and overweight/obesity, mainly among women.^{65, 83-86, 89, 120, 126}

However, it is difficult to directly compare our findings to those of other published studies because of inconsistencies in food security measurement methods, especially in regards to the difference between food insecurity **with and without hunger**. Few studies have distinguished between food insecurity **with and without hunger**, which our findings suggest could be important. Of the studies which have distinguished between varying levels of food insecurity, our findings are consistent with those of Kaiser *et al.* (2004) who found that women who were food insecure **with hunger** were significantly more likely to be obese compared to food secure women using two different food security scales (please refer to Chapter 3 for study details)⁸⁵; our findings are also similar to those of Harrison *et al.* (2005) who reported that women in food-secure households had an average BMI of 26.8 compared to 28.2 and 28.4 among women in households reporting food insecurity **with and without**

hunger respectively (results significantly different at $\alpha=0.05$).⁸⁸ Adams *et al.* (2003) explored the food security/overweight/obesity relationship by race and reported similar findings to ours among Asians, Blacks and Hispanics (food insecurity **with hunger** associated with increased odds of obesity) but reported opposite findings in non-Hispanic white women and other racial origins (food insecurity **without hunger** associated with obesity, no significant association between food insecurity **with hunger** and obesity).⁸⁴ Finally, our findings might also be considered similar to those of the most recent cross-sectional study in which Holben *et al.* (2006) found that the prevalence of obesity increased linearly with increasing severity in food insecurity; this study, however, did not distinguish between men and women and the main analyses did not distinguish between food insecurity **with** and **without hunger**.¹²⁶

Our findings might be considered to be in contrast to those of Townsend *et al.* (2001), who found a positive association between “mild” food insecurity (comparable to food insecurity **without hunger**) and overweight/obesity in women but no association between “moderate” or “severe” food insecurity and overweight/obesity (comparable to food insecurity **with hunger**).⁸³

While no Canadian study has distinguished between food insecurity **with and without hunger**, other than the present study, generally speaking, our findings share some similarities to the findings of Che and Chen (2001) who reported a positive association between food insecurity and obesity and with those of Vozoris and Tarasuk (2003) who found that men in food insufficient households were less likely to be overweight.^{65, 70} While we did not find any significant associations between food security status and overweight/obesity in men in our adjusted models, in the unadjusted model, men who were

food insecure **without hunger** were significantly less likely to be overweight/obese than food secure men.

As hypothesized in Chapter 3, variations in the conclusions drawn about the postulated food security/overweight/obesity relationship across studies may be due to differences in: the study population, sample size, food security measurement, definitions of BMI cut-points denoting overweight and obesity, and control of potentially confounding variables. For example, the present study used a validated methodology to ascertain food security status based on the U.S. Household Food Security Scale¹⁸ and used measured height and weight data to calculate BMI; to our knowledge, the fact that this study used both a validated measure of food security and measured data to ascertain BMI is unique to Canadian studies in adults.

8.2.1.2 Explanations for a potential food insecurity/overweight/obesity relationship

Several potential explanations have been proposed for an observed positive relationship between food insecurity and overweight/obesity. The first (*explanation 1*) is that food insecurity, or inadequate resources to purchase foods, leads to the purchase and consumption of low-cost, energy dense foods that promote weight gain.^{52, 84, 92} Relatedly, while Canada's Food Guide to Healthy Eating recommends eating a variety of foods in order to meet nutritional requirements,¹⁹⁵ based on the literature reviewed in Chapter 2, it is reasonable to suggest that food insecure individuals are limited in terms of the variety of foods they consume. A recent review of dietary diversity in relation to diet quality, overweight and obesity, and food security found that eating a variety of foods is important for energy balance (to prevent weight gain).¹⁹⁶ We cannot directly determine whether or not this explanation would be supported in our sample because we did not examine the cost,

variety or energy density of the foods consumed by the respondents. Indirectly, though, if the food insecurity/overweight/obesity relationship could be fully explained by the purchase of low-cost energy dense foods, we might expect similar findings in men and women, and a gradient across levels of food insecurity, which was not the case in this study. Still, variations in physical activity levels at work, (physically demanding jobs vs. office jobs) between men and women, which were not accounted for in these analyses, might have a role to play in explaining how this mechanism might differ between the sexes.

The findings of this study might be more consistent with *explanation 2*, that because hunger is cyclical, it leads to weight gain as a result of cyclical food consumption.⁹² Overeating when foods are available and cyclical monthly eating patterns are well documented coping strategies among the food insecure.¹⁹⁷ Indeed, increases in disordered eating patterns have been reported as the severity of food insecurity increases.⁷⁵ Canadian data have shown significant variations in energy intake among low-income individuals, especially women, which likely reflects cycles in income availability.⁷⁷ One Canadian study found that in food insecure households, there is more food available in the first 3 weeks of the month than the last.⁷⁷ As Townsend has suggested, this type of cyclical eating behaviour is similar to binge eating, which can result in weight gain.^{83, 93, 94, 198, 199} Thus, the pattern of overeating when foods are plentiful followed by shorter periods of hunger may gradually lead to weight gain.^{83, 89} This explanation would be consistent with our findings in women, which showed that, food insecure women **with hunger** were more likely to be overweight/obese relative to food secure women, whereas food insecure women **without hunger** were not significantly more likely to be overweight/obese. On the other hand, the

severely food insecure, a category which was not analyzed independently in this study, may be more prone to weight loss due to severe cyclical food deprivation.^{87, 95}

The third explanation, sometimes referred to as the third factor explanation, posits that food insecurity and overweight/obesity occur together as a result of the social and economic experience of poverty.⁹² In this explanation, food insecurity and overweight/obesity are social issues which result from poverty. Our findings do not support this explanation as we controlled for income and education, two important measures of socioeconomic status, and still found food insecurity **with hunger** to be strongly associated with overweight/obesity in women. That is not to say that social and economic deprivation are unimportant, rather there is broad consensus that poverty is the underlying cause of food insecurity such that if food insecurity leads to overweight/obesity, addressing poverty would improve food security. This could have an indirect impact on the burden of overweight/obesity. Rather, our findings suggest that poverty (as measured by household income level) is not a confounder in the food insecurity/overweight/obesity relationship, i.e. it does not fully account for the observed association. Still, it is possible that our poverty measures did not adequately capture the possible underlying third factor, that is, the experience of social and economic stigmatization implied here.⁹²

Finally, the fourth explanation is that food insecurity is a stressor that leads to a weight related stress response.⁹² The rationale here is that the stress experienced by the food insecure may induce certain psychological and behavioural responses, including disordered eating patterns, decreases in physical activity, depression and substance abuse, which may in turn lead to weight gain. Although we did control for physical activity levels, we did not control for depression or substance abuse. It is plausible though that women may be more

susceptible to stress induced weight gain and that stress levels would increase with increasing severity in food insecurity (i.e. **without hunger vs. with hunger**). Thus, it is possible that this explanation is not inconsistent with our findings.

While our findings are likely best explained by *explanation 2*, we can not confirm any of these explanations as we did not directly explore them and each warrants further study. Further research that replicates our findings and that directly explores these explanations is needed.

8.2.1.3 Sex differences in the food insecurity/overweight/obesity relationship

The sex difference in the food insecurity/overweight/obesity relationship found here, whereby a significant positive association was present among food insecure women **with hunger** but not among men, is interesting and consistent with our primary research hypothesis (food insecurity would be positively associated with overweight/obesity in women) as well as with several other studies.^{70, 83, 88} Our study findings also suggest the potential for an opposite relationship in men, whereby food insecurity may be inversely associated with overweight/obesity; these results were not significant though, so we cannot draw definitive conclusions.

It is still not clear why sex differences in the food insecurity/overweight/obesity relationship exist. Townsend *et al.* (2001), who used a representative U.S. population based survey of adults to explore this relationship, found similar sex differences, whereby no significant associations existed between food insecurity and overweight/obesity in men, and as an explanation, suggested that the comparison between men and women may not be appropriate as women who report food insecurity are often household heads whereas food insecure men often live alone.⁸³ The present study does not support this explanation as we

controlled for family type (one's role in the household) and sex differences persisted, although it is possible that this measure was not sufficient to capture the differences associated with varying family roles.

We offer the following alternate possible explanations for the sex differences we observed: i) we may not have had adequate sample size among men to detect any significant associations, as a high sampling variability was associated with all levels of food insecurity in men; ii) women and men may perceive food insecurity differently, and thus respond to the questionnaire differently, creating some form of a social bias in response patterns; (iii) based on the four postulated mechanisms underlying this relationship, it is possible that men and women respond differently both physiologically and psychologically to food insecurity. For example, men have different physiological responses to cyclic eating or experience poverty differently, which in turn leads to weight gain in women and weight loss or no change in men; (iv) activities at school and work were excluded from our physical activity measurement and it is possible, particularly among lower-income groups, that men work in more physically demanding occupations and thus have more of an opportunity to counteract the hypothesized overweight/obesity promoting mechanisms of food insecurity at play; and (v) finally, our method of overweight/obesity classification may have inappropriately classified some men as overweight/obese. For comparison purposes across the literature, and because it is a widely accepted method,¹⁻³ we chose to use the same BMI cut-point for women and men to classify respondents as overweight/obese ($BMI \geq 25.0\text{kg/m}^2$).^{6, 7} As previously discussed in Chapter 1, BMI has some important limitations such as the fact that it is more prone to error among very muscular individuals.⁵ This limitation in BMI may help to explain some of the difference in the food insecurity/overweight/obesity relationship

between women and men as well as the non-significant findings in men. Proportionately speaking, in this study, among those who were either overweight or obese, more women were obese than men, and more men were overweight than women (see section 6.2.1). As such, it may have been more appropriate to use a different overweight/obesity cut-point in women and men to explore this relationship, as some authors have done.⁸³ The fact that physical activity level was not significantly associated with overweight/obesity in men supports the possibility of some misclassification between normal/underweight and overweight/obesity men.

8.2.1.4 Food insecurity and income in relation to overweight/obesity

The lack of attenuation in the odds ratio for food insecurity as a predictor of overweight/obesity after controlling for income was surprising, and warrants discussion. Income and food security have been found to be highly correlated in previous studies,⁶²⁻⁶⁶ thus, we chose to explore models with and without income to examine the potential impact of income on the food insecurity/overweight/obesity relationship. Although we did not conduct a formal test of collinearity between food security and income, after exploring models with and without income, we found that the standard errors and odds ratios for food security and income categories did not change appreciably across the models, therefore, we concluded that collinearity was not an issue. Still, because income and food security status are so closely related, as was the case in this study, one might expect that after controlling for income, the relationship between food security/overweight/obesity might attenuate considerably. This was not the case here, as the relationship between food insecurity **with hunger** and overweight/obesity in women persisted even after controlling for income; the odds ratios, and their accompanying confidence intervals, were also largely unchanged in

men. An additional related finding of interest was that, at the univariable regression stage, no significant associations were found between household income level and overweight/obesity status with the exception of men in the highest income household who were more likely than men in the lowest income household to be overweight/obese.

We offer two possible explanations for our findings concerning the food insecurity, income and overweight/obesity relationship. First, perhaps both low and high-income women are prone to overweight/obesity for different reasons. For example, women in high income households may be more prone to pressure to be thin and thus voluntarily restrict food (binge diets) whereas low-income women may involuntarily restrict foods (binge eating similar to binge diet), with both cases potentially leading to weight gain. As previously discussed, cyclical eating is one of the primary explanations underlying the food insecurity/overweight/obesity relationship. Although income was not significantly associated with overweight/obesity in this study, a large proportion (nearly half) of all women were overweight/obese in any given income category. Because we know that income is associated with food security status, another possible explanation may be that low-income women, who are more likely to be food insecure, are overweight/obese as a result of being food insecure whereas higher-income women, who tend to be food secure, are overweight/obese as a result of overeating because foods are more plentiful in their environment.

Secondly, it is possible that our categorical income variable was not a sensitive enough control variable and that, had a continuous income variable been used, the relationship between food insecurity and overweight/obesity in women may not have been as strong with income in the model. This explanation is less likely though because, based on

our cross-tabulations, our categorical income variable clearly captured the expected gradient relationship between food security and income.

8.2.1.5 Food insecurity, family type and overweight/obesity

Finally, this study provided little evidence that any apparent relationship between food security status and overweight/obesity is modified by family type (one's role in the household). We had hypothesized that respondents with children who reported food insecurity would have been more likely than food insecure respondents without children to be overweight/obese; the rationale for this was that food insecure parents might sacrifice their own nutritional well-being for their children, putting them at an even greater risk for a poor diet and cyclical eating than their childless counterparts. This explanation warrants further study because we did not have a sufficient sample size to explore this relationship in detail; low cell counts for data representing those who were food insecure **with hunger**, and single parents, especially in men, were particularly problematic. A study which specifically samples low-income individuals would help to ensure sufficient power to explore this hypothesis.

8.2.2 Environmental scan of policies, programs and initiatives targeting food insecurity in Canada

To place our analyses of the survey data into an applied context, we endeavoured to synthesize existing information on policies, programs and initiatives targeting food insecurity in Canada; we also sought to identify policies, programs and initiatives intended to address the implications of food security for healthy body weights. The results of our environmental scan demonstrated that there is broad recognition of the importance of addressing food insecurity in Canada and awareness of its public policy implications. Still,

at the F/P/T government level, in spite of numerous publications on this topic, we found few concrete recommendations for addressing food insecurity, especially concerning the food security/overweight/obesity relationship. We found that many recently sponsored government programs are still relying on traditional methods of tackling food insecurity by funding more short-term and capacity-building strategies and making smaller changes to public social policies. We also found that there have been challenges in the implementation of many of these policies, programs and initiatives and a lack of coordination among F/P/T, municipal and regional authorities.

While critiques of these policies, programs and initiatives have commended government attention to the issue of food insecurity, they argue that current efforts are unsustainable and insufficient, primarily on the basis of their inability to overcome the systemic poverty that is generally agreed to underlie food insecurity. Based on our review, academics and advocates appear to be strongly in favour of redesign strategies for addressing food insecurity; there also seemed to be a consensus in the main recommendations offered by these communities. Specifically, we identified five broad categories of policy options for addressing food insecurity in this body of literature, which are not intended to be mutually exclusive: (i) a rise in real incomes for low-income groups, through increases in minimum wages and/or social assistance, (ii) programs to create more affordable housing, (iii) increased access to education and training opportunities, (iv) increased access to affordable child care and finally, (v) policies that protect the cost of food staples.^{61, 141, 143, 148, 184-186} Notably though, there was no consensus on the most appropriate of these five options, nor on how best to implement them.

We found far less recognition of the relationship between food security and overweight/obesity within a political or programmatic context, both in terms of the number of reports discussing the issue and the depth in which it was discussed, across all bodies of literature reviewed. The most relevant Canadian document identified was published on behalf of a Montreal Taskforce on Hunger and Social Development.¹⁴³ This Taskforce recommended that member groups refrain from distributing certain foods which are known to be obesogenic, with the specific intent of calling attention to inappropriate donation and distribution patterns to the poor. *Understanding the Paradox of Hunger and Obesity*,⁹² an American document, addressed this issue more directly and we chose to include it in our review owing to its direct relevance and because of the scarcity of Canadian literature on food insecurity and overweight/obesity.⁹² Interestingly, the recommendations offered in this document were very similar to those offered by the academic and advocacy communities for addressing food insecurity more generally: namely that economic and social resources need to be augmented at the household level and that more publicly funded services are needed to adequately address food insecurity, and its health consequences, at the population level.

8.3 Study strengths

This study had several unique features that strengthen its importance as an original contribution to the body of research on food insecurity and overweight/obesity. For example, an important aspect of this study was the use of a systematic review to help identify areas for improvement in this field of research, to select appropriate research questions and to inform the conceptual model which guided our analyses. Importantly, this is also the first Canadian study to explore, in detail, the relationship between food insecurity and overweight/obesity by sex and family type using a large national representative sample

of the Canadian population. Furthermore, to our knowledge, this study is the first in Canada to use both measured height and weight data and a validated measure of household food security to explore this relationship in adults; both used standardized protocols. Finally, the policy relevance of this study was enhanced by a broad environmental scan of policies, programs and initiatives in Canada targeting food security; and where possible, food security and healthy weights. The environmental scan is intended to provide a policy context through which we can interpret our analytic findings and is also a stand-alone document that can provide part of the information base for the development of plans and actions to enhance food security in Canada.

8.4 Study limitations

Although this study had a number of strengths, there were several limitations that may have influenced our study findings. The first is that because the analyses presented here were based on a cross-sectional data set, any inferences regarding cause and effect between food security status and overweight/obesity should be made with caution.

Additionally, because our analyses were based on a secondary data set, we were limited in terms of variable selection (e.g. what variables were available in the data set and the wording of questions in the survey). For example, physical activity was based on leisure time activities; activities at school and work were excluded and thus, overall physical activity levels may not have been accurately reflected. Also, psychological factors, such as stress, were not included in the analyses, and as Townsend notes, the food insecurity/overweight/obesity relationship observed here, and elsewhere, could be due to these or other unmeasured factors.⁸³

Another limitation is that, with the exception of height and weight, all data were self-reported, which may have introduced a variety of social biases. For example, it is possible that some information, such as food security and income responses, were misreported or underreported by some respondents, due to the sensitive nature of these questions, and the telephone survey format.

Also of note is the fact that not all Canadians were included in the sampling frame; homeless people, residents of the territories and on-reserve Aboriginals, who are more likely to be food insecure, were not sampled. As a result, our food insecurity numbers are likely underestimated for the Canadian population and we cannot generalize our findings with regard to the food insecurity/overweight/obesity relationship to these excluded groups.

In some cases, sample sizes were insufficient (food insecure men, some cultural origins, and single parent men) and thus the data for these categories was somewhat problematic (i.e the need for caution in disclosing results to avoid confidentiality breaches and low power). Although results are provided for all of these categories, they should be interpreted with caution because of the high sampling variability associated with these estimates. The need to sometimes collapse categories due to small cell counts may have had its own consequences. For example, we collapsed food insecure **with moderate hunger** with food insecure **with severe hunger**; we do not feel that this introduced any substantial biases as these categories are largely measuring the same thing in adults (repeated reductions in food intake and hunger sensation); where they differ is with respect to food insecurity in children at the household level. This method of collapsing food security categories is also supported by the Guide for the use of the U.S. Household Security Scale.¹⁸ As well, we collapsed the underweight category with the normal weight category to create a

dichotomous outcome variable; we do not feel that this introduced any substantial bias because the number of respondents in the underweight category was negligible. As previously mentioned, inadequate sample sizes were particularly problematic for our analyses of the effect of family type on the food insecurity/overweight/obesity relationship, an area of investigation which warrants further study.

Furthermore, there was a substantial amount of missing data for two key variables: measured BMI (~40%) and income (~11%). In terms of BMI, the analyses could not have been done with the entire data set (including self-reported height and weight) because we specifically wanted to take advantage of the accuracy of the measured height and weight data as no other Canadian study has been able to do so. This level of non-response for BMI may have biased estimates if respondents differed systematically from those for whom measurements were obtained. Tjepkema (2005) explored differences between those respondents who provided measured data vs. those who did not in this data set. Men who provide measured data differed significantly from those who did not provide measured data by age, province and household income. In the same study, women who provided measured data differed significantly from those who did not provide measured data by province, fruit and vegetable consumption, marital status, and finally household income.²⁵ The magnitude of this non-response bias was substantially reduced by the use of a special technique: a special weight, created by Statistics Canada for use with the data set reduced to respondents with measured height and weight data was used here (section 5.3.1.1).

With respect to the income variable, we compared the characteristics of respondents in our final analytic sample to the characteristics of respondents in a sample including those with missing income data. We found only minor differences. Thus, we believe that any bias

introduced in removing respondents with missing data on the income variable is negligible and that our analytic sample is still very generalizable to the Canadian population.

Finally, the main limitation of our environmental scan was the lack of information on food insecurity in relation to overweight/obesity.

8.5 Conclusions: Implications for research, policy and practice

Over the past 5-10 years, researchers have begun to investigate the somewhat paradoxical positive relationship often observed between food insecurity and BMI. The majority of these studies have been published in the United States and have been characterized by limitations in study design such as lack of validated measures of food security and self-reported BMI.

Based on the findings of this thesis, we have identified seven specific implications/priorities for research, policy and practice in the area of food insecurity and healthy weights (not mutually exclusive): (i) additional studies in Canada are needed in this area for comparison purposes and to confirm our results; (ii) longitudinal studies in this area are needed to determine whether or not food insecurity leads to overweight/obesity; (iii) longitudinal studies carried out in the future should explore, in greater detail, the mechanisms (explanations) through which food insecurity may be linked to weight status; (iv) central to research in the area of food insecurity and healthy weights is the need for a more thorough understanding of the nature and extent of food insecurity and poverty; (v) more policy evaluation research in the area of food security is needed; (vi) intersectoral collaboration will be required to address food security and the role of government in addressing food security needs to be clarified to successfully move forward; and (vii) a

system to monitor food and nutrition status, as well as food insecurity among Canadians is needed. Each of these priorities is discussed in greater detail in the following sections.

First, additional studies, which use robust measurements, such as the ones used in the analyses presented here, are needed in Canada to allow for comparison between studies and to provide greater confidence in study results. Priorities in this area of research might include further exploring sex differences in the food insecurity/overweight/obesity relationship, examining the difference between food insecurity **severity levels** and its implications for body weight (for example, specifically exploring body weight and severe food insecurity, a category which was not analyzed independently in this study) and further research on the impact of family type on the food insecurity/overweight/obesity relationship, as our analysis was limited in this area. Studies which specifically sample low-income individuals would help to ensure sufficient power to explore these areas further.

Second, when feasible, future studies must focus on using rigorous study designs. If longitudinal data were available, the timing of the relationship between food insecurity and overweight/obesity could be established. Two longitudinal studies, from the United States, published by the same authors, have recently explored the relationship between baseline food security status and subsequent weight gain; both were based on the same sample. In the first study, Jones and Frongillo (2006) favored *explanation 4*, that household food insecurity acts as a stressor in a woman's life and may lead to stress-induced weight gain, and hypothesized that this relationship could be modified by participation in the U.S. food stamp program (FSP) (i.e. participation may offset the effects of food insecurity on weight gain).¹²⁰ The results of the first study indicated that persistent food insecurity among women was associated with a smaller weight gain compared to weight gain in the persistently food

secure women, controlling for other important risk factors, and that weight gain among the food insecure was offset by participation in the FSP.¹²⁰ There were no significant associations between change in food insecurity status and weight change in the data explored.¹²⁰ In light of these findings, the authors suggested that the results might be consistent with the third factor explanation (*explanation 3*); they also suggested though that it is very likely that weight gain that leads to obesity, full participation in FSP, and persistent food insecurity result from a longstanding process that was not adequately captured by the variables included in their models. They suggested that the effects of long-term poverty and the resultant stress could be examined in future studies with more observation points over time.¹²⁰ In their second longitudinal study, Jones and Frongillo (2007) specifically sought to determine if food insecurity leads to subsequent weight gain.¹²⁷ Overall, their findings did not suggest that food insecurity is associated with subsequent weight gain in women over a 2-year period as there were no significant differences in the percentages of women who gained a clinically significant amount (defined as 2.3 kg) by food insecurity status.¹²⁷ Because the findings of these two longitudinal studies are inconsistent with several studies based on cross-sectional designs, more longitudinal research is needed to confirm their findings.

Third, because several factors are associated with food security and weight status, longitudinal studies carried out in the future should explore, in greater detail, the mechanisms (explanations) through which food insecurity may be linked to weight status using multiple robust measures of food insecurity and weight status over a longer period of time.¹²⁷ For example, McIntyre and Tarasuk, two Canadian researchers in this area, are currently investigating *explanation 2* to determine whether or not cyclical eating patterns

among food insecure women are related to unhealthy body weights.²⁰⁰ It might also be worthwhile to do further research using the CCHS 2.2 (2004) using the detailed nutrition information available in the 24-hour dietary recall component of the survey to explore the energy density and variety of foods consumed among the food secure and insecure to shed light on the merits of *explanation 1*. Longitudinal research studying the different explanations may also help to determine the most appropriate policies, programs and interventions.^{83, 92} Should future research demonstrate that food insecurity does in fact lead to overweight/obesity, the policy implications could be tied directly to the mechanism underling this relationship. For example, as we discussed in our environmental scan, should *explanation 1* be supported by empirical research, policy recommendations might include requiring food assistance programs to meet minimal nutritional requirements and/or an increase social assistance rates.⁹² If, on the other hand, *explanation 2* were to be supported by empirical evidence, the policy recommendation might be to distribute social assistance funds more frequently to help curb cyclical eating.⁹²

Fourth, central to research in the area of food insecurity and healthy weights is the need for a more thorough understanding of the nature and extent of food insecurity and poverty. Specifically, researchers and policy-makers could seek to better understand the daily realities of food insecurity in Canada. This may also help to clarify the possible role of each explanation in the food insecurity/overweight/obesity relationship, which could in turn assist policy-makers in determining what types of environmental changes are most important. For example, researchers could conduct in depth studies of food insecure individuals and families over time and find that food security status may be more influenced by the pattern of inflows and outflows of resources within the month or year, rather than the

overall relationship between income and expenditures.¹⁸⁸ This would have similar policy implications as for *explanation 2* regarding the distribution of social assistance.

Fifth, some research has explored the associations between food security and SES and various health outcomes, including overweight/obesity, our environmental scan illustrated that there is little policy documentation on the observed association between food security and healthy weights and few evaluations of the effectiveness of policies that aim to address food insecurity; no evaluations here considered both issues together. One of the obvious implications of this finding is that more policy evaluation research is needed.

Sixth, it is also clear from our environmental scan that intersectoral collaboration will be required to address food security and that the role of government in addressing food security needs to be clarified to successfully move forward.^{146, 184, 185} Because the factors that contribute to food security are wide ranging, policy responses will need to be diverse as well.¹⁸⁸ Since the release of the Lalonde report in 1974, Canadian policy makers in all sectors of government, particularly those in the health sectors, have been exposed to the notion of non-medical or social determinants of health.²⁰¹ Several changes occurred in Canada in light of this new and important knowledge, for example, Canada's principal health research funding body, now the Canadian Institutes for Health Research (CIHR), has one of its four pillars dedicated to the non-medical determinants of health and the federal government created the Canadian Population Health Initiative (CPHI) to move research and knowledge translation activities further ahead in this area.²⁰¹ However, as Lavis points out, many of these resulting changes are firmly rooted in the health sector despite the fact that the main implications of non-medical determinants of health lie outside of the health sector in areas such as social services and finance.²⁰¹ Indeed, many of the suggested policy

recommendations for addressing food insecurity lie outside of the formal health sector; and perhaps, as some have suggested, the most important role for the health sector here is to act as a leader, collaborator and knowledge broker.^{148, 202}

Finally, we support calls for the implementation of a system to monitor food and nutrition status, as well as food insecurity among Canadians.^{141, 148, 203} Such a system would also be useful in elucidating the relationship between food insecurity and changing social and economic policies, conditions and intervention programs.^{12, 148}

In summary, the findings from this thesis suggest that the food insecurity/overweight/obesity relationship and its policy implications are complex and that we need a better understanding of how underlying social and economic conditions, sex, and family type relate to household income, food security, and healthy weights as well as their interrelationships. To better understand the relationship between food insecurity and overweight/obesity and its policy implications, more research which explores the food insecurity/overweight/obesity relationship is needed, including research that explores the merits of the different explanations presented here. There is a particular need for longitudinal analyses and policy evaluation research in this area.

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APPENDICES

APPENDIX A

The Food Security Core-Module Questionnaire

U.S. Household Standard Food-Security/Hunger Survey Module (p. 52-58).

Bickel G, Nord M, Price C, Hamilton W, Cook J. Guide to Measuring Household Food Security, Revised 2000. Alexandria, Virginia: U.S. Department of Agriculture, Food and Nutrition Service; 2000.

U.S. HOUSEHOLD FOOD-SECURITY/HUNGER SURVEY MODULE: 3-STAGE DESIGN (2 INTERNAL SCREENERS)

Questionnaire transition into module--administer to all households: These next questions are about the food eaten in your household in the last 12 months, since (current month) of last year, and whether you were able to afford the food you need.

General food sufficiency question/screener: Questions 1, 1a, 1b (OPTIONAL: These questions are NOT used in calculating the food-security/hunger scale.)

Question 1 may be used as a screener: (a) in conjunction with income as a *preliminary* screen to reduce respondent burden for *higher income households only*; and/or (b) in conjunction with the 1st-stage internal screen to make that screen "more open"--i.e., provide another route through it.

1. [IF ONE PERSON IN HOUSEHOLD, USE "I" IN PARENTHETICALS, OTHERWISE, USE "WE."]

Which of these statements best describes the food eaten in your household in the last 12 months: --enough of the kinds of food (I/we) want to eat; --enough, but not always the kinds of food (I/we) want; --sometimes not enough to eat; or, --often not enough to eat?

[1] Enough of the kinds of food we want to eat [SKIP 1a and 1b]

[2] Enough but not always the kinds of food we want [SKIP 1a; ask 1b]

[3] Sometimes not enough to eat [Ask 1a; SKIP 1b]

[4] Often not enough [Ask 1a; SKIP 1b]

[] DK or Refused (SKIP 1a and 1b)

1a. [IF OPTION 3 OR 4 SELECTED, ASK] Here are some reasons why people don't always have enough to eat. For each one, please tell me if that is a reason why YOU don't always have enough to eat. [READ LIST. MARK ALL THAT APPLY.]

YES NO DK

Not enough money for food

Not enough time for shopping or cooking

Too hard to get to the store

On a diet

No working stove available

Not able to cook or eat because of health problems

1b. [IF OPTION 2 SELECTED, ASK] Here are some reasons why people don't always have the quality or variety of food they want. For each one, please tell me if that is a reason why

YOU don't always have the kinds of food you want to eat. [READ LIST. MARK ALL THAT APPLY.]

YES NO DK

- Not enough money for food
- Kinds of food (I/we) want not available
- Not enough time for shopping or cooking
- Too hard to get to the store
- On a special diet

BEGIN FOOD-SECURITY CORE MODULE (i.e., SCALE ITEMS)

Stage 1: Questions 2-6 --ask all households:

[IF SINGLE ADULT IN HOUSEHOLD, USE "I," "MY," AND "YOU" IN PARENTHETICALS; OTHERWISE, USE "WE," "OUR," AND "YOUR HOUSEHOLD;" IF UNKNOWN OR AMBIGUOUS, USE PLURAL FORMS.]

2. Now I'm going to read you several statements that people have made about their food situation. For these statements, please tell me whether the statement was often true, sometimes true, or never true for (you/your household) in the last 12 months, that is, since last (name of current month).

The first statement is "(I/We) worried whether (my/our) food would run out before (I/we) got money to buy more." Was that often true, sometimes true, or never true for (you/your household) in the last 12 months?

- Often true
- Sometimes true
- Never true
- DK or Refused

3. "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- Often true
- Sometimes true
- Never true
- DK or Refused

4. "(I/we) couldn't afford to eat balanced meals." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- Often true
- Sometimes true
- Never true
- DK or Refused

[IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK Q5 - 6; OTHERWISE SKIP TO 1st-Level Screen.]

5. "(I/we) relied on only a few kinds of low-cost food to feed (my/our) child/the children) because (I was/we were) running out of money to buy food." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- Often true
- Sometimes true
- Never true
- DK or Refused

6. "(I/We) couldn't feed (my/our) child/the children) a balanced meal, because (I/we) couldn't afford that." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- Often true
- Sometimes true
- Never true
- DK or Refused

1st-level Screen (screener for Stage 2): If AFFIRMATIVE RESPONSE to ANY ONE of Questions 2-6 (i.e., "often true" or "sometimes true") OR response [3] or [4] to Question 1 (if administered), then continue to Stage 2; otherwise, skip to end.

Stage 2: Questions 7-11 --ask households passing the 1st-level Screen: (estimated 40% of hh's < 185% Poverty; 5.5% of hh's > 185% Poverty; 19% of all households).

[IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK Q7; OTHERWISE SKIP TO Q8]

7. "(My/Our child was/The children were) not eating enough because (I/we) just couldn't afford enough food." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- Often true
- Sometimes true
- Never true
- DK or R

8. In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?

- Yes
- No (SKIP 8a)
- DK or R (SKIP 8a)

8a. [IF YES ABOVE, ASK] How often did this happen---almost every month, some months but not every month, or in only 1 or 2 months?

- Almost every month
- Some months but not every month
- Only 1 or 2 months
- DK or R

9. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money to buy food?

- Yes
- No
- DK or R

10. In the last 12 months, were you every hungry but didn't eat because you couldn't afford enough food?

- Yes
- No
- DK or R

11. In the last 12 months, did you lose weight because you didn't have enough money for food?

- Yes
- No
- DK or R

2nd-level Screen (screener for Stage 3): If AFFIRMATIVE RESPONSE to ANY ONE of Questions 7 through 11, then continue to Stage 3; otherwise, skip to end.

Stage 3: Questions 12-16 --ask households passing the 2nd-level Screen: (estimated 7-8% of hh's < 185% Poverty; 1-1.5% of hh's > 185% Poverty; 3-4% of all hh's).

12. In the last 12 months, did (you/you or other adults in your household) ever not eat for a whole day because there wasn't enough money for food?

- Yes
- No (SKIP 12a)
- DK or R (SKIP 12a)

12a. [IF YES ABOVE, ASK] How often did this happen---almost every month, some months but not every month, or in only 1 or 2 months?

- Almost every month
- Some months but not every month
- Only 1 or 2 months
- DK or R

[IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK 13-16; OTHERWISE SKIP TO END.]

13. The next questions are about children living in the household who are under 18 years old. In the last 12 months, since (current month) of last year, did you ever cut the size of (your child's/any of the children's) meals because there wasn't enough money for food?

- Yes
- No
- DK or R

14. In the last 12 months, did (CHILD'S NAME/any of the children) ever skip meals because there wasn't enough money for food?

Yes

No (SKIP 14a)

DK or R (SKIP 14a)

14a. [IF YES ABOVE ASK] How often did this happen---almost every month, some months but not every month, or in only 1 or 2 months?

Almost every month

Some months but not every month

Only 1 or 2 months

DK or R

15. In the last 12 months, (was your child/ were the children) ever hungry but you just couldn't afford more food?

Yes

No

DK or R

16. In the last 12 months, did (your child/any of the children) ever not eat for a whole day because there wasn't enough money for food?

Yes

No

DK or R

User Notes

(1) Response Options: For interview surveys, DK ("don't know") and "Refused" are blind responses--that is, they are not presented as response options, but are marked if volunteered. For self administered surveys, DK is presented as a response option.

(2) Internal Screeners: Two levels of internal screening are provided for survey designers who wish to reduce respondent burden for households not manifesting: (a) *any* level of food insecurity (1st-level screener); or (b) any signs of *hunger* (2nd-level screener). The optional Q1 also may be used in conjunction with the 1st-level screener to provide an additional, independent basis for passing households through the screen (i.e., making the screen somewhat less stringent). To further reduce burden for higher-income respondents, a preliminary screener may be constructed using Q1 along with a household income measure. Households with income above twice the poverty threshold, AND who respond <1> to Q1 may be skipped to the end of the module and classified as food secure. (This preliminary screen should not be used for lower-income households.) Use of this preliminary screener reduces total burden in a survey with many higher-income households, and the cost, in terms of reduced accuracy in identifying food-insecure households, is slight. Research has shown that a very small proportion of the higher-income households screened out by this procedure will register food insecurity if administered the full module. Consequently, if Q1 is not desired for research purposes, a preferred strategy is to omit Q1 and administer Stage 1 of the module to all households.

Administration time for Stage 1 is very nearly the same as administration time for the preliminary USDA food sufficiency question/screener.

(3) Time Reference Period: The scale items may be modified from the 12-month reference period to a shorter time period if required for your research design. The CPS food-security database includes 30-day reference periods for the more severe scale items (Q8-Q18) and other surveys have used the core module with reference periods shorter than 12 months. For example, the questionnaire items may be modified from the 12-month period to the 30-day reference period by changing the “last 12-month” reference in each question to “last 30 days.” In this case, items 8a, 12a, and 14a must be changed to read as follows: 8a/12a/14a: [IF YES ABOVE, ASK] In the last 30 days, how many days did this happen? ____ days [] DK

(4) Food-Security/Hunger Scale: Questions 2-16 provide a complete, validated set of food insecurity/ hunger indicator variables for use in: (1) scaled measurement of the severity of household food insecurity and hunger; (2) classification of households according to designated severity ranges; and (3) comparison of food-insecurity and hunger prevalence with national benchmark data.

APPENDIX B

High Human Development Countries, excluding developing countries.

Human Development Report 2005, International Cooperation at Crossroads, Aid, trade and security in an unequal world. New York, New York: United Nations Development Programme; 2005.

- 1 Norway
- 2 Iceland
- 3 Australia
- 4 Luxembourg
- 5 Canada
- 6 Sweden
- 7 Switzerland
- 8 Ireland
- 9 Belgium
- 10 United States
- 11 Japan
- 12 Netherlands
- 13 Finland
- 14 Denmark
- 15 United Kingdom
- 16 France
- 17 Austria
- 18 Italy
- 19 New Zealand
- 20 Germany
- 21 Spain
- 23 Israel
- 24 Greece
- 26 Slovenia
- 27 Portugal
- 31 Czech Republic
- 32 Malta
- 35 Hungary
- 36 Poland
- 38 Estonia
- 39 Lithuania
- 42 Slovakia
- 43 Bahrain
- 45 Croatia
- 48 Latvia
- 55 Bulgaria

APPENDIX C

Search Strategy

Medline (1996 to January Week 4 2006)	PsychINFO (1806 to January Week 5 2006)	CINAHL (1982 to January Week 4 2006)
food insecur\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	Food insecur\$.mp. [mp=title, abstract, subject headings, table of contents, key concepts]	food insecur\$.mp. [mp=title, subject heading word, abstract, instrumentation]
food secur\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	Food secur\$.mp. [mp=title, abstract, subject headings, table of contents, key concepts]	food secur\$.mp. [mp=title, subject heading word, abstract, instrumentation]
food sufficien\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	food insufficien\$.mp. [mp=title, abstract, subject headings, table of contents, key concepts]	food sufficien\$.mp. [mp=title, subject heading word, abstract, instrumentation]
food insufficien\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	food sufficien\$.mp. [mp=title, abstract, subject headings, table of contents, key concepts]	food insufficien\$.mp. [mp=title, subject heading word, abstract, instrumentation]
food povert\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	food pover\$.mp. [mp=title, abstract, subject headings, table of contents, key concepts]	food povert\$.mp. [mp=title, subject heading word, abstract, instrumentation]
hunger.mp. or exp Hunger/	hunger.mp. or exp HUNGER/	hunger.mp. or exp Hunger/
food deprivation\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	food deprivation\$.mp. [mp=title, abstract, subject headings, table of contents, key concepts]	food deprivation\$.mp. [mp=title, subject heading word, abstract, instrumentation]
1 or 2 or 3 or 4 or 5 or 6 or 7	body mass index.mp.	1 or 2 or 3 or 4 or 5 or 6 or 7
BMI.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	BMI.mp.	BMI.mp. [mp=title, subject heading word, abstract, instrumentation]
body mass index.mp. or exp Body Mass Index/	overweight.mp.	body mass index.mp. or exp Body Mass Index/
overweight.mp. or exp Overweight/	exp OBESITY/	overweight.mp. or exp Overweight/
obes\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	obes\$.mp. [mp=title, abstract, subject headings, table of contents, key concepts]	obes\$.mp. [mp=title, subject heading word, abstract, instrumentation]
exp Obesity/ or exp Obesity Hypoventilation Syndrome/	body weight.mp. or exp Body Weight/	body weight.mp. or exp Body Weight/
body weight.mp. or exp Body Weight/	body fat.mp.	exp Adipose Tissue/ or body fat.mp.
exp Adipose Tissue/ or body fat.mp.	underweight.mp. or exp UNDERWEIGHT/	underweight.mp. or exp Thinness/
underweight.mp. or exp Thinness/	weight.mp.	weight.mp.
weight.mp.	1 or 2 or 3 or 4 or 5 or 6 or 7	obes\$.mp. [mp=title, subject heading word, abstract, instrumentation]
9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17	8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16	9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17
8 and 18	17 and 18	8 and 18
limit 19 to humans	limit 19 to human	limit 19 to (adult <19 to 44 years> or middle age <45 to 64 years>)
limit 20 to ("adult (19 to 44 years)" or "middle age (45 to 64 years)")	limit 20 to ("300 adulthood <age 18 yrs and older>" or 320 young adulthood <age 18 to 29 yrs> or 340 thirties <age 30 to 39 yrs> or 360 middle age <age 40 to 64 yrs>)	limit 20 to english
limit 21 to english language	limit 21 to english language	
Total retrieved: 814	265	155

APPENDIX D

Sample Data Abstraction Form

Reviewer Information	
Initials	
Date	
Primary Study Information	
Title	
Authors	
Date	
Journal	
Language of Publication	English
Verification of Study Eligibility (based on inclusion/exclusion criteria)	
Instructions: Answer Yes, No or Can't Tell. If any of the following inclusion criteria are not met, the study will no longer be considered for the systematic review.	
Inclusion Criteria	Response
STUDY DESIGN: Is the study design either cohort, case control, cross-sectional, a randomized or a non-randomized study intervention?	
EXPOSURE: Does this study use a measure of food insecurity defined a priori which captures one or more of the following dimensions of food insecurity: 1. Not eating the desired quality or variety of foods 2. Being concerned about not having enough to eat; and 3. Not having enough to eat.	
EXPOSURE: Is food insecurity measured at the household or individual level?	
OUTCOME: Does this study measure body weight using body mass index (BMI)?	
POPULATION: Is the study population 18 years of age or older?	
POPULATION: Do the study participants reside in a developed country as described by the human development report 2005?	
Included or Excluded (if excluded-why?)	
Comments:	
Study Characteristics and Design-Data Abstraction adapted from Aschengrau A, Seage GR. <i>Essentials of epidemiology in public health</i> . Sudbury, Mass: Jones and Bartlett; 2003.	
A. Collection of Data	Response
1. What were the objectives of the study?	
2. What type of study was conducted?	
3. What was the primary exposure of interest? How was this measured?	
4. What was the primary outcome of interest? How was this measured?	
5. Where there secondary, tertiary outcomes measures? How were these measured?	
6. Describe the source of the study population and the population age range and sex	
7. Describe the process of subject selection and sample size	
B. Analysis of Data	Response
1. What type of statistical analyses was conducted?	
2. What measures of association were reported in this study?	
3. What measures of statistical stability were reported in this study?	
4. What methods were used to control for confounding bias during data analysis?	
C. Interpretation of Data	Response
1. What were the major results of this study?	
2. What value for the measure of association was	

reported and what was its associated measure of statistical stability?	
3. What limitations are discussed with respect to this study?	
4. What were the author's main conclusions?	
5. To what larger population can the results be generalized?	
Quality Assessment Checklist -adapted from Aschengrau A, Seage GR. <i>Essentials of epidemiology in public health</i> . Sudbury, Mass: Jones and Bartlett. 2003 and Best Evidence Topic Critical Appraisal worksheets. <i>Best BET's</i> 2006. Available at: URL: http://www.bestbets.org/index.html .	
Instructions: Answer Yes, No, To some extent, Can't Tell	
Objectives and Hypothesis	Response
1. Are the objectives of the study clearly stated?	
Design and Measurement and Observation	
1. Is the study design suitable for the objectives?	
2. Did the sample population represent the full spectrum of the population of interest?	
3. Could there have been bias in the selection of the study population? How likely was this bias?	
4. Is it clear what was measured, how it was measured and what the outcomes were?	
5. Could there have been bias in the collection of information? How likely was this bias?	
6. Was the primary exposure accurately measured? Are these measurements reproducible?	
7. Was the primary outcome accurately measured? Are these measurements reproducible?	
Presentation of Results	
1. Are the basic data adequately described?	
2. Are the results presented clearly, objectively and in sufficient detail to enable readers to make their own judgement?	
Analysis of data	
1. Are the methods appropriate to the data?	
2. Were the methods used to control for confounding bias during the data analysis sufficient?	
3. Are the statistics correctly interpreted?	
Interpretation and Discussion	
1. Are the author's conclusions justified by the data?	
2. How is the interpretation of these results affected by potential biases? Discuss	
3. Does the discussion section adequately address the limitations of the study?	
4. Can the results be generalised? If so, to what population?	

APPENDIX E

List of Excluded Studies

Study	Reasons for Exclusion
Antoniades M, Tarasuk V. A survey of food problems experienced by Toronto street youth. <i>Canadian Journal of Public Health Revue Canadienne de Sante Publique</i> 89(6):371-5, 1998 November;-Dec.	(Population) Population of interest in this study is youth (25y or younger).
Che J, Chen J. Food insecurity in Canadian households. <i>Health Reports</i> 12(4):11-22, 2001 August.	(Population) Analysis does not appear to be restricted to adults over the age of 18.
C.L Craig, C.Cameron, A.Bauman. Socio-Demographic and Lifestyle Correlates of Obesity: Technical Report on the Secondary Analyses Using the 2000-2001 Canadian Community Health Survey. Canadian Population Health Initiative, Canadian Institute for Health Information; 2005.	(Outcome) BMI not assessed independently. Study looks at odds of having healthy lifestyle and healthy BMI simultaneously.
Crawford P.B et al. How can Californians be overweight and hungry? <i>California Agriculture</i> 2004;58(1):12-7.	(Design) Commentary/review article. No primary research.
Drewnowski A, Specter SE. Poverty and obesity: the role of energy density and energy costs. [Review] [123 refs]. <i>American Journal of Clinical Nutrition</i> 79(1):6-16, 2004 January.	(Design) Commentary/review article. No primary research.
Gibson D. Food stamp program participation is positively related to obesity in low income women.[see comment]. <i>Journal of Nutrition</i> 133(7):2225-31, 2003 July.	(Exposure/population) The exposure of interest in this study is long-term food stamp participation vs. food insecurity. Population of interest is youth 14-22y.
Gibson D. Long-term food stamp program participation is differentially related to overweight in young girls and boys. <i>Journal of Nutrition</i> 134(2):372-9, 2004 February.	(Exposure/population) The exposure of interest in this study is percentage of time a child's family participated in the Food stamp program over 5 calendar years vs. food insecurity. Population of interest is children between 5 and 18y.
Gibson D. Long-term food stamp program participation is positively related to simultaneous overweight in young daughters and obesity in mothers. <i>J Nutr</i> 2006 April;136(4):1081-5.	(Exposure/population) The exposure of interest in this study is long-term food stamp participation vs. food insecurity. Population of interest includes children 14-22y.
Gulliford MC, Mahabir D, Roche B. Food insecurity, food choices, and body mass index in adults: nutrition transition in Trinidad and Tobago.[see comment]. <i>International Journal of Epidemiology</i> 32(4):508-16, 2003 August.	(Population) Population based survey of residents in Trinidad and Tobago
Jones SJ, Frongillo EA. The Modifying Effects of Food Stamp Program Participation on the Relation between Food Insecurity and Weight Change in Women. <i>J Nutr</i> 2006 April;136(4):1091-4.	This study was excluded due to discrepancies in reporting: awaiting clarification from the authors at the time of submission of this report.
Nube M. Relationships between undernutrition prevalence among children and adult women at national and subnational level. <i>European Journal of Clinical Nutrition</i> 59(10):1112-20, 2005 October.	(Exposure/Outcome/Population) This study is irrelevant. Analysis is focused on the relationship between undernutrition prevalence rates among children and adult women. BMI is not the outcome of interest but rather a marker of undernutrition. Countries included are unclear.
Oh SY, Hong MJ. Food insecurity is associated with dietary intake and body size of Korean	(Outcome, Population) Height and weight have not been converted to BMI. Population of interest is Korean children between 4 and 12y.

children from low-income families in urban areas. <i>European Journal of Clinical Nutrition</i> 57(12):1598-604, 2003 December	
Olson C.M, Strawderman M.S. The Food Insecurity-Obesity Paradox in Women. 10-21-2003. Unpublished work	This study was excluded because it is a draft copy of the final report (2yrs old) and is to be kept confidential at the author's request (pending publication).
Olson CM. Nutrition and health outcomes associated with food insecurity and hunger. [Review] [14 refs]. <i>Journal of Nutrition</i> 129(2S Suppl):521S-524S, 1999 February.	(Study Design) Commentary/review article. No primary research.
Piaseu N, Mitchell P. Household food insecurity among urban poor in Thailand. <i>Journal of Nursing Scholarship</i> 2004 2nd Quarter; 36(2):115-21.	(Population) Population of interest is Thai women.
Russell D, Parnell W, Wilson N. Nutrition trends in New Zealand. <i>New Zealand Public Health Report</i> 1999 Sep; 6(9):65-8.	(Outcome//Population) Height and weight have not been converted to BMI. BMI is not reported as outcome. Population of interest is 15y or older.
Sawaya AL, Martins PA, Grillo LP, Florencio TT. Long-term effects of early malnutrition on body weight regulation. <i>Nutrition Reviews</i> 2004 Jul; 62(7 part 2):S127-S133.	(Study Design) Commentary/review article. No primary research.
Shariff ZM, Khor GL. Obesity and household food insecurity: evidence from a sample of rural households in Malaysia. <i>European Journal of Clinical Nutrition</i> 59(9):1049-58, 2005 September.	(Population) Population of interest is Malaysian women.
Sharkey JR. Risk and presence of food insufficiency are associated with low nutrient intakes and multimorbidity among homebound older women who receive home-delivered meals. <i>Journal of Nutrition</i> 133(11):3485-91, 2003 November.	(Outcome) BMI is not the outcome of interest but rather is used as a variable to control for confounding in the analysis.
Studdert LJ, Frongillo EA, Jr., Valois P. Household food insecurity was prevalent in Java during Indonesia's economic crisis. <i>Journal of Nutrition</i> 131(10):2685-91, 2001 October.	(Outcome/Population) BMI is not measured. Population age is unclear; target population is residents of Indonesia.
Townsend MS. The relationships of income and food insecurity with overweight in women. 2001.	(Duplicate) This is a dissertation abstract. A study which is included in the review is based on this thesis dissertation. Confirmed by email with the author to be a duplicate.
Tsai AC, Chang JMC, Lin H, Chuang Y, Lin S, Lin Y. Assessment of the nutritional risk of >53-year-old men and women in Taiwan. <i>Public Health Nutrition</i> 2004 Feb; 7(1):69-76.	(Outcome/Population) BMI is not an outcome measured but rather is used as a predictor of nutritional risk. Population based survey of residents in Taiwan.
Vespa J, Watson F. Who is nutritionally vulnerable in Bosnia-Herzegovina?[see comment]. <i>BMJ</i> 311(7006):652-4, 1995 September 9.	(Exposure/Outcome/Population) This study is irrelevant. Can't assess whether or not food insecurity was measured and BMI is not measured as outcome but rather as a predictor of nutritional status. Population of interest is residents of Bosnia Herzegovina.

APPENDIX F

Quality Assessment Results for all 10 included studies

Primary Study Information	
Title	Food Insecurity Is Associated with Increased Risk of Obesity in California Women
Authors	Adams et al.
Date	2003
Journal	J. Nutr.
Language of Publication	English
Quality Assessment Checklist	
Instructions: Answer Yes, No, To some extent, Can't Tell	
<i>Objectives and Hypothesis</i>	<i>Response</i>
1. Are the objectives of the study clearly stated?	Y
<i>Design and Measurement and Observation</i>	
1. Is the study design suitable for the objectives?	Y
2. Did the sample population represent the full spectrum of the population of interest?	N-the most food insecure women may not have been included because they are more likely to not have a phone.
3. Could there have been bias in the selection of the study population? How likely was this bias?	Y-it is likely that excluded women differed from participants in characteristics such as income, education and race, and were among the most food insecure
4. Is it clear what was measured, how it was measured and what the outcomes were?	Y
5. Could there have been bias in the collection of information? How likely was this bias?	Y-reporting bias of BMI likely but not likely to influence results. Analysis were repeated using adjusted values for height and weight based a previously published method and the results did not change in direction or significance
6. Was the primary exposure accurately measured? Are these measurements reproducible?	TSE FI accurately measured and reproducible but method not validated
7. Was the primary outcome accurately measured? Are these measurements reproducible?	N-self-reported Y-Reproducible
<i>Presentation of Results</i>	
1. Are the basic data adequately described?	Y
2. Are the results presented clearly, objectively and in sufficient detail to enable readers to make their own judgement?	Y
<i>Analysis of data</i>	
1. Are the methods appropriate to the data?	Y
2. Were the methods used to control for confounding bias during the data analysis sufficient?	TSE-better measure of physical activity would have been useful
3. Are the statistics correctly interpreted?	Y
<i>Interpretation and Discussion</i>	
1. Are the author's conclusions justified by the data?	Y
2. How is the interpretation of these results affected by potential biases? Discuss	The relationship observed is not likely to be explained solely on the basis of bias Misclassification often biases result toward null
3. Does the discussion section adequately address the limitations of the study?	Y
4. Can the results be generalised? If so, to what population?	Y-to female populations which could be reached via this survey method

Primary Study Information	
Title	Food Insufficiency and Prevalence of Overweight Among Adult Women
Authors	Basiotis et al.
Date	2002
Journal	Nutrition Insights; A publication of the USDA Centre for Nutrition Policy and Promotion
Language of Publication	English
Quality Assessment Checklist	
Instructions: Answer Yes, No, To some extent, Can't Tell	
Objectives and Hypothesis	Response
1. Are the objectives of the study clearly stated?	Y
Design and Measurement and Observation	
1. Is the study design suitable for the objectives?	Y
2. Did the sample population represent the full spectrum of the population of interest?	Can't tell-sampling procedure not available Telephone???
3. Could there have been bias in the selection of the study population? How likely was this bias?	Can't tell
4. Is it clear what was measured, how it was measured and what the outcomes were?	Y
5. Could there have been bias in the collection of information? How likely was this bias?	TSE-not likely to have biased results to a great extent
6. Was the primary exposure accurately measured? Are these measurements reproducible?	Y
7. Was the primary outcome accurately measured? Are these measurements reproducible?	Y
Presentation of Results	
1. Are the basic data adequately described?	N
2. Are the results presented clearly, objectively and in sufficient detail to enable readers to make their own judgement?	N
Analysis of data	
1. Are the methods appropriate to the data?	Y-although more sophisticated analysis could have been conducted
2. Were the methods used to control for confounding bias during the data analysis sufficient?	N-none mentioned
3. Are the statistics correctly interpreted?	Can't tell
Interpretation and Discussion	
1. Are the author's conclusions justified by the data?	Can't tell
2. How is the interpretation of these results affected by potential biases? Discuss	Can't tell
3. Does the discussion section adequately address the limitations of the study?	N-no limitations discussed
4. Can the results be generalised? If so, to what population?	Can't tell-possibly to other similar US population member.

Primary Study Information	
Title	Nutritional Consequences of Food Insecurity in a Rural New York State County
Authors	Frongillo et al.
Date	19997
Journal	Paper submitted to the Institute for Research on Poverty
Language of Publication	English
Quality Assessment Checklist	
Instructions: Answer Yes, No, To some extent, Can't Tell	
Objectives and Hypothesis	Response
1. Are the objectives of the study clearly stated?	Y
Design and Measurement and Observation	
1. Is the study design suitable for the objectives?	Y
2. Did the sample population represent the full spectrum of the population of interest?	Y-extensive measures were used to contact study participants. Refusal rates varied by SES group.
3. Could there have been bias in the selection of the study population? How likely was this bias?	TSE-Refusal rates varied by SES group
4. Is it clear what was measured, how it was measured and what the outcomes were?	Y
5. Could there have been bias in the collection of information? How likely was this bias?	TSE-but not highly likely, Reporting bias, recall bias? Was original group of women randomly sampled?
6. Was the primary exposure accurately measured? Are these measurements reproducible?	Y
7. Was the primary outcome accurately measured? Are these measurements reproducible?	TSE-measured height and weight, no exact information on how measurements were taken.
Presentation of Results	
1. Are the basic data adequately described?	Y
2. Are the results presented clearly, objectively and in sufficient detail to enable readers to make their own judgement?	TSE-difficult sometimes to understand where interpretation is coming from.
Analysis of data	
1. Are the methods appropriate to the data?	TSE-unsure as to why some confounders were included (height?) in the model. Authors categorized income and then model as continuous variable?
2. Were the methods used to control for confounding bias during the data analysis sufficient?	Y-but most covariates kept in the model are not significant.
3. Are the statistics correctly interpreted?	TSE-often statements are made without specifying level of significance.
Interpretation and Discussion	
1. Are the author's conclusions justified by the data?	TSE-again, most of the data are not statistically significant and this doesn't really come across in the paper.
2. How is the interpretation of these results affected by potential biases? Discuss	Can't tell-not enough information to discuss at length. Was original sample of women randomly selected?
3. Does the discussion section adequately address the limitations of the study?	N-no limitations are discussed.
4. Can the results be generalised? If so, to what population?	TSE-to other similar US populations?

Primary Study Information	
Title	Choice of instrument influences relationship between food insecurity and obesity in Latino women
Authors	Kaiser et al.
Date	2004
Journal	Am J Clin Nutr
Language of Publication	English
Quality Assessment Checklist	
Instructions: Answer Yes, No, To some extent, Can't Tell	
Objectives and Hypothesis	Response
1. Are the objectives of the study clearly stated?	Y
Design and Measurement and Observation	
1. Is the study design suitable for the objectives?	Y
2. Did the sample population represent the full spectrum of the population of interest?	Can't tell-convenience sampling methods were employed.
3. Could there have been bias in the selection of the study population? How likely was this bias?	Can't tell
4. Is it clear what was measured, how it was measured and what the outcomes were?	Y
5. Could there have been bias in the collection of information? How likely was this bias?	To some extent-with women responding in English who may not have been truly proficient in English.
6. Was the primary exposure accurately measured? Are these measurements reproducible?	Y
7. Was the primary outcome accurately measured? Are these measurements reproducible?	Y
Presentation of Results	
1. Are the basic data adequately described?	Y
2. Are the results presented clearly, objectively and in sufficient detail to enable readers to make their own judgement?	Y
Analysis of data	
1. Are the methods appropriate to the data?	Y
2. Were the methods used to control for confounding bias during the data analysis sufficient?	To some extent-based on the information provided, there may be other confounding variables, such as physical activity, which were not accounted for?
3. Are the statistics correctly interpreted?	Y
Interpretation and Discussion	
1. Are the author's conclusions justified by the data?	Y
2. How is the interpretation of these results affected by potential biases? Discuss	Can't tell
3. Does the discussion section adequately address the limitations of the study?	Y
4. Can the results be generalised? If so, to what population?	N-we can't tell if sample is representative

Primary Study Information	
Title	Self-reported overweight and obesity are not associated with concern about enough food among adults in New York and Louisiana
Authors	Laraia et al.
Date	2004
Journal	Preventative Medicine
Language of Publication	English
Quality Assessment Checklist	
Instructions: Answer Yes, No, To some extent, Can't Tell	
Objectives and Hypothesis	Response
1. Are the objectives of the study clearly stated?	Y
Design and Measurement and Observation	
1. Is the study design suitable for the objectives?	Y
2. Did the sample population represent the full spectrum of the population of interest?	No- Study excluded individuals living on Indian Reserves, the homeless and those without telephones, who may at risk of both obesity and concern of enough food to eat.
3. Could there have been bias in the selection of the study population? How likely was this bias?	Y-likely
4. Is it clear what was measured, how it was measured and what the outcomes were?	Y
5. Could there have been bias in the collection of information? How likely was this bias?	Y-self-report bias, likely-but also likely biases results toward the null.
6. Was the primary exposure accurately measured? Are these measurements reproducible?	TSE-self-reported height/weight
7. Was the primary outcome accurately measured? Are these measurements reproducible?	TSE-concern of enough food to eat in last 30 days
Presentation of Results	
1. Are the basic data adequately described?	Y
2. Are the results presented clearly, objectively and in sufficient detail to enable readers to make their own judgement?	Y
Analysis of data	
1. Are the methods appropriate to the data?	TSE-depends on what relationship they were interested in studying. The authors examine the hypothesis that BMI predicts concern over enough food to eat which is counterintuitive to other arguments made in the paper and the hypotheses underlying the potential association. Also unclear why they only examined morbid obesity vs. all other categories of BMI. Might have been more logical to consider overweight or obese vs normal weight/underweight?
2. Were the methods used to control for confounding bias during the data analysis sufficient?	Can't tell-might have included age and sex in the model-were not found to be confounders but these are usually important variables to keep in most models. Generally BMI and FI differ by gender and age.
3. Are the statistics correctly interpreted?	Can't tell-they report RR but do not explain how they obtain a RR from the logistic regression model?
Interpretation and Discussion	
1. Are the author's conclusions justified by the data?	TSE
2. How is the interpretation of these results affected by potential biases? Discuss	Likely biases results toward the null.
3. Does the discussion section adequately address the limitations of the study?	TSE-no response rate reported
4. Can the results be generalised? If so, to what population?	To similar US populations which could be sampled in a similar manner.

Primary Study Information	
Title	Food Insecurity Is Associated with Past and Present Economic Disadvantage and Body Mass Index
Authors	Sarlio-Lahteenkorva et al.
Date	2001
Journal	J. Nutr.
Language of Publication	English
Quality Assessment Checklist	
Instructions: Answer Yes, No, To some extent, Can't Tell	
Objectives and Hypothesis	Response
1. Are the objectives of the study clearly stated?	TSE
Design and Measurement and Observation	
1. Is the study design suitable for the objectives?	Y-although given background information and arguments made in the paper it might have been more logical to model BMI as outcome.
2. Did the sample population represent the full spectrum of the population of interest?	Can't tell-authors caution that it may have missed the most vulnerable population members
3. Could there have been bias in the selection of the study population? How likely was this bias?	Can't tell-sampling method is not detailed in the methods section.
4. Is it clear what was measured, how it was measured and what the outcomes were?	Y
5. Could there have been bias in the collection of information? How likely was this bias?	Y-self-report bias=likely
6. Was the primary exposure accurately measured? Are these measurements reproducible?	TSE-Self-reported data
7. Was the primary outcome accurately measured? Are these measurements reproducible?	Can't tell-non-validated measure of FI
Presentation of Results	
1. Are the basic data adequately described?	Y
2. Are the results presented clearly, objectively and in sufficient detail to enable readers to make their own judgement?	Y
Analysis of data	
1. Are the methods appropriate to the data?	N-given underlying hypothesis presented in paper suggesting association b/w FI and BMI, it would have made more sense to model BMI as outcome.
2. Were the methods used to control for confounding bias during the data analysis sufficient?	Y
3. Are the statistics correctly interpreted?	Y
Interpretation and Discussion	
1. Are the author's conclusions justified by the data?	Y
2. How is the interpretation of these results affected by potential biases? Discuss	Can't tell
3. Does the discussion section adequately address the limitations of the study?	Y-however it does not suggest that the regression modeling could have been done in alternate fashion as I have suggested
4. Can the results be generalised? If so, to what population?	N-due to economic recession at the time of survey administration.

Primary Study Information	
Title	Food Insecurity is Positively Related to Overweight in Women
Authors	Townsend et al.
Date	2001
Journal	J. Nutr.
Language of Publication	English
Quality Assessment Checklist	
Instructions: Answer Yes, No, To some extent, Can't Tell	
Objectives and Hypothesis	Response
1. Are the objectives of the study clearly stated?	Y
Design and Measurement and Observation	
1. Is the study design suitable for the objectives?	Y
2. Did the sample population represent the full spectrum of the population of interest?	N-may have missed most vulnerable groups (homeless)
3. Could there have been bias in the selection of the study population? How likely was this bias?	Not likely
4. Is it clear what was measured, how it was measured and what the outcomes were?	Y
5. Could there have been bias in the collection of information? How likely was this bias?	Y-likely, reporting bias
6. Was the primary exposure accurately measured? Are these measurements reproducible?	Can't tell-may be subject to reporting bias but measure has been validated
7. Was the primary outcome accurately measured? Are these measurements reproducible?	Can't tell-may be subject to reporting bias researchers attempted to adjust for this.
Presentation of Results	
1. Are the basic data adequately described?	Y
Analysis of data	
1. Are the methods appropriate to the data?	Y
2. Were the methods used to control for confounding bias during the data analysis sufficient?	Y-given what was available
3. Are the statistics correctly interpreted?	Y
Interpretation and Discussion	
1. Are the author's conclusions justified by the data?	Y
2. How is the interpretation of these results affected by potential biases? Discuss	Can't tell
3. Does the discussion section adequately address the limitations of the study?	Y
4. Can the results be generalised? If so, to what population?	Y-to other similar developed populations

Primary Study Information	
Title	Self-Reported Concern About Food Security Associated with Obesity-Washington, 1995-1999
Authors	VanEenwyk J & Sabel J.
Date	2003
Journal	MMWR
Language of Publication	English
Quality Assessment Checklist	
Instructions: Answer Yes, No, To some extent or Can't Tell	
Objectives and Hypothesis	Response
1. Are the objectives of the study clearly stated?	Y
Design and Measurement and Observation	
1. Is the study design suitable for the objectives?	Y
2. Did the sample population represent the full spectrum of the population of interest?	CT-perhaps not due to phone method
3. Could there have been bias in the selection of the study population? How likely was this bias?	Y-phone survey
4. Is it clear what was measured, how it was measured and what the outcomes were?	Y
5. Could there have been bias in the collection of information? How likely was this bias?	Y-self-report, recall. Likely
6. Was the primary exposure accurately measured? Are these measurements reproducible?	CT Not validated measure
7. Was the primary outcome accurately measured? Are these measurements reproducible?	Y
Presentation of Results	
1. Are the basic data adequately described?	N Need more descriptive statistics P-values of other variables included in model
2. Are the results presented clearly, objectively and in sufficient detail to enable readers to make their own judgement?	TSE
Analysis of data	
1. Are the methods appropriate to the data?	Y
2. Were the methods used to control for confounding bias during the data analysis sufficient?	Y
3. Are the statistics correctly interpreted?	Y
Interpretation and Discussion	
1. Are the author's conclusions justified by the data?	Y
2. How is the interpretation of these results affected by potential biases? Discuss	Relationship b/w FI and BMI may be different with measured height and weight? FI prevalence may be higher than estimated
3. Does the discussion section adequately address the limitations of the study?	Y
4. Can the results be generalised? If so, to what population?	CT-perhaps to US population/developed countries

Primary Study Information	
Title	Household Food Insufficiency is Associated with Poorer Health
Authors	Vozoris et al.
Date	2003
Journal	J. Nutr.
Language of Publication	English
Quality Assessment Checklist	
Instructions: Answer Yes, No, To some extent, Can't Tell	
<i>Objectives and Hypothesis</i>	<i>Response</i>
1. Are the objectives of the study clearly stated?	Y
<i>Design and Measurement and Observation</i>	
1. Is the study design suitable for the objectives?	Y
2. Did the sample population represent the full spectrum of the population of interest?	No-populations who may be especially vulnerable to food insecurity where systematically excluded from the study sample
3. Could there have been bias in the selection of the study population? How likely was this bias?	Y-see above
4. Is it clear what was measured, how it was measured and what the outcomes were?	Y
5. Could there have been bias in the collection of information? How likely was this bias?	Y-self-report bias
6. Was the primary exposure accurately measured? Are these measurements reproducible?	Can't tell-the validity of this measure has been assessed elsewhere: The validity of this measure is said to be indicated by the strong associations between household food insufficiency and lower reported energy and nutrient intakes and between household food insufficiency and income-based measure of poverty
7. Was the primary outcome accurately measured? Are these measurements reproducible?	Can't tell-self-reported
<i>Presentation of Results</i>	
1. Are the basic data adequately described?	Y
2. Are the results presented clearly, objectively and in sufficient detail to enable readers to make their own judgement?	Y
<i>Analysis of data</i>	
1. Are the methods appropriate to the data?	Y
2. Were the methods used to control for confounding bias during the data analysis sufficient?	N-several potential confounders such as physical activity level, ethnicity were not included in the analysis; they may not have been available in the data set?
3. Are the statistics correctly interpreted?	Y
<i>Interpretation and Discussion</i>	
1. Are the author's conclusions justified by the data?	Y
2. How is the interpretation of these results affected by potential biases? Discuss	Food insecurity is likely underestimated as are rates of overweight and obesity (self-reported). Other confounding factors may have altered data interpretation
3. Does the discussion section adequately address the limitations of the study?	TSE-does not discuss limited number of confounding factors
4. Can the results be generalised? If so, to what population?	TSE-to other Canadians who may be selected in a similar survey.

Appendix G

Total Household Income-5 categories: Derived variable which classifies the respondent's total household income into five categories based on total household income and the number of individuals living in the household:

- **Lowest income grouping**
< \$10,000 if 1 to 4 people;
< \$15,000 if 5+ people
- **Lower middle income grouping**
\$10,000 to \$14,999 if 1 or 2;
\$10,000 to \$19,999 if 3 or 4;
\$15,000 to \$29,999 if 5+
- **Middle income grouping**
\$15,000 to \$29,999 if 1 or 2;
\$20,000 to \$39,999 if 3 or 4;
\$30,000 to \$59,999 if 5+
- **Upper middle income grouping**
\$30,000 to \$59,999 if 1 or 2;
\$40,000 to \$79,999 if 3 or 4;
\$60,000 to \$79,999 if 5+
- **Highest income grouping**
≥ \$60,000 if 1 or 2;
≥ \$80,000 if 3+

Appendix H

MEDLINE search strategy-environmental scan (MEDLINE 1996 to Week 2 2007)

Search terms	Studies Retrieved
food insecurit\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	236
food securit\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	406
food povert\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	5
food insufficienc\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	35
policy.mp. or exp Public Policy/	67243
program\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	211036
initiative\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]	14846
1 or 2 or 3 or 4	557
5 or 6 or 7	273275
8 and 9	246
limit 10 to (humans and english language and yr="2000 - 2007")	185

Appendix I

Corresponding Unweighted and alternate models from Chapter 6

Table 6.1A Description of final analytical sample compared to sample with data missing on income variables (unweighted)

Characteristic (number of subjects with missing variable)	Final Sample of respondents with measured BMI. Proportion (%) (n) [Unwtd n=11162]	Sample including respondents with missing data on income variable (n) [Unwtd n=12167]
BMI Classification (kg/m²) (N/A)		
Underweight or Normal Weight (<25.0)	37.22(4155)	38.0 (4617)
Overweight or Obese (>=25.0)	62.8 (7007)	62.1 (7550)
Food Security Status (92)		
Food Secure	92.5 (10322)	92.9 (11299)
Food Insecure without hunger	4.4 (494)	a
Food Insecure with hunger	3.1 (346)	a
Sex (0)		
Male	42.9 (4789)	42.2 (5134)
Female	57.1 (6373)	57.8 (7033)
Age (0)		
18-24	13.5 (1511)	14.7 (1793)
25-34	13.9 (1551)	13.3 (1613)
35-44	12.9 (1434)	12.3 (1499)
45-54	16.8 (1861)	16.2 (1966)
55-64	15.4 (1722)	15.1 (1838)
65 or older	27.6 (3083)	28.4 (3458)
Family Type (69)		
Parent w/ spouse/partner and children	13.6 (1521)	13.1 (1596)
Single Parent w/child	3.8 (425)	3.7 (455)
All other family types	82.6 (9216)	83.1 (10116)
Cultural or Racial Origin (18)		
White	89.6 (10001)	89.7 (10919)
Black	0.7 (80)	
Southeast/East Asian	2.6 (290)	2.6 (321)
Off-reserve Aboriginal	3.0 (337)	
Other	4.1 (454)	4.0 (490)
Education (364)		
Less than secondary school graduation	19.8 (2207)	19.8 (2403)
Secondary school graduation	13.2 (1469)	13.2 (1610)
Some post-secondary	7.5 (837)	7.5 (909)
Post-secondary graduation	59.6 (6649)	59.6 (7245)
Household Income (2378)		
Lowest income	4.7 (528)	4.3 (528)
Lower middle income	9.3 (1036)	8.5 (1036)
Middle income	25.5 (2843)	23.4 (2843)
Upper middle income	34.8 (3889)	32.0 (3889)
Highest income	25.7 (2866)	23.6 (2866)
Not stated/missing	N/A	8.3 (1005)
Physical Activity Index (6)		
Active	18.3 (2037)	18.3 (2231)
Moderate	24.6 (2745)	24.6 (2988)
Inactive	57.2 (6380)	57.1 (6948)

CI=Confidence Interval, Unwtd=unweighted

a= Data can not be presented based on Statistics Canada confidentiality regulations due to risk of residual disclosure.

Table 6.2A Description of final analytic sample by gender (unweighted)

Characteristic	WOMEN	MEN
	Proportion (%) (n) Unwtd n=6373	Proportion (%) (n) Unwtd N=4789
BMI classification (kg/m²)		
Underweight or Normal Weight (<25.0)	41.0 (2612)	32.2 (1543)
Overweight or Obese (>=25.0)	59.0 (3761)	67.8 (3246)
Food Security Status		
Food Secure	91.6 (5837)	93.7 (4485)
Food Insecure without hunger	4.9 (315)	3.7 (179)
Food Insecure with hunger	3.5 (221)	2.6 (125)
Age		
18-24	12.8 (814)	14.6 (697)
25-34	13.6 (867)	14.3 (684)
35-44	11.7 (748)	14.3 (686)
45-54	16.2 (1034)	17.3 (827)
55-64	15.5 (990)	15.3 (732)
65 or older	30.1 (1920)	24.3 (1163)
Family Type		
Parent w/ spouse/partner and children	13.0 (826)	14.5 (695)
Single Parent w/child	5.6 (358)	1.4 (67)
All other family types	81.4 (5189)	84.1 (4027)
Cultural or Racial Origin		
White	89.8 (5722)	89.4 (4279)
Black	0.7 (43)	0.8 (37)
Southeast/East Asian	2.4 (151)	2.9 (139)
Off-reserve Aboriginal	3.4 (218)	2.5 (119)
Other	3.8 (239)	4.5 (215)
Education		
Less than secondary school graduation	21.1 (1347)	18.0 (860)
Secondary school graduation	13.1 (836)	13.2 (633)
Some post-secondary	7.6 (487)	7.3 (350)
Post-secondary graduation	58.1 (3703)	61.5 (2946)
Household Income		
Lowest income	5.6 (354)	3.6 (174)
Lower middle income	11.8 (749)	6.0 (287)
Middle income	28.2 (1800)	21.8 (1043)
Upper middle income	32.8 (2093)	37.5 (1796)
Highest income	21.6 (1377)	31.1 (1489)
Physical Activity Index		
Active	16.1 (1025)	21.1 (1012)
Moderate	24.3 (1549)	25.0 (1196)
Inactive	59.6 (3799)	53.9 (2581)

Unwtd=unweighted

Table 6.3A Prevalence of overweight/obesity by food security status for women and men (unweighted)

	Overweight/Obesity (%) (n)	
	Women [Unwtd n=3761]	Men [Unwtd n=3246]
TOTAL	59.0 (3761)	67.8 (3246)
POPULATION		
<i>Food Security Status</i>		
Food Secure	58.8 (3429)	68.4 (3066)
Food Insecure without hunger	58.4 (184)	59.8 (107)
Food Insecure with hunger	67.0 (148)	58.4 (73)

Table 6.4A Univariable regression model predicting overweight/obesity by food security status (unweighted)

	WOMEN [Unwtd N=6373]	MEN [Unwtd N=4789]
	OR	OR
<i>Food Security Status</i>		
Food Secure [REF]	1.0	1.0
Food Insecure without hunger	1.0	0.7
Food Insecure with hunger	1.4	0.7

OR=odds ratio; REF=reference category; Confidence Intervals are not applicable here as they are not statistically accurate.

Table 6.5A Overweight prevalence according to selected demographic, socio-demographic, health and lifestyle variables (unweighted)

	Overweight/Obesity (%) (n)	
	WOMEN [Unwtd n=3761]	MEN [Unwtd n=3246]
TOTAL POPULATION	59.0 (3761)	67.8 (3246)
<i>Age</i>		
18-24	36.1 (294)	40.2 (280)
25-34	49.4 (428)	63.5 (434)
35-44	55.5 (415)	70.3 (482)
45-54	65.3 (675)	76.8 (635)
55-64	68.7 (675)	78.0 (571)
65 or older	66.1 (1269)	72.6 (844)
<i>Family Type</i>		
Parent w/ spouse/partner and children	59.2 (489)	76.6 (532)
Single Parent with child	60.3 (216)	79.1 (53)
All other family types	58.9 (3056)	66.1 (2661)
<i>Cultural or Racial Origin</i>		
White	59.1 (3382)	69.0 (2953)
Southeast/East Asian	32.5 (49)	40.3 (56)
Off-reserve Aboriginal	72.9 (159)	69.8 (83)
Other (here includes Black as well) ^b	60.6 (171)	61.1 (154)
<i>Education</i>		
Less than secondary school graduation	69.1 (931)	70.7 (608)
Secondary school graduation	60.1 (502)	66.8 (423)
Some post-secondary	62.42 (304)	61.1 (214)
Post-secondary graduation	54.7 (2024)	67.9 (2001)
<i>Household Income</i>		
Lowest income	61.0 (216)	57.5 (100)
Lower middle income	61.7 (462)	63.4 (182)
Middle income	62.6 (1127)	62.8 (655)
Upper middle income	59.3 (1242)	68.3 (1227)
Highest income	51.9 (714)	72.7 (1082)
<i>Physical activity index</i>		
Active	48.5 (497)	64.8 (656)
Moderate	56.3 (872)	66.1 (791)
Inactive	63.0 (2392)	69.7 (1799)

^b= Cell counts for Black was below 30 but above 5 thus it was collapsed here for confidentiality reasons but is analyzed separately in the weighted analyses.

Table 6.6A Univariable regression model predicting overweight/obesity by selected sociodemographic and lifestyle variables (unweighted)

Sociodemographic and lifestyle variables	WOMEN [Unwtd N=6373]	MEN [Unwtd N=4789]
	OR	OR
<i>Age</i>		
18-24 [REF]	1.0	1.0
25-34	1.7	2.6
35-44	2.2	3.5
45-54	3.3	4.9
55-64	3.9	5.3
65 or older	3.4	3.9
<i>Family Type</i>		
Parent w/ spouse/partner and children	1.1	1.7
Single Parent with child	1.1	1.9
All other family types [REF]	1.0	1.0
<i>Cultural or Racial Origin</i>		
White [REF]	1.0	1.0
Black	1.6	0.8
Southeast/East Asian	0.3	0.3
Off-reserve Aboriginal	1.9	1.0
Other	1.0	0.7
<i>Education</i>		
Less than secondary school graduation [REF]	1.0	1.0
Secondary school graduation	0.7	0.8
Some post-secondary	0.7	0.7
Post-secondary graduation	0.5	0.9
<i>Household Income</i>		
Lowest income [REF]	1.0	1.0
Lower middle income	1.0	1.3
Middle income	1.1	1.2
Upper middle income	0.9	1.6
Highest income	0.7	2.0
<i>Physical activity index</i>		
Active [REF]	1.0	1.0
Moderate	1.4	1.1
Inactive	1.8	1.2

OR=odds ratio; REF=reference category; Confidence Intervals are not applicable here as they are not statistically accurate.

Table 6.7A Proportion of Overweight/Obese women by Food Security Status according to Family Type (Unweighted)

% Overweight/Obese (Unweighted n)	
Total population	59.0
Food Security Status	
<i>Food Secure</i>	
Parent with spouse and children	58.1 (444)
Single Parent with child	61.5 (163)
All other	58.7 (2822)
<i>Food Insecure without hunger</i>	
Parent with spouse and children	72.6 (37)
Single Parent with child	47.9 (23)
All other	57.4 (124)
<i>Food Insecure with Hunger</i>	
Parent with spouse and children	72.7 (8)
Single Parent with child	66.7 (30)
All other	69.7 (110)

Table 6.8A Food Security Status by Household Income for Women-Unweighted

	Food Secure (%) (Unwtd n)	Food Insecure without hunger (%) (Unwtd n)	Food Insecure with hunger (%) (Unwtd n)
TOTAL	91.6	4.9	3.5
<i>Household Income</i>			
Lowest income	57.6 (204)	17.5 (62)	24.9 (88)
Lower middle income	81.7 (612)	10.6 (79)	7.7 (58)
Middle income or Upper middle and Highest income ^c	95.3 (5021)	3.3 (174)	1.4 (75)

Unwtd=unweighted

c= Collapsed due to small cell count and Statistics Canada confidentiality regulations

Table 6.9A and 6.10A Final Model: Multivariable regression model predicting overweight/obesity by food security status in Women and Men (unweighted)^{d, e}

	Women Adjusted OR (n=6353)	Men Adjusted OR (n=4762)
<i>Food security status</i>		
Food Secure (Ref)		
Food Insecure without hunger	1.0	1.0
Food Insecure with hunger	1.5	0.9
<i>Age</i>		
18-24 (Ref)		
25-34	1.7	2.4
35-44	2.1	3.1
45-54	3.4	4.2
55-64	4.0	5.0
65 or older	3.2	4.0
<i>Family Type</i>		
Other (Ref)		
Parent w/ spouse/partner and children	1.2	1.5
Single Parent with child	1.0	1.5
<i>Cultural or Racial Origin</i>		
White (Ref)		
Black	2.1	1.0
Southeast/East Asian	0.4	0.3
Off-reserve Aboriginal (4)	2.2	1.3
Other (5)	1.2	0.9
<i>Education</i>		
Less than secondary school graduation (Ref)		
Secondary school graduation	0.8	1.0
Some post-secondary	1.1	0.9
Post-secondary graduation	0.8	0.9
<i>Household Income</i>		
Lowest income (Ref)		
Lower middle income	1.0	1.3
Middle income	1.2	1.2
Upper middle income	1.2	1.7
Highest income	1.0	2.2
<i>Physical Activity Index</i>		
Active (Ref)		
Moderate	1.3	1.0
Inactive	1.6	1.1

OR=odds ratio; REF=reference category; Confidence Intervals are not applicable here as they are not statistically accurate.

d= The reference woman and man are: White and Food secure with the following other characteristics: Aged 18-24, categorized as belonging to all other family types, less than secondary school graduation, lowest income and active.

e= HL goodness of fit p-value = 0.6873 and 0.3414 for unweighted model in women and men respectively.

Table 6.11A Alternate Model 1: Multivariable regression model predicting overweight/obesity by food security status in Women (weighted; n=6373)^{d, e}

	SE	Adjusted OR ^f (Unwtd Adjusted OR)	95% CI	p-value
<i>Food security status</i>				
Food Secure (Ref)				
Food Insecure without hunger	0.3	0.9 (1.0)	0.6, 1.6	0.8139
Food Insecure with hunger	0.3	2.1 (1.5)	1.2, 3.8	0.0125
<i>Age</i>				
18-24 (Ref)				
25-34	0.2	1.4 (1.7)	0.9, 2.2	0.1194
35-44	0.2	1.7 (2.1)	1.1, 2.6	0.0099
45-54	0.2	3.4 (3.3)	2.4, 5.0	0.0000
55-64	0.2	3.5 (4.0)	2.4, 5.0	0.0000
65 or older	0.2	3.5 (3.3)	2.4, 4.9	0.0000
<i>Family Type</i>				
Other (Ref)				
Parent w/ spouse/partner and children	0.2	1.2 (1.2)	0.9, 1.6	0.2744
Single Parent with child	0.2	1.1 (1.0)	0.7, 1.7	0.7237
<i>Cultural or Racial Origin</i>				
White (Ref)				
Black	0.7	1.7 (2.0)	0.4, 7.0	0.4328
Southeast/East Asian	0.3	0.4 (0.4)	0.2, 0.7	0.0018
Off-reserve Aboriginal (4)	0.3	2.3 (2.1)	1.2, 4.4	0.0083
Other (5)	0.3	1.1 (1.2)	0.7, 1.9	0.6757
<i>Education</i>				
Less than secondary school graduation (Ref)				
Secondary school graduation	0.2	1.0 (0.9)	0.7, 1.4	0.9159
Some post-secondary	0.2	1.6 (1.1)	1.0, 2.4	0.0428
Post-secondary graduation	0.1	0.8 (0.8)	0.6, 1.1	0.1855
<i>Physical Activity Index</i>				
Active (Ref)				
Moderate	0.2	1.8 (1.3)	1.1, 2.2	0.0173
Inactive	0.2	2.0 (1.6)	1.5, 2.7	0.0000

OR=odds ratio; CI=confidence interval; REF=reference category; SE=Standard Error

d= The reference woman is White and Food secure with the following other characteristics: Aged 18-24, categorized as belonging to all other family types, less than secondary school graduation, and active.

e= HL goodness of fit [p<0.001] but for Unweighted model [p=0.9976]

f= Not adjusted for income

Table 6.12A Alternate Model 1: Multivariable regression model predicting overweight/obesity by food security status in Men (weighted; n=4789) ^{d,e}

	SE	Adjusted OR ^f (Unwtd Adjusted OR)	95% CI	p-value
<i>Food security status</i>				
Food Secure (Ref)				
Food Insecure without hunger	0.4	0.4 (0.8)	0.2, 0.9	0.0352
Food Insecure with hunger	0.4	0.5 (0.7)	0.2, 1.1	0.0725
<i>Age</i>				
18-24 (Ref)				
25-34	0.2	2.6 (2.4)	1.8, 3.9	0.0000
35-44	0.2	3.0 (3.1)	2.0, 4.6	0.0000
45-54	0.2	3.1 (4.4)	2.0, 4.8	0.0000
55-64	0.2	4.0 (5.0)	2.6, 6.3	0.0000
65 or older	0.2	3.8 (3.7)	2.7, 5.4	0.0000
<i>Family Type</i>				
Other (Ref)				
Parent w/ spouse/partner and children	0.2	1.4 (1.4)	1.0, 2.0	0.0693
Single Parent with child	0.5	1.9 (1.5)	0.7, 5.3	0.2447
<i>Cultural or Racial Origin</i>				
White (Ref)				
Black	0.6	0.4 (1.0)	0.1, 1.5	0.1887
Southeast/East Asian	0.3	0.2 (0.3)	0.1, 0.5	0.0000
Off-reserve Aboriginal (4)	0.4	1.1 (1.3)	0.5, 2.4	0.7922
Other (5)	0.3	0.5 (0.8)	0.3, 0.9	0.0139
<i>Education</i>				
Less than secondary school graduation (Ref)				
Secondary school graduation	0.2	1.0 (1.1)	0.7, 1.7	0.8466
Some post-secondary	0.3	0.7 (1.0)	0.3, 1.2	0.2006
Post-secondary graduation	0.2	1.0 (1.1)	0.7, 1.4	0.8016
<i>Physical Activity Index</i>				
Active (Ref)				
Moderate	0.2	0.8 (1.0)	0.6, 1.1	0.1643
Inactive	0.2	0.9 (1.1)	0.7, 1.2	0.4771

OR=odds ratio; CI=confidence interval; REF=reference category; SE=Standard Error; Unwtd=unweighted

d= The reference Man is White and Food secure with the following other characteristics: Aged 18-24, categorized as belonging to all other family types, less than secondary school graduation, and active.

e= HL goodness of fit [p=0.0011] but for Unweighted model [p=0.7577]

f= Not adjusted for income

Table 6.13A Alternate Model 2: Multivariable regression model predicting overweight/obesity by food security status in Women (weighted; n=6353) ^{d, e, g}

	SE	Adjusted OR (Unweighted adjusted OR)	95% CI	p-value
<i>Food security status</i>				
Food Secure (Ref)				
Food Insecure without hunger	0.2	1.1 (1.0)	0.7, 1.8	0.6380
Food Insecure with hunger	0.3	2.3 (1.5)	1.2, 4.3	0.0088
<i>Age</i>				
18-24 (Ref)				
25-34	0.2	1.1 (1.7)	0.7, 1.7	0.5907
35-44	0.2	1.5 (2.2)	1.0, 2.3	0.0400
45-54	0.2	3.4 (3.4)	2.4, 4.9	0.0000
55-64	0.2	3.3(3.9)	2.3, 4.7	0.0000
65 or older	0.2	3.1(3.2)	2.2, 4.4	0.0000
<i>Family Type</i>				
Other (Ref)				
Parent w/ spouse/partner and children	0.1	1.3 (1.2)	1.0,1.7	0.0785
Single Parent with child	0.2	1.2 (1.0)	0.8,1.8	0.2959
<i>Cultural or Racial Origin</i>				
White (Ref)				
Black	0.6	5.4 (2.6)	1.6, 18.2	0.0064
Southeast/East Asian	0.3	0.3 (0.6)	0.1, 0.4	0.0000
Off-reserve Aboriginal (4)	0.3	2.3 (2.2)	1.2, 4.4	0.0116
Other (5)	0.2	1.4 (1.3)	0.9, 2.1	0.1528
<i>Education</i>				
Less than secondary school graduation (Ref)				
Secondary school graduation	0.2	1.0 (0.8)	0.7, 1.3	0.7885
Some post-secondary	0.2	1.9 (1.1)	1.2, 3.0	0.0036
Post-secondary graduation	0.2	0.8 (0.8)	0.6, 1.1	0.2748
<i>Household Income</i>				
Lowest income (Ref)				
Lower middle income	0.3	0.9 (1.0)	0.5, 1.6	0.8182
Middle income	0.3	1.3 (1.2)	0.8, 2.2	0.2619
Upper middle income	0.3	1.2 (1.2)	0.7, 2.0	0.5426
Highest income	0.3	1.1 (1.0)	0.6, 1.8	0.8143
<i>Physical Activity Index</i>				
Active (Ref)				
Moderate	0.2	1.8 (1.3)	1.3, 2.5	0.0002
Inactive	0.1	2.3 (1.6)	1.8, 3.1	0.0000

OR=odds ratio; CI=confidence interval; REF=reference category; SE=Standard Error

d= The reference woman is White and Food secure with the following other characteristics: Aged 18-24, categorized as belonging to all other family types, less than secondary school graduation, lowest income and active.

e= HL goodness of fit [p<0.001] but for Unweighted model [p=0.5912].

g=Potential influential outliers removed

Table 6.14A Alternate Model 2: Multivariable regression model predicting overweight/obesity by food security status in Men (weighted; n=4762)^{d,e,g}

	SE	Adjusted OR (Unweighted adjusted OR)	95% CI	P-value
<i>Food security status</i>				
Food Secure (Ref)				
Food Insecure without hunger	0.3	0.9 (1.1)	0.5, 1.6	0.6278
Food Insecure with hunger	0.4	0.6 (0.9)	0.3, 1.4	0.2506
<i>Age</i>				
18-24 (Ref)				
25-34	0.2	2.5 (2.5)	1.6, 3.7	0.0000
35-44	0.2	2.5 (2.1)	1.7, 3.8	0.0000
45-54	0.2	3.9 (4.2)	2.6, 6.0	0.0000
55-64	0.2	4.7 (5.0)	3.1, 7.1	0.0000
65 or older	0.2	3.9 (4.0)	2.8, 5.4	0.0000
<i>Family Type</i>				
Other (Ref)				
Parent w/ spouse/partner and children	0.2	1.8 (1.5)	1.3, 2.4	0.0006
Single Parent with child	0.6	5.5 (2.1)	1.7, 17.2	0.0037
<i>Cultural or Racial Origin</i>				
White (Ref)				
Black	0.8	1.9 (1.5)	0.4, 9.0	0.4379
Southeast/East Asian	0.3	0.2 (0.3)	0.1, 0.3	0.0000
Off-reserve Aboriginal (4)	0.4	1.1 (1.3)	0.5, 2.2	0.9714
Other (5)	0.3	0.6 (0.9)	0.3, 1.0	0.0375
<i>Education</i>				
Less than secondary school graduation (Ref)				
Secondary school graduation	0.2	1.0 (1.0)	0.6, 1.5	0.8435
Some post-secondary	0.3	0.9 (0.9)	0.5, 1.5	0.5122
Post-secondary graduation	0.2	0.9 (0.9)	0.6, 1.3	0.5019
<i>Household Income</i>				
Lowest income (Ref)				
Lower middle income	0.4	1.4 (1.0)	0.6, 3.2	0.3675
Middle income	0.3	1.1 (1.2)	0.6, 2.1	0.7102
Upper middle income	0.3	1.3 (1.7)	0.7, 2.5	0.3700
Highest income	0.3	2.0 (2.2)	1.0, 3.8	0.0437
<i>Physical Activity Index</i>				
Active (Ref)				
Moderate	0.2	0.7 (1.0)	0.5, 1.0	0.0724
Inactive	0.2	1.1 (1.1)	0.8, 1.5	0.5852

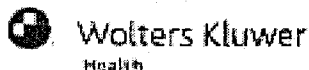
OR=odds ratio; CI=confidence interval; REF=reference category; SE=Standard Error

d= The reference Man is White and Food secure with the following other characteristics: Aged 18-24, categorized as belonging to all other family types, less than secondary school graduation, lowest income and active.

e= HL goodness of fit for Unweighted model (p=0.2619) vs. weighted model (p=0.0206).

g= Potential influential outliers removed

Appendix J



07/26/07

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Email correspondence with Dr. Marilyn Townsend regarding permission to adapt an original conceptual model for this thesis (see Fig 4.1, pg. 65-67 for details).

Quoting Townsend:

Certainly. You have my permission.

At 09:47 AM 5/15/2006, you wrote:

>Hello again Dr. Townsend,
>Thanks again for the information you provided recently; it has been
>most helpful. I'm writing to request permission to present an adapted
>version of the conceptual model you put forth in a 2001 publication
>"Food Insecurity is related to overweight in Women" for the purposes of my study.

>Thanks,

>Marissa

>

>-----Original Message-----

>From: Marilyn Townsend

>Sent: Friday, May 12, 2006 5:15 PM

>To: 1

>Subject: RE: Food insecurity dissertation

>Marilyn Townsend, Ph.D., R.D.

>Cooperative Extension Specialist

>Nutrition Department

>University of California, Davis