



## **Effective Public Health Practice Project**



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# **Is There a Relationship Between Food Insecurity and Overweight/Obesity?**

**August 2007**

**Funded by the  
Ontario Ministry of Health and Long-Term Care  
and  
Hamilton Public Health Services PHRED Program**

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Hamilton Public Health  
Services

Kingston Frontenac Lennox  
& Addington Health Unit

Middlesex-London Health Unit

Sudbury & District Health  
Unit

Ottawa Public Health

Ontario Ministry of Health and  
Long-Term Care



## Effective Public Health Practice Project



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# Is There a Relationship Between Food Insecurity and Overweight/Obesity?

**August 2007**

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## **EPHPP Reviews and Summary Statements**

To determine the effectiveness of interventions included in the Mandatory Health Programs and Services Guidelines (MHPSG), the following systematic reviews were completed and funded by the Public Health Research, Education and Development (PHRED) Program of the Public Health Division, Ontario Ministry of Health and Long-Term Care in the City Of Hamilton, Ontario, Canada

### **GENERAL STANDARDS**

#### **Equal Access**

##### **Health Hazard Investigation**

- New roads and human health: A systematic review 2005
- Effectiveness of public health in organized response to non-natural environmental disasters \* 1999
- Effectiveness of environmental awareness interventions \* 1999

##### **Program Planning and Evaluation**

- Psychosocial and psychological interventions for preventing postpartum depression 2005
- Effectiveness of physical activity programs at worksites with respect to work-related outcomes 2005
- Meta-analysis of psychosocial interventions for caregivers of people with dementia 2005
- Health related virtual communities and electronic support groups: Systematic review of the effects of online peer-to-peer interactions 2005
- Web sites for promoting health 2003
- The effectiveness of patient diabetes education in the management of type 2 diabetes 2002
- The effectiveness of on-line health information for consumers 2002
- Mass media interventions: Effects on health services use 2001
- A meta-analysis of fear appeals: Implications for effective public health campaigns 2001
- Electronic social support groups to improve health \* 2000
- Effectiveness of video for health education 2000

## CHRONIC DISEASE AND INJURIES

- Effectiveness of environmental awareness interventions \* 1999

### **Chronic Disease Prevention**

- The effectiveness of interventions to increase physical activity with marginalized populations\* 2006
- The effectiveness of multi-faceted interventions in the workplace to reduce chronic disease\* 2006
- Competitions and incentives for smoking cessation 2006
- Enhancing partner support to improve smoking cessation 2006
- Group behaviour therapy programmes for smoking cessation 2006
- Individual behavioural counselling for smoking cessation 2006
- A review of interventions to reduce tobacco use in colleges and universities 2006
- Physician advice for smoking cessation 2006
- Workplace interventions for smoking cessation 2006
- Exercise for health for early postmenopausal women: A systematic review of randomized controlled trials 2006
- Home versus centre based physical activity programs in older adults 2006
- Interventions for promoting physical activity 2006
- The effectiveness of school-based interventions in reducing adolescent risk behaviours: A systematic review of reviews\* 2005
- The effectiveness of interventions to prevent excessive weight gain in pregnancy\* 2005
- Dietary advice given by a dietitian versus other health professionals or self-help resources to reduce blood cholesterol 2005
- A review of 25 long-term adolescent tobacco and other drug use prevention program evaluations 2005
- Counselling to promote a healthy diet in adults: A summary of evidence for the US Preventive Services Task Force 2005
- Reviews of evidence on interventions to prevent dental caries, oral and pharyngeal cancers, and sports-related craniofacial injuries 2005
- Systematic review of long-term effects of advice to reduce dietary salt in adults 2005
- Effectiveness of physical activity enhancement and obesity prevention programs in children and youth (Healthy Weights Review (HWR))\*; comprised of the following five reviews: 2004
  - Environmental interventions to improve nutrition and increase physical in children and youth
  - Interventions to improve nutritional intake in children and youth
  - Interventions to increase physical activity and nutritional intake in children and youth
  - Interventions to increase physical activity in children and youth
  - Interventions to reduce physical inactivity in children and youth
- Effectiveness of worksite physical activity programs on physical activity, physical fitness and health 2004
- Exercise to improve self-esteem in children and young people 2004
- Mass media interventions for preventing smoking in young people 2004
- Exercise as an aid in smoking cessation 2004
- Young people and healthy eating: A systematic review on barriers and facilitators 2003
- The effectiveness of routinely taught breast self-examination in reducing mortality 2003
- The effectiveness of patient diabetes education in the management of type 2 diabetes 2002
- The effectiveness of school-based strategies for the primary prevention of obesity and for promoting physical activity and/or nutrition, the major modifiable risk factors for type 2 Diabetes\* 2002
- Effectiveness of primary prevention of eating disorders \* 2001
- Using school-based programs to improve heart healthy eating behaviours of children 2001
- Effectiveness of interventions to promote healthy eating in pre-school children aged 1 to 5 years 2001
- Effectiveness of smoking cessation interventions 2001
- Limited (information only) patient education programs for adults with asthma 2001
- The effectiveness of health promotion interventions in the workplace 2001
- The effect of exercise training on bone mass among pre- and postmenopausal women 2001
- The effectiveness of the health promoting schools approach and school-based health promotion interventions 2001
- Effectiveness of home based support for older people 2001
- The effectiveness of school-based interventions in promoting physical activity and fitness among children and youth: A systematic review \* 2001

- Effectiveness of dust mite control to reduce asthma symptoms 2000
  - The effectiveness of interventions for preventing tobacco smoke in public places 2000
  - Effectiveness of a telephone intervention as a delivery strategy within the scope of public health nursing practice 2000
  - The effectiveness of postpartum smoking relapse prevention strategies: A systematic review of the evidence 1992-1999\* 2000
  - The effectiveness of community interventions to increase fruit and vegetable consumption in people four years of age and older \* 1999
  - Effectiveness of coalitions in heart health promotion, tobacco use reduction, and injury prevention: a systematic review of the literature 1990-1998 \* 1999
  - Smoking cessation during pregnancy 1999
  - The effectiveness of community-based heart health programs: a systematic overview update \* 1999
  - The effectiveness of workplace-based health risk appraisal in improving knowledge, attitudes or behaviours 1999
- Early Detection of Cancer**
- The effectiveness of interventions to promote mammography among women with historically lower rates of screening 2005
  - Effectiveness of strategies to increase cervical cancer screening in clinic-based settings: A systematic review of the literature 1989-1999 \* 2000
  - Community-based strategies to promote cervical cancer screening \* 2000
- Injury Prevention Including Substance Abuse Prevention**
- Home visits during pregnancy and after birth for women with an alcohol or drug problem 2006
  - Non-legislative interventions for the promotion of cycle helmet wearing by children 2006
  - Interventions for promoting booster seat use in four to eight year olds travelling in motor vehicles 2006
  - Population-based interventions for the prevention of fall-related injuries in older people 2006
  - School-based driver education for the prevention of traffic crashes 2005
  - A systematic review of the effectiveness of the community reinforcement approach in alcohol, cocaine and opioid addiction 2005
  - A review of 25 long-term adolescent tobacco and other drug use prevention program evaluations 2005
  - Post-license driver education for the prevention of road traffic crashes 2004
  - A meta-analysis of fall prevention programs for the elderly: How effective are they? 2004
  - Interventions to prevent the recurrence of elder abuse 2003
  - The effectiveness of preventative home visits to elderly people living in the community 2003
  - Interventions for increasing pedestrian and cyclist visibility 2003
  - Child pedestrian safety 2003
  - The effectiveness of physical exercise for sleep problems in adults aged 60+ 2002
  - Effectiveness of a telephone intervention as a delivery strategy within the scope of public health nursing practice 2000
  - Effectiveness of video for health education 2000
  - Effectiveness of anticipatory care interventions with community-dwelling elderly persons 2000
  - Effectiveness of coalitions in heart health promotion, tobacco use reduction, and injury prevention: a systematic review of the literature 1990-1998 \* 1999
  - Prevention of unintentional injuries in childhood and young adolescence 1999
  - Effectiveness of school-based programs in reducing adolescent risk behaviour: a systematic review of reviews \* 1999
  - The effectiveness of school-based curriculum suicide prevention programs for adolescents \* 1999

## FAMILY HEALTH

### **Sexual Health**

- Women, sex and HIV 2004
- The effectiveness of public health interventions to reduce or prevent spousal abuse toward women\* 2001
- The effectiveness of the health promoting schools approach and school-based health promotion interventions 2001
- Peer health promotion interventions for youth 2000

- Effectiveness of school-based programs in reducing adolescent risk behaviour: a systematic review of reviews \* 1999
  - A systematic review of the effectiveness of adolescent pregnancy primary prevention programs\* 1999
  - A systematic review of the effectiveness of primary prevention programs to prevent sexually transmitted diseases (STDs) in adolescents\* 1999
- Reproductive Health**
- Home visits during pregnancy and after birth for women with an alcohol or drug problem 2006
  - The effectiveness of interventions to prevent excessive weight gain in pregnancy\* 2005
  - The effectiveness of folate supplementation for the prevention of neural tube defects 2002
  - Antenatal education for childbirth/parenthood 2001
    - The effectiveness of public health strategies to reduce or prevent the incidence of low birth weight in infants born to adolescents: A systematic review \* 2001
  - The effectiveness of postpartum smoking relapse prevention strategies: A systematic review of the evidence 1992-1999\* 2000
  - Smoking cessation during pregnancy 1999
  - The effectiveness of home visiting as a delivery strategy for public health nursing interventions to clients in prenatal and postnatal period: A systematic review \* 1999
- Child Health**
- The effectiveness of early childhood home visitation in preventing violence: a systematic review 2006
  - The effectiveness of school-based interventions in reducing adolescent risk behaviours: A systematic review of reviews\* 2005
  - Reviews of evidence on interventions to prevent dental caries, oral and pharyngeal cancers, and sports-related craniofacial injuries 2005
  - Social deprivation and the prevention of unintentional injury in childhood. A systematic review 2005
  - Optimal duration of exclusive breastfeeding 2002
  - Community-based interventions to improve child mental health: review of reviews\* 2002
  - The effectiveness of school social work from a risk and resilience perspective 2002
  - The effectiveness of school-based violence prevention programs for children at risk 2002
  - The effectiveness of public health interventions to reduce or prevent spousal abuse toward women\* 2001
  - The effectiveness of the health promoting schools approach and school-based health promotion interventions 2001
  - Support for breastfeeding mothers 2001
  - Effectiveness of pre-school screening for hearing, speech, language and vision 2001
  - Antenatal education for childbirth/parenthood 2001
  - Parent-training programmes for improving maternal psychosocial health 2001
  - Effectiveness of a telephone intervention as a delivery strategy within the scope of public health nursing practice 2000
  - Effectiveness of video for health education 2000
  - The effectiveness of postpartum smoking relapse prevention strategies: A systematic review of the evidence 1992-1999\* 2000
  - Promotion of healthy feeding in infants under one year of age 2000
  - Smoking cessation during pregnancy 1999
  - Effectiveness of school-based programs in reducing adolescent risk behaviour: a systematic review of reviews \* 1999
  - A systematic review of the effectiveness of peer/paraprofessional 1:1 interventions targeted towards mothers (parents) of 0-6 year old children \* 1999
  - Effectiveness of parenting groups with professional involvement in improving parent and child health/development outcomes \* 1999
  - The effectiveness of home visiting as a delivery strategy for public health nursing interventions to clients in prenatal and postnatal period: A systematic review \* 1999
  - The effectiveness of school-based curriculum suicide prevention programs for adolescents \* 1999

## INFECTIOUS DISEASES

|   |      |
|---|------|
| • Bioterrorism preparedness   | 2003 |
| • The effectiveness of needle exchange programs in modifying HIV-Related outcomes: A systematic review of the evidence 1997-1999*         | 2000 |
| <b>Control of Infectious Diseases</b>   |      |
| • The effectiveness of methoprene for controlling mosquito populations in Ontario that can carry West Nile Virus                          | 2004 |
| <b>Food Safety</b>  |      |
| • Effectiveness of food safety interventions *  | 2001 |
| • Food safety in community-based settings   | 1999 |
| <b>Infection Control</b>  |      |
| • Effective infection control interventions in day care centres   | 1999 |
| <b>Rabies Control</b>   |      |
| <b>Safe Water</b>   |      |
| <b>Sexually Transmitted Diseases</b>  |      |
| • Review and meta-analysis of HIV prevention intervention research for heterosexual adult populations in the United States                | 2005 |
| • Effectiveness of video for health education   | 2000 |
| • A systematic review of the effectiveness of primary prevention programs to prevent sexually transmitted diseases (STDs) in adolescents* | 1999 |
| • The effectiveness of needle exchange programs in modifying HIV-Related outcomes: A systematic review of the evidence 1997-1999*         | 1999 |
| <b>Tuberculosis Control</b>   |      |
| • Enhancing adherence to tuberculosis treatment   | 1999 |
| <b>Vaccine Preventable Diseases</b>   |      |
| • Vaccines for preventing influenza in healthy children   | 2006 |
| • Effect of patient reminder/recall interventions on immunization rates   | 2001 |
| • The effectiveness of the health promoting schools approach and school-based health promotion interventions                              | 2001 |

*\* indicates a review completed by the Effective Public Health Practice Project. Completed reviews and summary statements are added to our web site as they become available. Please check <http://www.hamilton.ca/phcs/ephpp/> regularly for new or updated information.*

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## Preface

The Public Health Division of the Ontario Ministry of Health released the Mandatory Health Programs and Services Guidelines (MHPSG) in December 1997. Although the MHPSG provide guidelines for a wide range of public health practices in Ontario, the strength of evidence for many of the guidelines has not been summarized in a systematic way.

The Effective Public Health Practice Project (EPHPP), under the auspices of the Public Health Research, Education and Development (PHRED) Program develops and provides systematic reviews of the effectiveness of specific requirements of the MHPSG. Each review is linked to one of the three general standards or three program standards. The reviews summarize the best available research evidence for public health practice in these areas. Research evidence is one piece of information needed to inform decision making in public health. Other factors, such as the local environment, local priorities, and available resources are also important.

The reviews are conducted by review groups composed of members of the Ontario PHRED program health units as well as representatives from other health units around the province. The PHRED Provincial Operations Committee oversees the project.

Potential review topics are initially identified through a survey of public health practitioners and managers across Ontario. Each review group follows a systematic approach that includes comprehensive search strategies and quality assessment of each primary research study selected for inclusion in the review.

One of the primary objectives of EPHPP is to ensure that the information is relevant to public health practitioners in the field. We contact Medical Officers of Health, program managers and others to ask for volunteer experts to take on the role of peer reviewers for the draft reports.

The EPHPP project has many benefits. Public health professionals develop skills in conducting systematic reviews and increase their awareness of the importance and feasibility of evidence-based practice. Through this project, we established new links with the Cochrane Collaboration. Reviews are in the process of being registered with the various Cochrane Review Groups, making the reviews accessible to the international public health community. Finally, by providing education, support and a collegial atmosphere in which to expand and share public health research, the EPHPP has contributed to the development of a strong province-wide network of public health professionals.



## Effective Public Health Practice Project Summary Statement

August 2007

This is a summary statement written to condense the work of the authors of a systematic review. The reference for the full review is below. The intent of this summary is to provide an overview of the findings and implications of the full review. For more information on individual studies included in the review, please see the review itself.

**Reference for Review:** Mirza, M., Fitzpatrick-Lewis, D., Thomas, H. (2007). Is there a relationship between food insecurity and overweight/obesity? Hamilton, ON: Effective Public Health Practice Project.

**Issue:** Obesity has been identified as a global population health problem. In Canada between 1979-2004 the prevalence of obesity increased from 14% to 23% of the adult population. Overweight and obesity are linked with many chronic illnesses including cardiovascular disease, cancer and diabetes. Recent research has emerged suggesting a possible relationship between levels of food security and increased levels of overweight and obesity. This review will examine the literature to attempt to determine the relationship between food insecurity and overweight/obesity.

**Review Content Summary:** To be considered relevant studies had to meet the following criteria: the issue was consistent with the Ontario Mandatory Health Programs and Services Guidelines; the study reported on issues of food security/insecurity and/or food insufficiency AND obesity/body weight; the studies included food insecurity measure (e.g. USDA Household Food Security Scale), poverty and/or SES were not, in and of themselves, adequate for inclusion; obesity was measured through BMI, height/weight, anthropomorphic measures or self-report; and, there was a comparison group. Potentially relevant articles (n=4525) were retrieved. Of those 15 were rated relevant. Data were extracted for all the relevant articles. Fourteen of the articles were cross-sectional studies and one was a case-control study. Four studies examined the relationship of food insecurity and overweight/obesity in adults (mixed genders). Three articles reported on food security status and overweight/obesity in the female population. Two studies examined food security and weight focusing on the older adult population. Six studies examined the issue as it impacts children.

**Comments on this Review's Methodology:** Relevant studies were assessed for methodological quality using an adapted version of the tool developed and tested by the Effective Public Health Practice Project (Thomas, Ciliska, Dobbins, & Micucci, 2004). Only three out of the six criteria were used. Because most of the studies were cross-sectional surveys, the criterion about allocation was deleted. Blinding was not relevant to these studies so it was also deleted. Because of the study designs, withdrawals and

drop-outs were not relevant so that criterion was also deleted. Global ratings were not calculated because of the small number of remaining criteria (n=3).

Two reviewers independently rated each article for methodological quality according to a predetermined scale outlined in the dictionary (available on the EPHPP website: [www.hamilton.ca/ephpp](http://www.hamilton.ca/ephpp)). All criteria were rated as strong, moderate or weak. Discrepancies in quality assessment ratings were resolved by consensus or by a third reviewer.

## Evidence and Implications for Practice & Policy

*Evidence points ARE NOT weighted or ranked according to strength.*

| What's the evidence?   | Implications for practice and policy   |
|--|--|
| > Many of the studies included in the review were conducted in the United States.  | > Given that the healthcare and social services context is different in Canada, studies need to be replicated within the Canadian context.   |
| > There is an inconsistent association between food insecurity and overweight/obesity in the population. The relationship is most consistent for women.  | > Practitioners should continue to identify barriers to food security and assist communities to implement and evaluate strategies to reduce them.<br>> Practitioners can take on an advocacy role to be aimed at reducing food insecurity among populations. |
| > A number of groups among which food insecurity is high have been excluded from the surveys.  | > Future surveys need to include marginalized populations (e.g. homeless people, Aboriginal people living on reserves)   |
| > Food insecurity appears to affect children, adults and seniors differently.  | > Examine these differences using qualitative methodologies.   |
| > There are a number of inconsistencies/methodological limitations in the reviewed studies.  | > These need to be addressed in future work.   |
| > Studies included in the review were cross sectional and observational case/control which did not provide an understanding of the causal relationship between food security status and overweight/obesity.  | > Future studies using different study designs may be helpful to address that gap.   |
| <p><b>General Implications:</b> Given the methodological limitations of the included studies in this review, the inconsistent association between food security status and overweight/obesity needs to be explored more fully within the Canadian context using strategies that address the limitations.</p> |  |

**Cost Benefit or Cost-Effectiveness Information:** none available

### References Used to Outline Issue

Ministry of Health/Public Health Branch (1997). *Mandatory Health Programs and Services Guideline*.

Thomas, H., Ciliska, D., Dobbins, M., & Micucci, S. (2004). A Process for Systematically Reviewing the Literature: Providing the Research Evidence for Public Health Nursing. *Worldviews on Evidence-Based Nursing*, 1, 176-184.

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Website: [www.hamilton.ca/ephpp](http://www.hamilton.ca/ephpp)

The format of this summary statement has been adapted from [health-evidence.ca](http://health-evidence.ca) ([www.health-evidence.ca](http://www.health-evidence.ca))

# **Abstract**

## ***Objectives***

The objective of this systematic review is to present the evidence on the relationship between food insecurity and overweight/obesity.

## ***Methods***

The search strategy followed the guidelines established by the Cochrane Collaboration for conducting systematic reviews. Electronic databases were searched and additional journals were hand-searched. Using information from key informants, grey literature was searched and related articles were retrieved. Relevant peer-reviewed journals were hand-searched and the reference lists of all relevant articles were reviewed. A standardized relevance tool, used by two independent reviewers, was used to rate each article. Quality assessment and data extraction were completed using adapted versions of the standardized instrument.

Data were reported in a narrative format.

## ***Results***

Four thousand, five-hundred and twenty-five potentially relevant articles were retrieved. One-hundred and forty eight articles were relevance tested. Fifteen passed quality assessment and data were extracted from those fifteen.

The primary outcome of interest of this systematic review is the relationship between food insecurity and overweight/obesity. The outcome results reported in the studies were inconsistent. However, there is some evidence that there is a relationship between food insecurity and overweight/obesity for girls age 8-17 and women. It should be noted that measurement tools between studies were inconsistent and that the majority of the studies included in this review had methodological flaws.

## ***Conclusions***

Although the studies are inconsistent with regard to a relationship between food insecurity and obesity there appears to be a trend toward this relationship. Further research focused specifically on these two issues is needed. Many variables can confound the relationship between food insecurity and obesity and those confounders should be controlled within future studies. As well, applying a consistent BMI cut point may provide meaningful outcome measures for comparative purposes. Future research will do much to clarify the controversial issue of the relationship between food insecurity and obesity.

# Background

## *Objective*

Income related food insecurity is a key social determinant of health. Food security is essential for healthy eating – without consistent economic access to sufficient nutritious food, healthy eating cannot be achieved, increasing the risk of poor health. The prevalence of food insecurity is higher among households with certain characteristics including low income, relying on social assistance, of reserve aboriginals and households with children (Health Canada, 2007). Public health units in Ontario provide many community-based programs and strategies (community food kitchens, community gardens, food skills workshops) in an effort to help stem the current levels of food insecurity in this province. There have also been initiatives undertaken by many of these same public health units to bring this topic to the forefront of public health policy makers at the provincial and federal levels. The Sudbury & District Public Health Unit (draft April 30, 2007), in particular, has been leading an effort over the last few years to include the social determinants of health in the proposed Ontario Public Health Standards which are currently under review. Changes such as those recommended would go a long way to ensuring equity in attainment of positive health status for all Ontarians.

The objective of this review was to determine if there was a relationship or association between food insecurity and obesity. In pursuing this objective, many decisions were made with regard to the design and location of the studies retrieved from our initial literature search (see the Methods section and Appendix 1, Search Strategy, for more detail). Due to the volume of material available globally on food insecurity, we decided to limit the studies for our review to those that were based on data from industrialized and/or transitional nations (Central Intelligence Agency, 2007; United Nations Statistics Division, 2006a, 2006b) and that were related to the health topic of obesity.

Normally when we do a systematic review we start with a question of interest and the review proceeds from there. In this instance we started with the topics of food insecurity and health and were required to find a question including both topics that would be relevant to public health practice in Ontario. The topic of food insecurity is one which is world-wide and there are many sub-topics such as agriculture (drought, genetically modified foods, natural disasters), policy (government policy at the federal, provincial/state, local levels and quasi-government policy (UN, World Bank)), programs (community gardens, community food kitchens), and health outcomes (chronic disease, hunger, birth defects, cognitive/behaviour problems in children, obesity) to name a few.

## *Food Insecurity*

In a North American context, food insecurity is a problem of income-related access to food (V. Tarasuk, personal communication, June 2007). In some national American and Canadian surveys conducted with questions related to food insecurity, the question of “enough money” to purchase food is usually the determining factor as to whether or not the household is classified as food secure or food insecure (Ontario Public Health Standards [OPHS], 2007; National Population Health Survey [NPHS], 2007; Continuing Survey of Food Intakes by Individuals [CSFII], 2007; National Health

and Nutrition Examination Survey [NHANES], 2007). Additional survey questions determine the level of food insecurity.

While inadequate access to food and/or money to purchase food is acknowledged as the primary source of food insecurity, it is not the only source of food insecurity. For example, geographic barriers to sufficient, safe, nutritious foods are experienced by people living in remote areas of Canada.

We will not be dealing with the issue of community food security (CFS) in this review as it encompasses much more than the relationship with obesity that is the focus of this review.

### ***The Prevalence of Food Insecurity in Canada***

The Canadian Community Health Survey (CCHS, Cycle 2.2, Nutrition (2004)) reports the latest data available on the household food security status of Canadians. Nationally, 9.2% of Canadian households were moderately (6.3%) or severely (2.9%) food insecure. This percentage translates into approximately 1.1 million Canadian households. Of the food insecure households with children, 44% of the adults and children shared the experience, 49.8% of the adults bore the brunt of the experience and protected their children from a lack of food. In 5.8% of those food insecure households the children, not the adults, experienced food insecurity. In Ontario, the prevalence of food insecure households is 8.4% (5.6% moderately food insecure, 2.7% severely food insecure) (Health Canada, 2007).

### ***Obesity***

While there are many measurements used to determine overweight and obesity in adults, the most common and generally understood is Body Mass Index (BMI). Body Mass Index is calculated by using weight in kilograms divided by height in metres squared. Overweight is usually a BMI of 25.0-29.9 and obese is BMI $\geq$ 30.0. Different tools are also used in measuring overweight and obesity in children. Some researchers used the height-for-weight Z-score and weight-for-age Z-score while others used the CDC gender-specific BMI for age charts.

### ***The Prevalence of Obesity***

Obesity has been identified as a global population health problem. Between 2004 and 2006 three reports focusing on the issue from a Canadian perspective were released by the Canadian Institute for Health Information (Canadian Institute for Health Information [CIHI], 2004; Raine, 2004; Toronto Public Health, 2005). These studies provide similar results regarding the rising prevalence of obesity among Canadians. Between 1979-2004 obesity among adults increased from 14% of the population to 23%. Among children and youth 2-17 years of age, 18% were overweight and 8% were obese (Toronto Public Health, 2005). In the United States, recent combined prevalence rates of overweight and obesity are about 66.3% for persons aged 20 years and over (Raine, 2004).

In a 2005 study, Le Petit and Berthelot used self-reported, longitudinal data from the 1994/95 and 2002/03 National Population Health Survey (NPHS) to determine the

numbers of Canadians in that eight-year time period who went from a normal weight to overweight and from overweight to obese (Le Petit & Berthelot, 2005). The data shows a continuing climb into overweight and obesity for a large percentage of adults >20 years. Thirty-two percent of normal weight range adults in the 1994/95 NPHS were overweight by the 2002/03 survey (females ↑ 28%, males ↑ 38%) and 2% had become obese. Of those classified as overweight in the 1994/95 NPHS almost 25% had become obese while 10% had lost weight and were now in the normal weight range. The likelihood of moving from the overweight to obese status was higher for females (28%) than males (20%) (Le Petit & Berthelot, 2005). In 2004, 28% of Ontario's children aged 2-17 years were overweight or obese while 60% of the province's adults were overweight or obese (Ontario Ministry of Health Promotion, 2006).

### ***Health Consequences of Obesity***

Overweight and obesity are linked with many chronic illnesses: cardiovascular disease (coronary heart disease, ischemic stroke), type 2 diabetes, dyslipidemia, insulin resistance, cancer (breast, endometrial, colon, prostate, kidney), gallbladder disease, sleep apnea and other respiratory problems, hypertension, osteoporosis, psychosocial problems, functional limitations and impaired fertility (Colman, 2001; Public Health Agency of Canada [PHAC], 2002; Starky, 2005).

### ***The Economic Costs of Obesity***

The estimate of the total economic impact of obesity in Canada as of 2001 was \$4.3 billion which equates to 2.2% of the total health care expenditures (Blanger-Ducharme & Tremblay, 2007; Katzmarzyk & Janssen, 2004). It should be noted that these figures are based on the prevalence of individuals with a BMI ≥ 30.0 as determined by self-reported data. It is well established that in self-reported data people tend to underestimate weight and overestimate height (Blanger-Ducharme & Tremblay, 2007; Colman, 2001; Starky, 2005), therefore, these economic cost reports may be on the conservative side.

US research (no similar Canadian research was located) indicates that those identified as obese increase health care costs by 36% and medication costs by 77% when compared with those of normal weight (Sturm, 2002). Sturm's report suggests that obesity appears to have moved ahead of other health risks in terms of health care costs. For example, past or current smoking (once considered the most costly health risk behaviour) increases health costs by only 21% and medication costs by only 28-30%.

Personal economy also appears to be negatively affected for those who are obese, although the directionality of this association is unclear (i.e. does obesity reduce the likelihood of marriage, or do those not married become obese). Both men and women who are overweight are less likely to be married, have lower educational attainment, lower household incomes and are more likely to live in poverty (Gortmaker, Must, Perrin, Sobol, & Dietz, 1993). This is particularly true for women (Crawley, 2000; Gortmaker et al.; Haskins & Ransford, 1999; Pagan & Davila, 1997). Gortmaker et al. found that women who were overweight as adolescents had lower household incomes

and greater household poverty (10% higher;  $p < 0.001$ ) than other women, independent of baseline characteristics.

### ***The Role of the Government of Ontario***

The Ontario Ministry of Health and Long-term Care Mandatory Health Programs and Services Guidelines [MHPSG] (1997) set standards that Public Health Departments in the province of Ontario follow. With regard to chronic diseases, the MHPSG states, “while treatment and early detection efforts are important, it is *prevention* which has the greatest potential to reduce the significant burden of chronic diseases and increase the overall level of the population’s health” (Ministry of Health/Public Health Branch, 1997).

The Chronic Disease Prevention section of the MHPSG includes strategies aimed at reducing the prevalence of risk factors that lead to chronic diseases by 2010, such as:

- reducing the amount of dietary fat consumed in the daily adult ( $\geq 18$  years of age) diet to  $\leq 30\%$  of total caloric intake;
- increasing the daily amount of fruit and vegetable servings for children ( $\geq 4$  years of age) to five or more for at least 75% of the proportion of the population;
- increasing the daily servings of milk products to three or more per day for children and adolescents  $\geq 10$  and  $\leq 16$  years of age for at least 75% of the proportion of the population and two or more milk products for adults;
- increasing the daily amount of grain product servings for children ( $\geq 4$  years of age) to five or more for at least 75% of the proportion of the population;
- to ensure more Ontarians have a healthy BMI in the range of 20.0 to 27.0  $\text{kg/m}^2$  ; (Ministry of Health/Public Health Branch, 1997).

In November 2004, Ontario’s Chief Medical Officer of Health, Dr. Sheela Basrur, advised the government of the current status of obesity and lack of physical activity in the province in her report “*Healthy Weights, Healthy Lives*” (Ontario Ministry of Health and Long-Term Care, 2004). In her message, she writes that “we are living in obesogenic environments, communities, workplaces, schools and homes that actually promote or encourage obesity”. She further notes that there is a lack of opportunity for young people to be physically active, adults working in sedentary occupations with long commutes, ‘super-sized’ food portions are the norm, communities lacking sidewalks, park land and bike lanes, and many people in our communities who do not have enough income to make healthy food choices.

In 2006 the Ministry of Health Promotion requested that the Effective Public Health Practice Project conduct a systematic review on the topic of food insecurity and chronic disease. After mapping more than 12,000 articles into the many and varied categories representing the general terms “food security, food insecurity or food insufficiency”, from our original literature search, we focussed on the health outcome of overweight and obesity in relation to food insecurity. This report is the outcome of that review.

## Introduction

### ***Risk Factors for Obesity***

Individual weight levels are often not a result of one simple cause and effect equation. In most cases of weight gain/loss there is a complex interaction of several factors including:

- *individual biological factors* – genetics; age; sex; family history; parity
- *social, economic and cultural factors* – income; education; cultural norms; family life; acceptability of overeating (portion sizes)
- *lifestyle, behavioural and health factors* – eating patterns; taste preferences; stress; physical activity levels; medications
- *environmental factors* – community environment (e.g. proximity to grocery stores, restaurants); geographic differences; transport; food industry influences (e.g. super-size portions, marketing and advertising)

Reproduced from Figure 6, The Complex Factors that Affect Weight, (Ontario Ministry of Health and Long-Term Care, 2004).

### ***Risk Factors for Food Insecurity***

The risk factors for food insecurity are repeated in almost every paper published on the topic listing the most common socio-demographic characteristics of the food insecure population: low-income, single-parent families with female head of household, unemployed, relying on social assistance, the working poor, lower levels of education, disabled and immigrants for example (Holben, 2006; Alaimo, 2005); (Tarasuk, 2001); (Rainville & Brink, 2001). Given that these risk factors are not mutually exclusive and that low income is associated with many of them, low income appears to be a very strong risk factor for food insecurity.

### ***The Paradox of Hunger and Obesity***

The paradox of hunger and obesity was raised when W.H. Dietz published a case study entitled “Does Hunger Cause Obesity” (Dietz, 1995) in which he reported a food insecure seven-year old African-American female who was at 220% of her ideal body weight. Dietz’s case report was followed by many who confirmed that food insecure people were becoming overweight and obese (Adams, Grummer-Strawn, & Chavez, 2003; Jones, Jahns, Laraia, & Haughton, 2003; Townsend, Pearson, Love, Achterberg, Murphy, 2001). The Food Research and Action Center (FRAC), part of the Center on Hunger and Poverty at Brandeis University, stated that there were several possible explanations for the weight gained by people lacking adequate resources to food: maximizing caloric intake by purchasing low-cost, high energy dense foods, exchange of quality with quantity where they can purchase more food of lower quality, periods of episodic hunger so that when food is available they overeat and, lastly, the body may conserve energy during periods of low food availability (Center on Hunger

and Poverty & Food Research and Action Center, 2003). To date, none of these explanations have been empirically demonstrated.

## **Research Question**

With the background information presented on obesity and food insecurity, we are now ready to bring the two issues together in order to answer the question:

Is there a relationship between food insecurity and obesity?

## **Methods**

Primary studies were reviewed.

### ***Searching the Literature***

The electronic literature search strategy is detailed in Appendix 1. Government agency websites in Canada and the United States were searched to locate grey literature. The membership of the Effective Public Health Practice Project (EPHPP) Food Insecurity Review Group contributed a significant number of articles found in the grey literature. Seventeen key journals were hand-searched for a five-year period from January 2002 to December 2006 (Appendix 2).

The EPHPP's strength is in ensuring the methodological rigour of systematic reviews. Our process is to include experts on our review group committees who work with us during the review and as peer reviewers of the draft review. Key informants provided us with links to unpublished literature in these areas and websites in Canada, the United States, Europe and Australia were searched for relevant publications.

### ***Relevance***

To be included, studies had to meet all of the following criteria (Relevance Tool, Appendix 3):

- A comparison group had to be included in the study. A comparison group could be the general population.
- The authors had to have included some definition of food insecurity OR food security OR food insufficiency. Poverty and/or SES were not, in and of themselves, adequate for inclusion.
- The authors had to include a measure of overweight/obesity (BMI, height/weight ratio, etc.)

Any article selected by either reviewer was downloaded to SRS 3.0 (Systematic Review Software, TrialStat! Corporation, Ottawa, Ontario, Canada). Two reviewers independently screened all titles and abstracts for potential relevance. The full article was then obtained for all potentially relevant articles and independently rated for relevance by two reviewers. Differences were resolved through consensus.

We did not include studies that used food assistance program participation as a variable for determining the relationship between food insecurity and obesity. Canada does not have federally funded food assistance programs similar to those in the United States.

### ***Quality Assessment***

Relevant studies were assessed for methodological quality using an adapted version of the tool developed and tested by the Effective Public Health Practice Project (Thomas et al., 2004). Only three of the criteria were used. Because most of the studies were cross-sectional surveys, the criterion concerning allocation was deleted. Blinding was not relevant to these studies so it was also deleted. Because of the study designs, withdrawals and drop-outs were not relevant so that criterion was also deleted. Global ratings were not calculated because of the small number of remaining criteria (n=3) those being selection bias, confounders and data collection methods.

Two reviewers independently rated each article for methodological quality according to a predetermined scale outlined in the dictionary ([www.hamilton.ca/ephpp](http://www.hamilton.ca/ephpp)). All criteria were rated as strong, moderate or weak. Discrepancies in quality assessment ratings were resolved by consensus or by a third reviewer.

### ***Data Extraction***

Data were extracted from all quality assessed studies. A standardized extraction form was used to gather information about the target population, intervention and outcomes. All statistically significant and non-significant outcomes that were considered to be relevant were reported.

## **Results**

In this section the results relating only to the research question regarding food insecurity and overweight and/or obesity are included, as many of the studies included outcomes not applicable to the scope of this review. The Quality Assessment results for the included studies have been summarized in Table 1. The data extracted from the included studies has been summarized in Table 2. In reporting the results, the review authors used the same terminology as the study authors to describe variables within each study. There are fifteen studies included in this review. Thirteen studies were conducted in the United States and two were conducted in Canada. The results from each study were formatted according to populations of interest: adults (mixed gender) (Che & Chen, 2001; Holben & Pheley, 2006; Vozoris & Tarasuk, 2003; Wilde & Peterman, 2006), females (Adams et al., 2003; Kaiser, Townsend, Melgar-Quinonez, Fujii, & Crawford, 2004; Townsend et al., 2001), older adults (Lee & Frongillo, 2001; Sahyoun & Basiotis, 2001), and children (Alaimo, Olson, & Frongillo, 2001; Casey, Szeto, Lensing, Bogle, & Weber, 2001; Matheson, J. Varady, A. Varady, & Killen, 2002; Rose & Bodor, 2006; Tanasescu, Ferris, Himmelgreen, Rodriguez, & Perez-Escamilla, 2000; Whitaker & Orzol, 2006).

## Adults (mixed gender)

Four adult studies were relevant and included in this review.

Che and Chen (2001) reported on the food insecurity status of Canadian adults (mixed gender), utilizing data from the 1998/99 National Population Health Survey and the Food Insecurity Supplement to that survey. In this study the authors created two categories of food insecurity; households with a compromised diet and those who worried about being food insecure. For the purposes of this review, only the statistics generated from the compromised diet population are considered. The authors looked at a number of variables: household income, household type, home ownership, marital status, immigrant status, aboriginal status, health status, BMI, and stress index. Obesity levels (BMI $\geq$ 30) among adults were higher in the food insecure population (15%) than in the food secure population (12%). The odds of being obese and food insecure were 1.5 times ( $p\leq 0.05$ ) the odds of being obese and food secure.

The Holben and Pheley (2006) study examined the relationship between several chronic health risks and food security/insecurity status in a rural US setting. This study used a convenience sample of 2,580 individuals. A subset of 808 participants from the original sample underwent clinical health assessments. In comparing this sample with two other studies (Nord M. et al., 2002; Andrews et al., 2000) Holben and Pheley stated that the level of food security for this sample (1999) was 72.8% while for the other two samples it was 91.9% (Ohio households, 1999-2001) and 89.9% (US households, 1999) respectively. The results from the clinical health examination showed a statistically significant difference ( $p=0.04$ ) in the mean BMI at the overweight level ( $\geq 25.0$ ) for food secure women (BMI  $29.1 \pm 7.5$ ), and food insecure women (BMI  $30.8 \pm 8.1$ ). For men, the values were BMI  $28.8 (\pm 5.4)$  for the food secure and BMI  $29.2 (\pm 7.1)$  for the food insecure male population ( $p=0.72$ ).

Vozoris and Tarasuk (2003) conducted a study utilizing data from the 1996/97 Canadian National Population Health Survey (NPHS) (Cycle 2). The objective was to quantify the prevalence of household food insecurity and to identify which sociodemographic characteristics were consistently reported within the various levels of food insufficiency (FI), and to report on health outcomes based on FI status for male and female adults. The comparison of the prevalence of overweight among the male population based on food security status indicated higher rates of overweight among the food sufficient (FS) males (45.6%) compared to the food insufficient males (30.5%). The opposite was true with the obese and morbidly obese categories, where the food insufficient males were higher than the food sufficient males in both instances (obese = 12.8% FI, 11.1% FS and morbidly obese = 3.5% FI, 2.4% FS). Food insufficient males had a reduced risk of being overweight in all three calculated odds ratios (OR crude (unadjusted), adjusted model 1, and adjusted model 2). The unadjusted OR for the morbidly obese category indicated 1.5 (CI 1.0-2.2) times the risk of being morbidly obese and food insufficient. The comparison of the prevalence of overweight among the female adults based on their food security status indicated higher rates of overweight among the food insufficient (FI) females (27.1%) compared to the food sufficient females (25.0%). This pattern remained constant among the females with higher rates of obesity and morbid obesity in the food insufficient female population. Like the men, the crude OR for the morbidly obese female category indicated 1.5 (CI 1.1-2.1) times the risk of being morbidly obese and food insufficient. There was no significant relationship shown between the overweight and obesity

categories for women, and the obesity category for men after potentially confounding variables were adjusted. However, men in food insufficient households were statistically less likely to be overweight, even after adjusting for potentially confounding variables.

Wilde and Peterman's study (2006) was based on data from the 1999-2000 and 2001-2002 NHANES survey. This study analyzed the relationship between household food security status and weight change over a 12-month period with a population of American women and men  $\geq 18$  years of age. Little difference was found between women and men with regard to the prevalence of food security status within all categories. The odds ratios indicated that women had a higher risk of being overweight at the most severe category of food insecurity, food insecure with hunger. Women in this category were 1.67 (CI 1.08-2.57,  $p < 0.05$ ) times more likely to be overweight than the fully food secure women. Marginally food secure women were 1.58 (CI 1.11-2.24,  $p < 0.05$ ) times more likely to be obese and the food insecure without hunger women were 1.76 (CI 1.44-2.15,  $p < 0.05$ ) more likely to be obese than the food secure women in this study. Men in the marginally food secure category had an increased risk of obesity (OR 1.43, CI 1.06-1.93,  $p < 0.05$ ) but this was the only category that was statistically significant. This study also looked at the prevalence of a weight gain/loss over the one-year period prior to the study using self-reported weight comparisons with measured weight. Study participants who most accurately self-reported their weight gain/loss in comparison to their measured weight gain/loss were classified as "good reporters" and were included in the dataset for the one-year weight gain/loss portion of the study. In comparison with the fully food secure women, the marginally food secure and food insecure without hunger women had a statistically significant ( $p < 0.05$ ) greater percentage increase in the  $\geq 2.27$  kg and  $\geq 4.54$  kg weight gain categories. Women in the marginally food secure category had an increased OR of 1.56 (CI 1.09-2.23,  $p < 0.05$ ) of gaining  $\geq 2.27$  kg in the previous one-year period and an increased OR of 1.68 (CI 1.21-2.33,  $p < 0.05$ ) of gaining  $\geq 4.54$  kg in that same time period. Women from the food insecure without hunger category had an increased OR of 1.43 (CI 1.02-2.00,  $p < 0.05$ ) of gaining  $\geq 2.27$  kg of weight over the one-year period but the odds of a weight gain exceeding 4.54 kg was not statistically significant. For men, the only statistically significant ( $p < 0.05$ ) change in comparison with fully food secure men was in the weight gain of  $\geq 2.27$  kg or  $\geq 4.54$  kg for marginally food secure men.

## **Females**

There were three included studies with women as the focus population. All were conducted in the United States. The purpose of each study varied but all included determining the prevalence of food insecurity and the relationship of overweight and/or obesity to the food secure and food insecure female population.

Adams et al. (2003) reported on the relationship between food insecurity and obesity (BMI  $\geq 30.0$ ) of Californian women  $> 18$  years of age using data from the California Women's Health Survey (CWHS). Broken down by ethnicity (Asian, Black, Hispanic, and White, Non-Hispanic), the authors found that the prevalence of obesity in relation to food insecurity with hunger (FIWH), the most severe level of food insecurity, increased from those values reported in food insecurity without hunger (FIWOH) in all ethnicities except for white, non-Hispanic women. For those women, the prevalence rate dropped from 28.1% obese (FIWOH) to 26.5% obese (FIWH). The risk for white,

non-Hispanic FIWOH women to be obese is shown in the odds ratio of 1.36 (CI 1.00-1.84,  $p<0.05$ ). Asian, Black and Hispanic women showed the greatest risk of obesity in the food insecure with hunger (FIWH) category with an odds ratio of 2.81 (CI 1.84, 4.28,  $p<0.05$ ). Asian, Black and Hispanic women showed increasing levels of obesity as the severity of their food insecurity increased, but this was not applicable to white, non-Hispanic women.

Kaiser et al. (2004) studied whether the choice of survey instrument had an influence on the reported relationship between food insecurity and obesity. Drawing on a convenience sample of 559 Latino females, three different survey instruments were used to measure obesity and food insecurity. In measuring the relationship of food insecurity to obesity, the adjusted odds ratio (AOR) for the food insecure with hunger population to be obese was 1.98 (1.14, 3.53 CI,  $p=0.03$ ) using the 10-item adult subscale. Using the 4-item adult subscale, the AOR for the food insecure with hunger population to be obese was 2.41 (1.23, 4.74 CI,  $p=0.02$ ). The AOR for the food insecure population without hunger, using both the 10-item and 4-item scales was not found to be statistically significant.

In a study on the relationship between food insecurity and overweight, Townsend et al. (2001) reported that food insecurity was positively related to overweight in females ( $p<0.0001$ ) but not males ( $p=0.44$ ). The prevalence of overweight by food security status for women ranged from 34% of the food secure, 41% mildly food insecure, 52% moderately food insecure and dropped to 20% for the severely food insecure. Utilizing bivariate analysis to test for statistical significance, the authors stated that food insecurity was significantly related to other variables. The p-value for the variables is as follows: income, education, occupation, ethnicity, age, household size, welfare status, FSP participation ( $p<0.001$ ); region of the country, television viewing;  $p<0.003$  for total energy intake ( $p<0.002$ ); urbanization ( $p<0.009$ ). The AOR for reporting overweight and mild food insecurity was 1.3 (CI 1.08, 1.52,  $p=0.0050$ ) but there were reduced odds for reporting overweight with increasing levels of food insecurity (moderate and severe). While this study did show a positive relationship between food insecurity and overweight in females it did not find a similar outcome between food insecurity and obesity.

## **Older Adults**

There were a limited number of studies with a population of older adults with food insecurity and obesity as an outcome. In our review, only two passed relevance testing and the results are discussed below. These studies were conducted in the United States.

Sayhoun and Basiotis' (2001) study concentrated on comparing the nutritional status of food sufficient and food insufficient persons  $\geq 65$  years of age. They used data from the NHANES III survey (1988-1994). The gender split was 48% men, 52% women. The study found that 14% of the food insufficient population had a  $BMI \leq 19.0$  (considered underweight) compared to 3% of the food sufficient population ( $p<0.05$ ). In terms of the proportion of obesity ( $BMI \geq 30.0$ ), the authors found no significant differences between the food sufficient and food insufficient groups. The authors stated that in addition to income adequacy, there were a number of different confounders that needed to be considered in the interpretation of the data when

dealing with the elderly such as their ability to purchase and prepare foods due to limited mobility, and in some cases, their inability to care for themselves.

In Lee and Frongillo's (2001) study, compared the nutritional status of the food secure and food insecure seniors' population with data from two surveys: NHANES III (1988-1994) and NSENY (Nutrition Survey of the Elderly in New York State) (1994). The data from the NSENY was only used for reporting and comparing the characteristics of the populations. The NHANES study determined that 1.7% were food insufficient and that there were no significant differences between the food sufficient and food insufficient populations in terms of BMI, with the food insufficient average BMI =26.8 while the food sufficient average BMI was 27.1 ( $p=0.476$ ).

## Children

Six studies involving children passed relevance testing and were included in this review. All were conducted in the United States.

In the Alaimo et al. (2001) study the prevalence of overweight by race-ethnicity, age, sex and family food security status showed the highest prevalence rates for white boys and girls in the 8-16 age group. Data on the prevalence of overweight by ethnicity, age, sex, and family food security showed the highest levels of overweight in Mexican-American children 2-7 years of age regardless of food security status. In the 8-16 years of age group, the highest levels of overweight in the family food insufficiency population were in the non-Hispanic white girls (41.3%) and the Mexican-American boys (35.7%). The authors state that food insufficient boys and girls in the 2-7 years of age group had reduced odds of being overweight with the OR for boys = 0.91 (CI 0.55-1.41), and the OR for girls = 0.64 (CI 0.38-1.08), both confidence intervals showing non-significant results. They also state that white, non-Hispanic girls aged 8-16 had 3.55 (CI 0.82-15.40) times greater odds of being at risk for overweight ( $p<0.10$ ) although this data was also not statistically significant.

The objective of the Casey et al. (2001) study was to compare food insufficient with food sufficient children 0-17 years of age on characteristics including food intake, nutrient intake, physical inactivity, overweight status and underweight status. Food security status was divided into three groups: food insufficient with low income ( $\leq$  130% of federal poverty line), food sufficient with low income ( $\leq$  130% of federal poverty line), and food sufficient with high income ( $>$  130% of federal poverty line). The authors reported that the percentage of children at risk of overweight (BMI $\geq$ 85<sup>th</sup> percentile)[please note: BMI was calculated for children 1 year and older] decreased by level of food insufficiency and income (food insufficient, low income = 46.7%; food sufficient, low income = 46.5%; food sufficient, high income = 31.5%), indicating a significant difference between food insufficient low income and food sufficient high income populations only.

Matheson et al. (2002) explored the relationship between food insecurity, household food supplies, dietary intake, and obesity in a study on a population of grade five Hispanic children in Northern California. The mean BMI of the food secure children ( $21.19 \pm 4.69$ ) was significantly ( $p=0.04$ ) higher than that of the food insecure children ( $19.80 \pm 2.88$ ) demonstrating a negative relationship between food insecurity and obesity. The authors noted that although the mean BMI of the food insecure children was lower than that of the food secure children, the food insecure children were not

underweight and that it was the food secure children who were at risk of becoming overweight.

Rose and Bodor (2006) used the data from the Early Childhood Longitudinal Study – Kindergarten Cohort (ECLS-K) to examine the relationship between food insecurity and overweight status. They used the 18-item USDA Household Food Security Scale to determine level of food insecurity and the gender specific BMI rate of  $\geq 95^{\text{th}}$  percentile to classify a child as overweight. They reported minimal differences in prevalence of overweight by gender (girls 11.2%, boys 11.8%). There were, however, differences in the prevalence of overweight by ethnicity for the full sample of boys, in which Latinos had the highest prevalence at 18.4%, Asian-American next with 14.8%, Other 13.1%, Black 10.2% and White 10.0%. This pattern was somewhat similar for the girls with Blacks at 14.3%, Others at 13.9%, Latino 13.8%, White 9.5% and Asian-American at 8.1%. Rose and Bodor stated the OR for a relationship between obesity and food insecurity was 0.80 (CI 0.66- 0.98,  $p=.027$ ) indicating, after controlling for other possible variables, children from food-insecure households were 20% less likely to be overweight creating a protective, inverse relationship.

The Tanasescu et al. (2000) observational case/control study was concerned with looking at six outcomes comparing obese (BMI  $\geq 85^{\text{th}}$  percentile) and controls (BMI  $< 85^{\text{th}}$  percentile) children 7-10 years of age: differences in diets, activity and inactivity patterns, maternal obesity, birthweights and infant feeding practices, the influence of socioeconomic status on the likelihood of childhood obesity, and negative health consequences associated with childhood obesity. For the purposes of this review the results of the interaction of obesity and food insecurity were examined. The number of obese to non-obese was 46.5% vs. 39.1% in the household food insecure category ( $p=0.60$ ) and 28.6% vs. 17.4% ( $p=0.35$ ) in the food secure category demonstrating no relationship between food insecurity and obesity.

The stated objective in Whitaker and Orzol (2006, p. 578) was to determine “whether there are racial/ethnic differences in the prevalence of obesity (BMI  $\geq 95^{\text{th}}$  percentile) among preschool children and to determine whether these differences are explained by socioeconomic factors”. Using regression models that controlled for maternal educational attainment, household income, and the children’s food security (as single indicators or together) they found that the odds of obesity were 84% to 104% ( $p=.02$ ) higher for Hispanic children than white children. Only among African American children was the prevalence of obesity statistically significantly ( $p=.006$ ) higher in those who were fully food secure.

## **Discussion**

### **Adults (mixed gender)**

There were four studies in this section with data collection for the two Canadian studies (Che & Chen, 2001; Vozoris & Tarasuk, 2003) coming from the National Population Health Survey (NPHS). American data (Wilde & Peterman, 2006; Holben & Pheley, 2006) was collected from the NHANES and a convenience sample from Ohio. Each of these studies showed a relationship between a level or levels of food insecurity and various categories of overweight, obesity or morbid obesity with either

their male and/or female populations. These results however, need to be tempered with the fact that historically, many large, national nutrition surveys in Canada and the United States have relied on self-reported data and are therefore suspect. Note a recently released study by Lyons, Park and Nelson (2007), "Food Insecurity and Obesity: A comparison of self-reported and measured height and weight" discussing this issue. The Canadian NPHS and American NHANES surveys do not include the homeless, people living in shelters or aboriginals living on reserves so it is possible that the most vulnerable populations facing food insecurity are under-represented in these surveys.

## **Females**

The three included studies on females showed varying degrees of a relationship between food insecurity and overweight/obesity (Adams et al., 2003; Kaiser et al., 2004; Townsend et al., 2001). In the Adams et al. (2003) study a relationship between food insecurity and obesity was found in all ethnicities/races reported. Kaiser's et al. (2004) study reported a statistically significant increased risk of obesity with an increasing severity of food insecurity levels regardless of which food security subscale was used.

Townsend et al. (2001) found a higher prevalence of overweight among the food insecure than the food secure. There are, however, some issues which cause us to regard the interpretation of the results of this study with caution. First, non-standard cut-points were used for BMI, with this study measuring overweight as a  $BMI \geq 27.3$  for females. Second, this study did not report crude odds ratios on which the adjusted odds ratios are reported. Third, the authors applied a correction factor for reporting the heights and weights of self-reported data in their study. No explanation of the development or reliability or validity testing of the factor was included. Finally, the authors intentionally chose to include in their sample women who had sufficient food but were worried about having enough, as if those women were actually food insecure. While this provided the authors with a sufficient sample size it in fact confounded their results.

All studies used United States data; therefore, the results may not be transferrable to the Canadian context. It was difficult to compare populations with the different BMI cut-points used by some researchers. A more consistent measurement process would be invaluable.

## **Older Adults**

Neither study (Lee & Frongillo, 2001; Sahyoun & Basiotis, 2001) on older adults reported odds ratios between the obese and non-obese survey respondents, only an averaging of BMI between the food sufficient and food insufficient populations. Both studies reported a higher prevalence of food insufficiency among the female populations. In the Sayhoun & Basiotis (2001) study the authors report no statistical significance between the proportion of obese people in the food insufficient and food sufficient group. In the older adults' group, it appears that while obesity is still a concern, another concern is in the numbers of seniors who are underweight ( $BMI \leq 19.0$ ) and food insufficient. Small sample sized for the food insufficient group may have reduced the power to determine statistical significance. The use of

standardized BMI cut-points to report underweight, normal weight, overweight, obese and morbidly obese BMIs in the adult population would be helpful in comparing data between studies. All studies used United States data; therefore, the results may not be transferrable to the Canadian context.

## **Children**

Data on children were collected from national and state surveys, and recruited through programs such as Migrant Education, Healthy Start and Special Supplemental Nutrition Program for Women, Infants, and Children. All the studies were US based. Studies looked at the association of food insecurity and obesity in combinations of girls and boys, children in age groups between new born and 18 years of age, and ethnicities of White non-Hispanic, Hispanic and Black. Five of the six studies showed no relationship between food insecurity and obesity and one study showed an inverse relationship between food insecurity and obesity (Matheson et al., 2002).

One limitation of studies exploring an association between food insecurity and obesity with children is that often children of different ages are grouped together as one heterogeneous group. This is done to ensure an adequate sample size for statistical analysis; however, it can confound the results (i.e. the eating patterns of food insecure adolescents may be substantially different from those of food insecure pre-adolescents). The ethnic division within these studies is also quite broad and it appears that food security levels of Aboriginal children living on reserves are not represented at all. As well, levels of food insecurity are determined by information provided by parents and/or caregivers. There is the potential that these levels are higher than the data indicate. All studies used United States data; therefore, the results may not be transferrable to the Canadian context.

## **Implications**

Although this review indicates that the relationship between food insecurity and overweight/obesity is inconsistent among the studies, the trends suggest that there are some implications for public health practitioners, policy makers and researchers.

### **For Practice:**

- Given that food insecurity (FI) is associated with different levels of overweight/obesity, practitioners could direct some of their activities related to families to identifying and resolving some of the barriers to reducing FI.
- Practitioners could be advocates for those experiencing FI to reduce the problem.
- On a population level, practitioners, within their local contexts, could work with other agencies and community groups to identify and implement strategies to reduce FI.

### **For Policy:**

- When considering policies to reduce obesity among the population, the reduction of food insecurity should be one of the strategies.

- When making policies about research funding specifically related to the prevention of obesity, resources could be directed to further exploring the relationship between food insecurity and obesity in the Canadian context.

### **For Research:**

- Given that the results overall were inconsistent regarding the relationship between FI and overweight/obesity, some of the methodological limitations cited [e.g. sample selection, exclusion of many who are most likely to be FI (i.e. homeless people, aboriginal people on reservations, residents of remote communities), inconsistent choices of BMI cut-points to establish overweight/obesity] need to be addressed in future work.
- Studies to evaluate the effectiveness of strategies to reduce barriers to food security need to be developed and rigorously tested.
- FI appears to affect children, adult males and females and seniors slightly differently. These differences could be examined in more detail using qualitative methodology. This would clarify the problem and indicate directions for potential solutions that could then be developed, implemented and evaluated. It could also test some of the proposed hypotheses regarding the findings.
- Cross sectional and observational case/control studies are not sufficient for understanding the causal relationship between food security status and overweight/obesity. Future research may be able to bridge that gap.
- Preponderance of studies used data from the United States resulting in information that may not be transferrable in the Canadian context. Increased Canadian based research is needed.

## **Conclusions**

This review examined the relationship between food insecurity and obesity. Fifteen primary studies were included in this review. Fourteen were cross-sectional studies and one was a case-control study. The included studies provided data on adults (mixed gender), females, older adults and children. Although the studies are inconsistent with regard to an association between food insecurity and obesity there appears to be a trend toward this relationship. Further research focused specifically on these two issues is needed. Many variables can confound the relationship between food insecurity and obesity and those confounders should be controlled within future studies. As well, applying a consistent BMI cut point may provide meaningful outcome measures for comparative purposes. Future research will do much to clarify the controversial issue of the relationship between food insecurity and obesity.

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## **Figures and Tables**

Figure 1 Search Results

Table 1 Quality Assessment Results for All Relevant Studies

Table 2 Results of Relevant Studies

**Figure 1: Search Results**

|  |  |                                |                          |
|--|--|--------------------------------|--------------------------|
| <b>Original Search Keywords:</b>                         | 12,258 citations   |                                |                          |
| Food Insecurity,<br>Food Security,<br>Food Insufficiency |  |                                |                          |
| <b>After de-duplication:</b>                             | 8,967  |                                |                          |
| <b>Relevance by Country Status:</b>                      |  |                                |                          |
| 3 <sup>rd</sup> World, Not Relevant = 4,442              | Industrialized World, Relevant = 4,525   |                                |                          |
|  |  |                                |                          |
| <b>Category Mapping:</b>                                 | Agriculture  | 1420                           |                          |
|  | Policy   | 1268                           |                          |
|  | Programs   | 337                            |                          |
|  | Health Outcomes  | 427                            |                          |
|  | Category Mapping:  | Chronic Disease                | 63                       |
|  |  | Hunger                         | 75                       |
|  |  | Birth Defects                  | 25                       |
|  |  | Cognitive/Behaviour (Children) | 57                       |
|  |  | Obesity                        | 170                      |
|  | Unsure/Other   | 1073                           |                          |
|  |  |                                |                          |
| <b>Relevance Testing Stage 1:</b>                        | Not Relevant = 4,377   |                                | Relevant = 148 → Stage 2 |
| <b>Relevance Testing Stage 2:</b>                        | Not Relevant = 133   |                                | Relevant = 15            |
| <b>Quality Assessment:</b>                               | There were no global ratings applied to individual papers as there were only three criteria on which quality assessment was based. |                                |                          |

**Table 1: Quality Assessment Results for All Relevant Studies (n=15)**

**Population: Adults (mixed)**

| <b>Authors and Date</b>   | <b>Selection Bias</b> | <b>Confounders</b> | <b>Data Collection Methods</b> |
|---------------------------|-----------------------|--------------------|--------------------------------|
| Che and Chen, 2001        | Moderate              | Strong             | Moderate                       |
| Holben and Pheley, 2006   | Weak                  | Weak               | Strong                         |
| Vozoris and Tarasuk, 2003 | Moderate              | Moderate           | Moderate                       |
| Wilde and Peterman, 2006  | Strong                | Strong             | Strong                         |

**Population: Females**

| <b>Authors and Date</b> | <b>Selection Bias</b> | <b>Confounders</b> | <b>Data Collection Methods</b> |
|-------------------------|-----------------------|--------------------|--------------------------------|
| Adams et al., 2003      | Moderate              | Moderate           | Moderate                       |
| Kaiser et al., 2004     | Moderate              | Moderate           | Moderate                       |
| Townsend et al., 2001   | Moderate              | Strong             | Strong                         |

**Population: Older Adults**

| <b>Authors and Date</b>    | <b>Selection Bias</b> | <b>Confounders</b> | <b>Data Collection Methods</b> |
|----------------------------|-----------------------|--------------------|--------------------------------|
| Lee and Frongillo, 2001    | Moderate              | Strong             | Moderate                       |
| Sahyoun and Basiotis, 2001 | Moderate              | Weak               | Moderate                       |

**Population: Children**

| <b>Authors and Date</b>  | <b>Selection Bias</b> | <b>Confounders</b> | <b>Data Collection Methods</b> |
|--------------------------|-----------------------|--------------------|--------------------------------|
| Alaimo et al., 2001      | Moderate              | Strong             | Moderate                       |
| Casey et al., 2001       | Moderate              | Strong             | Moderate                       |
| Matheson et al., 2002    | Moderate              | Weak               | Strong                         |
| Rose and Bodor, 2006     | Moderate              | Moderate           | Strong                         |
| Tanasescu et al., 2000   | Weak                  | Strong             | Strong                         |
| Whitaker and Orzol, 2006 | Moderate              | Moderate           | Moderate                       |

**Table 2: Results of Relevant Studies (n=15)**

**Adults**

| Author, date and country             | Description of Data Source(s):   | Results  | Limitations/comments: |         |             |    |               |    |                      |             |         |             |      |  |               |                   |        |  |
|--------------------------------------|--|--|-----------------------|---------|-------------|----|---------------|----|----------------------|-------------|---------|-------------|------|--|---------------|-------------------|--------|--|
| <p>Che and Chen, 2001<br/>Canada</p> | <p>National Population Health Survey and the Food Insecurity Supplement (1998/99, Cycle 3)<br/><br/>n=48,952 full NPHS<br/><br/>(n= 1,265 FI Supplement)</p> | <p><u>Prevalence of obesity (BMI≥30(kg/m<sup>2</sup>)by household food security status:</u></p> <table border="1" data-bbox="909 578 1455 667"> <thead> <tr> <th>Food Security Status</th> <th>% Obese</th> </tr> </thead> <tbody> <tr> <td>Food Secure</td> <td>12</td> </tr> <tr> <td>Food Insecure</td> <td>15</td> </tr> </tbody> </table> <p><u>Odds ratio<sup>§</sup> of obesity (BMI≥30(kg/m<sup>2</sup>)based on food security status :</u></p> <table border="1" data-bbox="909 805 1575 894"> <thead> <tr> <th>Food Security Status</th> <th>OR (95% CI)</th> <th>p value</th> </tr> </thead> <tbody> <tr> <td>Food Secure</td> <td>1.00</td> <td></td> </tr> <tr> <td>Food Insecure</td> <td>1.50 (1.20, 1.80)</td> <td>≤ 0.05</td> </tr> </tbody> </table> <p><sup>§</sup> Adjusted for age, sex and household income.</p> | Food Security Status  | % Obese | Food Secure | 12 | Food Insecure | 15 | Food Security Status | OR (95% CI) | p value | Food Secure | 1.00 |  | Food Insecure | 1.50 (1.20, 1.80) | ≤ 0.05 | <p>Limitations: The NPHS is based on surveys of households and therefore does not include the homeless, people residing in shelters, aboriginals living on reserves, people serving in the armed forces and those living in remote areas of Canada. Large portions of these populations are considered to be among the most food insecure. Not all members of a household are necessarily food insecure. The three screening questions for FI focussed on lacking sufficient funds - therefore length of FI or its periodicity (i.e. lack of money at month's end when assistance often runs out) are not covered.</p> |
| Food Security Status                 | % Obese  |  |                       |         |             |    |               |    |                      |             |         |             |      |  |               |                   |        |  |
| Food Secure                          | 12   |  |                       |         |             |    |               |    |                      |             |         |             |      |  |               |                   |        |  |
| Food Insecure                        | 15   |  |                       |         |             |    |               |    |                      |             |         |             |      |  |               |                   |        |  |
| Food Security Status                 | OR (95% CI)  | p value  |                       |         |             |    |               |    |                      |             |         |             |      |  |               |                   |        |  |
| Food Secure                          | 1.00   |  |                       |         |             |    |               |    |                      |             |         |             |      |  |               |                   |        |  |
| Food Insecure                        | 1.50 (1.20, 1.80)  | ≤ 0.05   |                       |         |             |    |               |    |                      |             |         |             |      |  |               |                   |        |  |

| Author, date and country                  | Data Source(s)  | Results   | Limitation/Comments |      |       |     |      |      |  |    |    |         |         |            |            |       |       |            |            |      |     |            |            |       |  |
|---|---|---|---------------------|------|-------|-----|------|------|--|----|----|---------|---------|------------|------------|-------|-------|------------|------------|------|-----|------------|------------|-------|--|
| <p>Holben and Pheley, 2006</p> <p>USA</p> | <p>Convenience sample of data gathered by surveys completed by individuals at community based sites.</p> <p>n=2,580</p> | <p>FS=Food Secure<br/> FI=Food Insecure (combination of FIWOH and FIWH)<br/> FIWOH=Food Insecure without Hunger<br/> FIWH=Food Insecure with Hunger</p> <p><u>Household food security status (%)</u>:</p> <table border="1" data-bbox="800 594 1192 683"> <tr> <td>FS</td> <td>72.8</td> </tr> <tr> <td>FIWOH</td> <td>7.1</td> </tr> <tr> <td>FIWH</td> <td>20.1</td> </tr> </table> <p><u>Mean BMI by food security status</u>:<br/> n=806, sub-sample for limited clinical health examination</p> <table border="1" data-bbox="800 821 1514 935"> <thead> <tr> <th></th> <th>FS</th> <th>FI</th> <th>p value</th> </tr> </thead> <tbody> <tr> <td>Females</td> <td>29.1 ± 7.5</td> <td>30.8 ± 8.1</td> <td>0.04*</td> </tr> <tr> <td>Males</td> <td>28.8 ± 5.4</td> <td>29.2 ± 7.1</td> <td>0.72</td> </tr> <tr> <td>All</td> <td>29.0 ± 6.8</td> <td>30.3 ± 7.9</td> <td>0.04*</td> </tr> </tbody> </table> <p>* Statistically significant.</p> | FS                  | 72.8 | FIWOH | 7.1 | FIWH | 20.1 |  | FS | FI | p value | Females | 29.1 ± 7.5 | 30.8 ± 8.1 | 0.04* | Males | 28.8 ± 5.4 | 29.2 ± 7.1 | 0.72 | All | 29.0 ± 6.8 | 30.3 ± 7.9 | 0.04* | <p>Limitations:</p> <p>Participants were from a convenience sample and were not necessarily representative of the region. Specific discrepancies from Census 2000 data: more racially diverse, overrepresented by women, fewer individuals without a high school education, lower income than is typical of the counties where the sample was drawn.</p> |
| FS  | 72.8  |   |                     |      |       |     |      |      |  |    |    |         |         |            |            |       |       |            |            |      |     |            |            |       |  |
| FIWOH                                     | 7.1   |   |                     |      |       |     |      |      |  |    |    |         |         |            |            |       |       |            |            |      |     |            |            |       |  |
| FIWH                                      | 20.1  |   |                     |      |       |     |      |      |  |    |    |         |         |            |            |       |       |            |            |      |     |            |            |       |  |
|   | FS  | FI  | p value             |      |       |     |      |      |  |    |    |         |         |            |            |       |       |            |            |      |     |            |            |       |  |
| Females                                   | 29.1 ± 7.5  | 30.8 ± 8.1  | 0.04*               |      |       |     |      |      |  |    |    |         |         |            |            |       |       |            |            |      |     |            |            |       |  |
| Males                                     | 28.8 ± 5.4  | 29.2 ± 7.1  | 0.72                |      |       |     |      |      |  |    |    |         |         |            |            |       |       |            |            |      |     |            |            |       |  |
| All                                       | 29.0 ± 6.8  | 30.3 ± 7.9  | 0.04*               |      |       |     |      |      |  |    |    |         |         |            |            |       |       |            |            |      |     |            |            |       |  |

| Author, date and country                | Data Source(s)   | Results  | Limitation/comments                    |      |         |  |       |  |    |    |    |    |            |           |      |      |      |       |       |           |     |      |      |      |                |        |     |     |     |     |  |     |  |  |            |           |                |                |       |           |                |                |                |        |                |                |  |
|---|--|--|--|------|---------|--|-------|--|----|----|----|----|------------|-----------|------|------|------|-------|-------|-----------|-----|------|------|------|----------------|--------|-----|-----|-----|-----|--|-----|--|--|------------|-----------|----------------|----------------|-------|-----------|----------------|----------------|----------------|--------|----------------|----------------|--|
| Vozoris and Tarasuk, 2003<br><br>Canada | National Population Health Survey 1996/97 (Cycle 2)<br><br>n=81,581 Full NPHS<br><br>Men<br>n= 11,656 overweight<br>n= 2,879 obese<br>n= 630 morbidly obese<br><br>Women<br>n= 6,135 overweight<br>n= 2,146 obese<br>n= 748 morbidly obese | FS=Food Sufficient<br>FI=Food Insufficient<br><br><u>Prevalence (%) of overweight , obesity and morbid obesity by food security status and sex:</u><br><br><table border="1" data-bbox="802 513 1541 683"> <thead> <tr> <th rowspan="2"></th> <th rowspan="2">BMI</th> <th colspan="2">Females</th> <th colspan="2">Males</th> </tr> <tr> <th>FS</th> <th>FI</th> <th>FS</th> <th>FI</th> </tr> </thead> <tbody> <tr> <td>Overweight</td> <td>25.0-29.9</td> <td>25.0</td> <td>27.1</td> <td>45.6</td> <td>30.6*</td> </tr> <tr> <td>Obese</td> <td>30.0-34.9</td> <td>8.7</td> <td>10.0</td> <td>11.1</td> <td>12.8</td> </tr> <tr> <td>Morbidly Obese</td> <td>≥ 35.0</td> <td>3.0</td> <td>4.4</td> <td>2.4</td> <td>3.5</td> </tr> </tbody> </table> <p data-bbox="802 711 1129 740">*Statistically significant, p&lt;0.05</p> <p data-bbox="802 797 1507 849"><u>Odds ratio for females in food insufficient Adults (mixed gender) for various weight/BMI categories:</u></p> <table border="1" data-bbox="802 878 1575 1117"> <thead> <tr> <th></th> <th>BMI</th> <th>OR Adjusted 1<sup>a</sup><br/>(95% CI)</th> <th>OR Adjusted 2<sup>b</sup><br/>(95% CI)</th> </tr> </thead> <tbody> <tr> <td>Overweight</td> <td>25.0-29.9</td> <td>1.2 (0.9- 1.5)</td> <td>1.2 (0.9- 1.5)</td> </tr> <tr> <td>Obese</td> <td>30.0-34.9</td> <td>1.0 (0.8- 1.4)</td> <td>0.9 (0.7- 1.2)</td> </tr> <tr> <td>Morbidly Obese</td> <td>≥ 35.0</td> <td>1.0 (0.6- 1.6)</td> <td>0.8 (0.5- 1.4)</td> </tr> </tbody> </table> |  | BMI  | Females |  | Males |  | FS | FI | FS | FI | Overweight | 25.0-29.9 | 25.0 | 27.1 | 45.6 | 30.6* | Obese | 30.0-34.9 | 8.7 | 10.0 | 11.1 | 12.8 | Morbidly Obese | ≥ 35.0 | 3.0 | 4.4 | 2.4 | 3.5 |  | BMI | OR Adjusted 1 <sup>a</sup><br>(95% CI) | OR Adjusted 2 <sup>b</sup><br>(95% CI) | Overweight | 25.0-29.9 | 1.2 (0.9- 1.5) | 1.2 (0.9- 1.5) | Obese | 30.0-34.9 | 1.0 (0.8- 1.4) | 0.9 (0.7- 1.2) | Morbidly Obese | ≥ 35.0 | 1.0 (0.6- 1.6) | 0.8 (0.5- 1.4) | Limitation: All data self-reported; NPHS excludes populations on Indian reserves, Canadian Armed Forces bases, the Yukon and Northwest Territories and some remote areas in Ontario and Quebec, long-term residents of hospitals or residential care facilities, and persons who are homeless. |
|   | BMI  | Females  |  |      | Males   |  |       |  |    |    |    |    |            |           |      |      |      |       |       |           |     |      |      |      |                |        |     |     |     |     |  |     |  |  |            |           |                |                |       |           |                |                |                |        |                |                |  |
|   |  | FS   | FI                                     | FS   | FI      |  |       |  |    |    |    |    |            |           |      |      |      |       |       |           |     |      |      |      |                |        |     |     |     |     |  |     |  |  |            |           |                |                |       |           |                |                |                |        |                |                |  |
| Overweight                              | 25.0-29.9  | 25.0   | 27.1                                   | 45.6 | 30.6*   |  |       |  |    |    |    |    |            |           |      |      |      |       |       |           |     |      |      |      |                |        |     |     |     |     |  |     |  |  |            |           |                |                |       |           |                |                |                |        |                |                |  |
| Obese                                   | 30.0-34.9  | 8.7  | 10.0                                   | 11.1 | 12.8    |  |       |  |    |    |    |    |            |           |      |      |      |       |       |           |     |      |      |      |                |        |     |     |     |     |  |     |  |  |            |           |                |                |       |           |                |                |                |        |                |                |  |
| Morbidly Obese                          | ≥ 35.0   | 3.0  | 4.4                                    | 2.4  | 3.5     |  |       |  |    |    |    |    |            |           |      |      |      |       |       |           |     |      |      |      |                |        |     |     |     |     |  |     |  |  |            |           |                |                |       |           |                |                |                |        |                |                |  |
|   | BMI  | OR Adjusted 1 <sup>a</sup><br>(95% CI)   | OR Adjusted 2 <sup>b</sup><br>(95% CI) |      |         |  |       |  |    |    |    |    |            |           |      |      |      |       |       |           |     |      |      |      |                |        |     |     |     |     |  |     |  |  |            |           |                |                |       |           |                |                |                |        |                |                |  |
| Overweight                              | 25.0-29.9  | 1.2 (0.9- 1.5)   | 1.2 (0.9- 1.5)                         |      |         |  |       |  |    |    |    |    |            |           |      |      |      |       |       |           |     |      |      |      |                |        |     |     |     |     |  |     |  |  |            |           |                |                |       |           |                |                |                |        |                |                |  |
| Obese                                   | 30.0-34.9  | 1.0 (0.8- 1.4)   | 0.9 (0.7- 1.2)                         |      |         |  |       |  |    |    |    |    |            |           |      |      |      |       |       |           |     |      |      |      |                |        |     |     |     |     |  |     |  |  |            |           |                |                |       |           |                |                |                |        |                |                |  |
| Morbidly Obese                          | ≥ 35.0   | 1.0 (0.6- 1.6)   | 0.8 (0.5- 1.4)                         |      |         |  |       |  |    |    |    |    |            |           |      |      |      |       |       |           |     |      |      |      |                |        |     |     |     |     |  |     |  |  |            |           |                |                |       |           |                |                |                |        |                |                |  |

Odds ratio for males in food insufficient Adults (mixed gender) for various weight/ BMI categories:

|                   | BMI       | Adjusted 1 <sup>α</sup><br>(95% CI) | Adjusted 2 <sup>β</sup><br>(95% CI) |
|-------------------|-----------|-------------------------------------|-------------------------------------|
| Overweight        | 25.0-29.9 | 0.7 (0.5- 0.9)*                     | 0.7 (0.5- 0.9)*                     |
| Obese             | 30.0-34.9 | 1.2 (0.8- 1.18)                     | 1.2 (0.8- 1.8)                      |
| Morbidly<br>Obese | ≥ 35.0    | 1.3 (0.8- 2.2)                      | 1.2 (0.7- 2.0)                      |

<sup>α</sup> Adjusted for age group, education level, income adequacy.

<sup>β</sup> As above (α) plus functional health.

\* Statistically significant, p≤0.05

| Author, date and country                   | Data Source(s)   | Results   | Limitations/comments |        |        |       |      |         |       |      |      |      |       |       |      |      |      |        |                                   |     |     |       |      |         |                        |       |        |        |        |         |                |       |        |        |        |       |                        |       |       |        |       |       |                |       |       |        |       |   |
|--|--|---|----------------------|--------|--------|-------|------|---------|-------|------|------|------|-------|-------|------|------|------|--------|-----------------------------------|-----|-----|-------|------|---------|------------------------|-------|--------|--------|--------|---------|----------------|-------|--------|--------|--------|-------|------------------------|-------|-------|--------|-------|-------|----------------|-------|-------|--------|-------|---|
| <p>Wilde and Peterman, 2006</p> <p>USA</p> | <p>Pooled data sets from the 1999-2000 and 2001-2002 NHANES collection periods.</p> <p>n=5,080 (females)<br/>n=4,618 (males)</p> | <p>FFS=Fully food secure<br/>MFS=Marginally food secure<br/>FIWOH=Food insecure without hunger<br/>FIWH=Food insecure with hunger</p> <p><u>Prevalence (%) of household food security status by sex:</u></p> <table border="1" data-bbox="779 508 1396 594"> <thead> <tr> <th></th> <th>FFS</th> <th>MFS</th> <th>FIWOH</th> <th>FIWH</th> </tr> </thead> <tbody> <tr> <td>Females</td> <td>84.07</td> <td>6.16</td> <td>6.15</td> <td>3.62</td> </tr> <tr> <td>Males</td> <td>85.24</td> <td>4.84</td> <td>6.32</td> <td>3.60</td> </tr> </tbody> </table> <p><u>Mean BMI by food security status and sex (%):</u></p> <table border="1" data-bbox="779 678 1572 959"> <thead> <tr> <th>Gender</th> <th>Category (BMI kg/m<sup>2</sup>)</th> <th>FFS</th> <th>MFS</th> <th>FIWOH</th> <th>FIWH</th> </tr> </thead> <tbody> <tr> <td>Females</td> <td>Overweight (25.0-29.9)</td> <td>59.62</td> <td>71.68*</td> <td>67.87*</td> <td>72.28*</td> </tr> <tr> <td>Females</td> <td>Obese (≥ 30.0)</td> <td>30.85</td> <td>43.06*</td> <td>46.34*</td> <td>39.63*</td> </tr> <tr> <td>Males</td> <td>Overweight (25.0-29.9)</td> <td>67.71</td> <td>70.70</td> <td>55.17*</td> <td>62.31</td> </tr> <tr> <td>Males</td> <td>Obese (≥ 30.0)</td> <td>26.45</td> <td>31.83</td> <td>20.34*</td> <td>24.93</td> </tr> </tbody> </table> <p>* Statistically significant, p&lt;0.05</p> |                      | FFS    | MFS    | FIWOH | FIWH | Females | 84.07 | 6.16 | 6.15 | 3.62 | Males | 85.24 | 4.84 | 6.32 | 3.60 | Gender | Category (BMI kg/m <sup>2</sup> ) | FFS | MFS | FIWOH | FIWH | Females | Overweight (25.0-29.9) | 59.62 | 71.68* | 67.87* | 72.28* | Females | Obese (≥ 30.0) | 30.85 | 43.06* | 46.34* | 39.63* | Males | Overweight (25.0-29.9) | 67.71 | 70.70 | 55.17* | 62.31 | Males | Obese (≥ 30.0) | 26.45 | 31.83 | 20.34* | 24.93 | <p>Second set of analyses (weight gain over the past 12 months) based on using data from those people in the sample who were classified as good reporters of weight (difference between self-reported and measured (both reported in NHANES)). Therefore the sample size declines at this point to n=4005 women and n=3671 men)</p> |
|  | FFS  | MFS   | FIWOH                | FIWH   |        |       |      |         |       |      |      |      |       |       |      |      |      |        |                                   |     |     |       |      |         |                        |       |        |        |        |         |                |       |        |        |        |       |                        |       |       |        |       |       |                |       |       |        |       |   |
| Females                                    | 84.07  | 6.16  | 6.15                 | 3.62   |        |       |      |         |       |      |      |      |       |       |      |      |      |        |                                   |     |     |       |      |         |                        |       |        |        |        |         |                |       |        |        |        |       |                        |       |       |        |       |       |                |       |       |        |       |   |
| Males                                      | 85.24  | 4.84  | 6.32                 | 3.60   |        |       |      |         |       |      |      |      |       |       |      |      |      |        |                                   |     |     |       |      |         |                        |       |        |        |        |         |                |       |        |        |        |       |                        |       |       |        |       |       |                |       |       |        |       |   |
| Gender                                     | Category (BMI kg/m <sup>2</sup> )  | FFS   | MFS                  | FIWOH  | FIWH   |       |      |         |       |      |      |      |       |       |      |      |      |        |                                   |     |     |       |      |         |                        |       |        |        |        |         |                |       |        |        |        |       |                        |       |       |        |       |       |                |       |       |        |       |   |
| Females                                    | Overweight (25.0-29.9)   | 59.62   | 71.68*               | 67.87* | 72.28* |       |      |         |       |      |      |      |       |       |      |      |      |        |                                   |     |     |       |      |         |                        |       |        |        |        |         |                |       |        |        |        |       |                        |       |       |        |       |       |                |       |       |        |       |   |
| Females                                    | Obese (≥ 30.0)   | 30.85   | 43.06*               | 46.34* | 39.63* |       |      |         |       |      |      |      |       |       |      |      |      |        |                                   |     |     |       |      |         |                        |       |        |        |        |         |                |       |        |        |        |       |                        |       |       |        |       |       |                |       |       |        |       |   |
| Males                                      | Overweight (25.0-29.9)   | 67.71   | 70.70                | 55.17* | 62.31  |       |      |         |       |      |      |      |       |       |      |      |      |        |                                   |     |     |       |      |         |                        |       |        |        |        |         |                |       |        |        |        |       |                        |       |       |        |       |       |                |       |       |        |       |   |
| Males                                      | Obese (≥ 30.0)   | 26.45   | 31.83                | 20.34* | 24.93  |       |      |         |       |      |      |      |       |       |      |      |      |        |                                   |     |     |       |      |         |                        |       |        |        |        |         |                |       |        |        |        |       |                        |       |       |        |       |       |                |       |       |        |       |   |

Odds ratio<sup>§</sup> of female and male overweight or obese based on food security status :

|                    | MFS               | FIWOH             | FIWH              |
|--------------------|-------------------|-------------------|-------------------|
| Females Overweight | 1.40 (0.97-2.02)  | 1.22 (0.8-1.72)   | 1.67 (1.08-2.57)* |
| Females Obese      | 1.58 (1.11-2.24)* | 1.76 (1.44-2.15)* | 1.28 (0.79-2.08)  |
| Males Overweight   | 1.26 (0.87-1.83)  | 0.71 (0.49-1.01)  | 0.94 (0.59-1.48)  |
| Males Obese        | 1.43 (1.06-1.93)* | 0.74 (0.49-1.10)  | 0.90 (0.56-1.45)  |

<sup>§</sup> Adjusted for race/ethnicity, income, education and current health status.

\* Statistically significant,  $p \leq 0.05$

OR for weight gain/loss over one year period for women and men<sup>§</sup>

| <b>Women</b><br>(n=3569) | MFS               | FIWOH             | FIWH             |
|--------------------------|-------------------|-------------------|------------------|
| Gained $\geq$ 2.27 kg    | 1.56 (1.09-2.23)* | 1.43 (1.02-2.00)* | 1.46 (0.81-2.66) |
| Gained $\geq$ 4.54 kg    | 1.68 (1.21-2.33)* | 1.36 (0.94-1.98)  | 1.36 (0.83-2.21) |
| Lost $\geq$ 2.27 kg      | 0.81 (0.54-1.21)  | 1.33 (0.81-2.18)  | 1.01 (0.63-1.60) |
| Lost $\geq$ 4.54 kg      | 0.77 (0.48-1.22)  | 1.40 (0.79-2.47)  | 0.95 (0.47-1.93) |
| <b>Men</b><br>(n=3337)   | MFS               | FIWOH             | FIWH             |
| Gained $\geq$ 2.27 kg    | 1.36 (0.94-1.95)  | 1.06 (0.79-1.42)  | 1.12 (0.56-2.24) |
| Gained $\geq$ 4.54 kg    | 1.28 (0.88-1.88)  | 1.07 (0.72-1.59)  | 1.12 (0.54-2.33) |
| Lost $\geq$ 2.27 kg      | 0.83 (0.51-1.35)  | 0.87 (0.54-1.42)  | 0.73 (0.36-1.49) |
| Lost $\geq$ 4.54 kg      | 0.86 (0.60-1.23)  | 0.89 (0.52-1.54)  | 1.02 (0.46-2.28) |

<sup>§</sup> Adjusted for race/ethnicity, income, education, current health status and self-reported weight from previous 12-month period.

\* Statistically significant,  $p \leq 0.05$

**Females**

| Author, date and country          | Data Source(s)   | Results   | Limitations/Comments |      |          |       |      |          |       |     |     |      |      |      |       |      |      |      |      |      |          |      |      |      |      |      |                     |      |      |      |      |      |  |                        |         |       |  |  |                     |                   |        |                           |                   |        |      |  |  |                     |                   |  |                           |                   |        |   |
|-----------------------------------|--|---|----------------------|------|----------|-------|------|----------|-------|-----|-----|------|------|------|-------|------|------|------|------|------|----------|------|------|------|------|------|---------------------|------|------|------|------|------|--|------------------------|---------|-------|--|--|---------------------|-------------------|--------|---------------------------|-------------------|--------|------|--|--|---------------------|-------------------|--|---------------------------|-------------------|--------|---|
| <p>Adams et al., 2003<br/>USA</p> | <p>California Women's Health Survey (CWHS) 1998 and 1999<br/><br/>n=8169</p> | <p>FS = Food Secure<br/>FIWOH = Food Insecure without Hunger<br/>FIWH = Food Secure with Hunger</p> <p><u>% Obese (BMI ≥ 30.0 kg/m<sup>2</sup>) by food security status and ethnicity:</u></p> <table border="1" data-bbox="779 557 1528 699"> <thead> <tr> <th></th> <th>All</th> <th>FS</th> <th>FIWOH</th> <th>FIWH</th> <th>p value*</th> </tr> </thead> <tbody> <tr> <td>Asian</td> <td>9.1</td> <td>6.6</td> <td>17.4</td> <td>38.5</td> <td>0.05</td> </tr> <tr> <td>Black</td> <td>29.9</td> <td>27.0</td> <td>36.2</td> <td>52.1</td> <td>0.05</td> </tr> <tr> <td>Hispanic</td> <td>25.5</td> <td>20.7</td> <td>32.1</td> <td>42.1</td> <td>0.05</td> </tr> <tr> <td>White, Non-Hispanic</td> <td>17.0</td> <td>15.6</td> <td>28.1</td> <td>26.5</td> <td>0.05</td> </tr> </tbody> </table> <p>*Chi-square test for linear trend within race/ethnicity</p> <p><u>Odds Ratio:</u> (Food Secure = 1.0)</p> <table border="1" data-bbox="779 865 1528 1097"> <thead> <tr> <th></th> <th>OR (adjusted) (CI 95%)</th> <th>p value</th> </tr> </thead> <tbody> <tr> <td>FIWOH</td> <td></td> <td></td> </tr> <tr> <td>White, Non-Hispanic</td> <td>1.36 (1.00- 1.84)</td> <td>&lt; 0.05</td> </tr> <tr> <td>Asian, Black and Hispanic</td> <td>1.47 (1.07- 1.94)</td> <td>&lt; 0.05</td> </tr> <tr> <td>FIWH</td> <td></td> <td></td> </tr> <tr> <td>White, Non-Hispanic</td> <td>0.82 (0.57- 1.55)</td> <td></td> </tr> <tr> <td>Asian, Black and Hispanic</td> <td>2.81 (1.84- 4.28)</td> <td>&lt; 0.05</td> </tr> </tbody> </table> <p>Adjusted for income, race/ethnicity, country of birth, age, education, general health status, walking (proxy for activity).</p> |                      | All  | FS       | FIWOH | FIWH | p value* | Asian | 9.1 | 6.6 | 17.4 | 38.5 | 0.05 | Black | 29.9 | 27.0 | 36.2 | 52.1 | 0.05 | Hispanic | 25.5 | 20.7 | 32.1 | 42.1 | 0.05 | White, Non-Hispanic | 17.0 | 15.6 | 28.1 | 26.5 | 0.05 |  | OR (adjusted) (CI 95%) | p value | FIWOH |  |  | White, Non-Hispanic | 1.36 (1.00- 1.84) | < 0.05 | Asian, Black and Hispanic | 1.47 (1.07- 1.94) | < 0.05 | FIWH |  |  | White, Non-Hispanic | 0.82 (0.57- 1.55) |  | Asian, Black and Hispanic | 2.81 (1.84- 4.28) | < 0.05 | <p>Limitations:</p> <p>Self-reported data. Women without phones and/or who didn't speak English or Spanish, were excluded from the survey. Authors state the excluded women probably differed in income, education, and ethnicity, and were possibly even more food insecure than those who participated in the survey.</p> |
|                                   | All  | FS  | FIWOH                | FIWH | p value* |       |      |          |       |     |     |      |      |      |       |      |      |      |      |      |          |      |      |      |      |      |                     |      |      |      |      |      |  |                        |         |       |  |  |                     |                   |        |                           |                   |        |      |  |  |                     |                   |  |                           |                   |        |   |
| Asian                             | 9.1  | 6.6   | 17.4                 | 38.5 | 0.05     |       |      |          |       |     |     |      |      |      |       |      |      |      |      |      |          |      |      |      |      |      |                     |      |      |      |      |      |  |                        |         |       |  |  |                     |                   |        |                           |                   |        |      |  |  |                     |                   |  |                           |                   |        |   |
| Black                             | 29.9   | 27.0  | 36.2                 | 52.1 | 0.05     |       |      |          |       |     |     |      |      |      |       |      |      |      |      |      |          |      |      |      |      |      |                     |      |      |      |      |      |  |                        |         |       |  |  |                     |                   |        |                           |                   |        |      |  |  |                     |                   |  |                           |                   |        |   |
| Hispanic                          | 25.5   | 20.7  | 32.1                 | 42.1 | 0.05     |       |      |          |       |     |     |      |      |      |       |      |      |      |      |      |          |      |      |      |      |      |                     |      |      |      |      |      |  |                        |         |       |  |  |                     |                   |        |                           |                   |        |      |  |  |                     |                   |  |                           |                   |        |   |
| White, Non-Hispanic               | 17.0   | 15.6  | 28.1                 | 26.5 | 0.05     |       |      |          |       |     |     |      |      |      |       |      |      |      |      |      |          |      |      |      |      |      |                     |      |      |      |      |      |  |                        |         |       |  |  |                     |                   |        |                           |                   |        |      |  |  |                     |                   |  |                           |                   |        |   |
|                                   | OR (adjusted) (CI 95%)   | p value   |                      |      |          |       |      |          |       |     |     |      |      |      |       |      |      |      |      |      |          |      |      |      |      |      |                     |      |      |      |      |      |  |                        |         |       |  |  |                     |                   |        |                           |                   |        |      |  |  |                     |                   |  |                           |                   |        |   |
| FIWOH                             |  |   |                      |      |          |       |      |          |       |     |     |      |      |      |       |      |      |      |      |      |          |      |      |      |      |      |                     |      |      |      |      |      |  |                        |         |       |  |  |                     |                   |        |                           |                   |        |      |  |  |                     |                   |  |                           |                   |        |   |
| White, Non-Hispanic               | 1.36 (1.00- 1.84)  | < 0.05  |                      |      |          |       |      |          |       |     |     |      |      |      |       |      |      |      |      |      |          |      |      |      |      |      |                     |      |      |      |      |      |  |                        |         |       |  |  |                     |                   |        |                           |                   |        |      |  |  |                     |                   |  |                           |                   |        |   |
| Asian, Black and Hispanic         | 1.47 (1.07- 1.94)  | < 0.05  |                      |      |          |       |      |          |       |     |     |      |      |      |       |      |      |      |      |      |          |      |      |      |      |      |                     |      |      |      |      |      |  |                        |         |       |  |  |                     |                   |        |                           |                   |        |      |  |  |                     |                   |  |                           |                   |        |   |
| FIWH                              |  |   |                      |      |          |       |      |          |       |     |     |      |      |      |       |      |      |      |      |      |          |      |      |      |      |      |                     |      |      |      |      |      |  |                        |         |       |  |  |                     |                   |        |                           |                   |        |      |  |  |                     |                   |  |                           |                   |        |   |
| White, Non-Hispanic               | 0.82 (0.57- 1.55)  |   |                      |      |          |       |      |          |       |     |     |      |      |      |       |      |      |      |      |      |          |      |      |      |      |      |                     |      |      |      |      |      |  |                        |         |       |  |  |                     |                   |        |                           |                   |        |      |  |  |                     |                   |  |                           |                   |        |   |
| Asian, Black and Hispanic         | 2.81 (1.84- 4.28)  | < 0.05  |                      |      |          |       |      |          |       |     |     |      |      |      |       |      |      |      |      |      |          |      |      |      |      |      |                     |      |      |      |      |      |  |                        |         |       |  |  |                     |                   |        |                           |                   |        |      |  |  |                     |                   |  |                           |                   |        |   |

| Author, date and country       | Data Source(s)   | Results   | Limitations/Comments |      |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
|--------------------------------|--|---|----------------------|------|-------|------|------|--------|------|------|-----|---|-------------|------|------|-----|-----|------------|------|------|------|-----|--|----|-------|-------|--------|------|------|-----|-------------|------|------|-----|------------|------|------|------|--|------------------------|---------|-------|--|--|---------------|-------------------|--|--------------|-------------------|--|-------|--|--|---------------|-------------------|------|--------------|-------------------|------|---|
| Kaiser et al., 2004<br><br>USA | Convenience sample of data collected between February and May 2001, low-income Latino women<br><br>n=559 | <p>FS=Food Secure<br/>           FIWOH=Food Insecure without Hunger<br/>           FIMH=Food Insecure with Moderate Hunger<br/>           FISH=Food Insecure with Severe Hunger<br/>           FIMSH=Food Insecure with Moderate/Severe Hunger</p> <p><u>Prevalence of weight status by food insecurity</u><br/> <u>10 Item scale:</u></p> <table border="1" data-bbox="682 573 1539 690"> <thead> <tr> <th></th> <th>FS</th> <th>FIWOH</th> <th>FIMH</th> <th>FISH</th> </tr> </thead> <tbody> <tr> <td>BMI&lt;25</td> <td>58.5</td> <td>33.9</td> <td>8.0</td> <td>0</td> </tr> <tr> <td>BMI 25-29.9</td> <td>48.2</td> <td>41.4</td> <td>8.6</td> <td>1.8</td> </tr> <tr> <td>BMI ≥ 30.0</td> <td>45.5</td> <td>38.3</td> <td>13.4</td> <td>2.9</td> </tr> </tbody> </table> <p><u>4 Item scale:</u></p> <table border="1" data-bbox="682 773 1402 889"> <thead> <tr> <th></th> <th>FS</th> <th>FIWOH</th> <th>FIMSH</th> </tr> </thead> <tbody> <tr> <td>BMI&lt;25</td> <td>59.2</td> <td>40.0</td> <td>0.8</td> </tr> <tr> <td>BMI 25-29.9</td> <td>48.6</td> <td>42.7</td> <td>8.6</td> </tr> <tr> <td>BMI ≥ 30.0</td> <td>45.0</td> <td>43.0</td> <td>12.0</td> </tr> </tbody> </table> <p><u>Odds Ratio<sup>§</sup> BMI≥30.0:</u></p> <table border="1" data-bbox="682 972 1407 1203"> <thead> <tr> <th></th> <th>OR (adjusted) (CI 95%)</th> <th>p value</th> </tr> </thead> <tbody> <tr> <td>FIWOH</td> <td></td> <td></td> </tr> <tr> <td>10-Item Scale</td> <td>1.16 (0.81- 1.73)</td> <td></td> </tr> <tr> <td>4-Item Scale</td> <td>1.25 (0.86- 1.82)</td> <td></td> </tr> <tr> <td>FIMSH</td> <td></td> <td></td> </tr> <tr> <td>10-Item Scale</td> <td>1.98 (1.14- 3.53)</td> <td>0.03</td> </tr> <tr> <td>4-Item Scale</td> <td>2.41 (1.23- 4.74)</td> <td>0.02</td> </tr> </tbody> </table> <p><sup>§</sup> Adjusted for parity, years lived in the USA, per capita income.</p> |                      | FS   | FIWOH | FIMH | FISH | BMI<25 | 58.5 | 33.9 | 8.0 | 0 | BMI 25-29.9 | 48.2 | 41.4 | 8.6 | 1.8 | BMI ≥ 30.0 | 45.5 | 38.3 | 13.4 | 2.9 |  | FS | FIWOH | FIMSH | BMI<25 | 59.2 | 40.0 | 0.8 | BMI 25-29.9 | 48.6 | 42.7 | 8.6 | BMI ≥ 30.0 | 45.0 | 43.0 | 12.0 |  | OR (adjusted) (CI 95%) | p value | FIWOH |  |  | 10-Item Scale | 1.16 (0.81- 1.73) |  | 4-Item Scale | 1.25 (0.86- 1.82) |  | FIMSH |  |  | 10-Item Scale | 1.98 (1.14- 3.53) | 0.03 | 4-Item Scale | 2.41 (1.23- 4.74) | 0.02 | <p>Limitations:</p> <p>Convenience sample used in recruitment for this study, therefore, caution is needed in generalizing these findings.</p> <p>The instrument used to measure Food Security was a Spanish version of the 18-item FSS that preceded the publication of the official translation. Higher consistency of responses among participants interviewed in Spanish rather than English could be because some who preferred to be interviewed in English might not have been truly proficient in the language.</p> <p>Comments:</p> <p>Data from the 18-item scale is not included as the authors state that the use of the standard 18-item USDA FSS, which includes the 10 adult and 8 child items, will not provide food insecurity prevalence statistics that are comparable to national data.</p> |
|                                | FS   | FIWOH   | FIMH                 | FISH |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
| BMI<25                         | 58.5   | 33.9  | 8.0                  | 0    |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
| BMI 25-29.9                    | 48.2   | 41.4  | 8.6                  | 1.8  |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
| BMI ≥ 30.0                     | 45.5   | 38.3  | 13.4                 | 2.9  |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
|                                | FS   | FIWOH   | FIMSH                |      |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
| BMI<25                         | 59.2   | 40.0  | 0.8                  |      |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
| BMI 25-29.9                    | 48.6   | 42.7  | 8.6                  |      |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
| BMI ≥ 30.0                     | 45.0   | 43.0  | 12.0                 |      |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
|                                | OR (adjusted) (CI 95%)   | p value   |                      |      |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
| FIWOH                          |  |   |                      |      |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
| 10-Item Scale                  | 1.16 (0.81- 1.73)  |   |                      |      |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
| 4-Item Scale                   | 1.25 (0.86- 1.82)  |   |                      |      |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
| FIMSH                          |  |   |                      |      |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
| 10-Item Scale                  | 1.98 (1.14- 3.53)  | 0.03  |                      |      |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |
| 4-Item Scale                   | 2.41 (1.23- 4.74)  | 0.02  |                      |      |       |      |      |        |      |      |     |   |             |      |      |     |     |            |      |      |      |     |  |    |       |       |        |      |      |     |             |      |      |     |            |      |      |      |  |                        |         |       |  |  |               |                   |  |              |                   |  |       |  |  |               |                   |      |              |                   |      |   |

| Author, date and country            | Data Source(s)  | Results   | Limitations/Comments |    |                      |    |                          |    |                        |    |  |                        |         |             |     |  |                      |                 |        |                          |                 |        |                        |                   |        |   |
|-------------------------------------|---|---|----------------------|----|----------------------|----|--------------------------|----|------------------------|----|--|------------------------|---------|-------------|-----|--|----------------------|-----------------|--------|--------------------------|-----------------|--------|------------------------|-------------------|--------|---|
| Townsend et al.,<br>2001<br><br>USA | Continuing Survey of Food Intakes by<br>Individuals (CSFII), 1994, 1995 and<br>1996.<br><br>n=4,509 | <p><u>% Overweight by food security status:</u></p> <table border="1" data-bbox="863 386 1276 505"> <tr> <td>Food Secure</td> <td>34</td> </tr> <tr> <td>Mild Food Insecurity</td> <td>41</td> </tr> <tr> <td>Moderate Food Insecurity</td> <td>52</td> </tr> <tr> <td>Severe Food Insecurity</td> <td>20</td> </tr> </table> <p><u>Odds Ratio:</u></p> <table border="1" data-bbox="863 586 1514 760"> <thead> <tr> <th></th> <th>OR (adjusted) (CI 95%)</th> <th>p value</th> </tr> </thead> <tbody> <tr> <td>Food Secure</td> <td>1.0</td> <td></td> </tr> <tr> <td>Mild Food Insecurity</td> <td>1.3 (1.08-1.52)</td> <td>0.0050</td> </tr> <tr> <td>Moderate Food Insecurity</td> <td>1.5 (0.90-2.61)</td> <td>0.1180</td> </tr> <tr> <td>Severe Food Insecurity</td> <td>0.39 (0.05- 2.83)</td> <td>0.3530</td> </tr> </tbody> </table> | Food Secure          | 34 | Mild Food Insecurity | 41 | Moderate Food Insecurity | 52 | Severe Food Insecurity | 20 |  | OR (adjusted) (CI 95%) | p value | Food Secure | 1.0 |  | Mild Food Insecurity | 1.3 (1.08-1.52) | 0.0050 | Moderate Food Insecurity | 1.5 (0.90-2.61) | 0.1180 | Severe Food Insecurity | 0.39 (0.05- 2.83) | 0.3530 | <p>Limitations:</p> <p>Overweight, but not obesity, measured in survey.</p> <p>Authors state "validation studies of all CSFII items have not been reported, making interpretation of some results problematic." Data self-reported but did use correction factor.</p> <p>Comments:</p> <p>Overweight cut-point defined as BMI =27.3-29.9 whereas most overweight is defined as 25.0 to 30.0 kg/m<sup>2</sup> BMI. This would result in fewer people being included in the overweight sample in comparison to other studies.</p> |
| Food Secure                         | 34  |   |                      |    |                      |    |                          |    |                        |    |  |                        |         |             |     |  |                      |                 |        |                          |                 |        |                        |                   |        |   |
| Mild Food Insecurity                | 41  |   |                      |    |                      |    |                          |    |                        |    |  |                        |         |             |     |  |                      |                 |        |                          |                 |        |                        |                   |        |   |
| Moderate Food Insecurity            | 52  |   |                      |    |                      |    |                          |    |                        |    |  |                        |         |             |     |  |                      |                 |        |                          |                 |        |                        |                   |        |   |
| Severe Food Insecurity              | 20  |   |                      |    |                      |    |                          |    |                        |    |  |                        |         |             |     |  |                      |                 |        |                          |                 |        |                        |                   |        |   |
|                                     | OR (adjusted) (CI 95%)  | p value   |                      |    |                      |    |                          |    |                        |    |  |                        |         |             |     |  |                      |                 |        |                          |                 |        |                        |                   |        |   |
| Food Secure                         | 1.0   |   |                      |    |                      |    |                          |    |                        |    |  |                        |         |             |     |  |                      |                 |        |                          |                 |        |                        |                   |        |   |
| Mild Food Insecurity                | 1.3 (1.08-1.52)   | 0.0050  |                      |    |                      |    |                          |    |                        |    |  |                        |         |             |     |  |                      |                 |        |                          |                 |        |                        |                   |        |   |
| Moderate Food Insecurity            | 1.5 (0.90-2.61)   | 0.1180  |                      |    |                      |    |                          |    |                        |    |  |                        |         |             |     |  |                      |                 |        |                          |                 |        |                        |                   |        |   |
| Severe Food Insecurity              | 0.39 (0.05- 2.83)   | 0.3530  |                      |    |                      |    |                          |    |                        |    |  |                        |         |             |     |  |                      |                 |        |                          |                 |        |                        |                   |        |   |

**Older Adults**

| Author, date and country                    | Data Source(s)  | Results  | Limitations/Comments |   |      |        |    |      |    |    |    |     |    |    |  |    |    |         |                               |      |      |       |  |   |      |        |    |     |    |    |    |    |    |    |   |
|---|---|--|----------------------|---|------|--------|----|------|----|----|----|-----|----|----|--|----|----|---------|-------------------------------|------|------|-------|--|---|------|--------|----|-----|----|----|----|----|----|----|---|
| <p>Lee and Frongillo, 2001<br/><br/>USA</p> | <p>Two data sets used: NHANES(III), 1988-1994 and NSENY, 1994</p> | <p>n = 4386 (NHANES III)<br/>n = 553 (NSENY)</p> <p>FS = Food Sufficient<br/>FI= Food Insufficient</p> <p><u>Food security status (%) for elderly by gender (NHANES III):</u></p> <table border="1" data-bbox="825 610 1304 699"> <thead> <tr> <th></th> <th>n</th> <th>Male</th> <th>Female</th> </tr> </thead> <tbody> <tr> <td>FS</td> <td>6343</td> <td>43</td> <td>57</td> </tr> <tr> <td>FI</td> <td>215</td> <td>43</td> <td>57</td> </tr> </tbody> </table><br><table border="1" data-bbox="825 727 1444 784"> <thead> <tr> <th></th> <th>FS</th> <th>FI</th> <th>p value</th> </tr> </thead> <tbody> <tr> <td>Avg. BMI (kg/m<sup>2</sup>)</td> <td>27.1</td> <td>26.8</td> <td>0.476</td> </tr> </tbody> </table> <p><u>Food security status (%) for elderly by gender (NSENY):</u></p> <table border="1" data-bbox="825 870 1304 954"> <thead> <tr> <th></th> <th>n</th> <th>Male</th> <th>Female</th> </tr> </thead> <tbody> <tr> <td>FS</td> <td>403</td> <td>40</td> <td>60</td> </tr> <tr> <td>FI</td> <td>80</td> <td>34</td> <td>66</td> </tr> </tbody> </table> |                      | n | Male | Female | FS | 6343 | 43 | 57 | FI | 215 | 43 | 57 |  | FS | FI | p value | Avg. BMI (kg/m <sup>2</sup> ) | 27.1 | 26.8 | 0.476 |  | n | Male | Female | FS | 403 | 40 | 60 | FI | 80 | 34 | 66 | <p>Limitations:</p> <p>No listing of BMI cut-points (only averaging per category FI or FS).</p> |
|   | n   | Male   | Female               |   |      |        |    |      |    |    |    |     |    |    |  |    |    |         |                               |      |      |       |  |   |      |        |    |     |    |    |    |    |    |    |   |
| FS  | 6343  | 43   | 57                   |   |      |        |    |      |    |    |    |     |    |    |  |    |    |         |                               |      |      |       |  |   |      |        |    |     |    |    |    |    |    |    |   |
| FI  | 215   | 43   | 57                   |   |      |        |    |      |    |    |    |     |    |    |  |    |    |         |                               |      |      |       |  |   |      |        |    |     |    |    |    |    |    |    |   |
|   | FS  | FI   | p value              |   |      |        |    |      |    |    |    |     |    |    |  |    |    |         |                               |      |      |       |  |   |      |        |    |     |    |    |    |    |    |    |   |
| Avg. BMI (kg/m <sup>2</sup> )               | 27.1  | 26.8   | 0.476                |   |      |        |    |      |    |    |    |     |    |    |  |    |    |         |                               |      |      |       |  |   |      |        |    |     |    |    |    |    |    |    |   |
|   | n   | Male   | Female               |   |      |        |    |      |    |    |    |     |    |    |  |    |    |         |                               |      |      |       |  |   |      |        |    |     |    |    |    |    |    |    |   |
| FS  | 403   | 40   | 60                   |   |      |        |    |      |    |    |    |     |    |    |  |    |    |         |                               |      |      |       |  |   |      |        |    |     |    |    |    |    |    |    |   |
| FI  | 80  | 34   | 66                   |   |      |        |    |      |    |    |    |     |    |    |  |    |    |         |                               |      |      |       |  |   |      |        |    |     |    |    |    |    |    |    |   |

| Author, Date and Country              | Data Source(s)  | Results  | Limitations/comments |    |    |                   |   |    |  |
|---------------------------------------|---|--|----------------------|----|----|-------------------|---|----|--|
| Sahyoun and Basiotis, 2001<br><br>USA | National Health and Nutrition Examination Survey (NHANESIII) 1988-1994<br><br>n=3885 people 65 years of age and older who completed the dietary information on the survey | n=3885<br><br>FS=Food Sufficient<br>FI=Food Insufficient<br><br>Elderly, Food Sufficiency Status (%) <table border="1" data-bbox="779 521 1293 578"> <thead> <tr> <th></th> <th>FS</th> <th>FI</th> </tr> </thead> <tbody> <tr> <td>BMI &lt;19.0 (kg/m2)</td> <td>3</td> <td>14</td> </tr> </tbody> </table><br>No statistically significant differences were found in the proportion of obese people in the two groups. |                      | FS | FI | BMI <19.0 (kg/m2) | 3 | 14 | Limitations:<br>Self reported data may challenge the reliability of the results. |
|                                       | FS  | FI   |                      |    |    |                   |   |    |  |
| BMI <19.0 (kg/m2)                     | 3   | 14   |                      |    |    |                   |   |    |  |

## Children

| Author, date and country          | Data Source(s):   | Results  | Limitations/Comments |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
|-----------------------------------|---|--|----------------------|----------------|--|----------------|--|----|----|----|----|---------------------|--|--|--|--|------|------|------|------|------|-------|------|-----|------|------|------------------|--|--|--|--|------|------|------|------|------|-------|------|------|------|------|------------------|--|--|--|--|------|------|------|------|------|-------|------|------|------|------|--|---------------|----------------|---------|-------------|-------------|-------------|---------------------|--|-------|-----------|---------------------|--|--|---------------------|--|--|--|------|--|---------------------|--|-------|--|----------------------|-------|------------------|--|--|--|------|--|--------------------|--|-------|--|---------------------|--|------------------|--|--|--|------|--|---------------------|--|-------|--|---------------------|--|---|
| Alaimo et al.,<br>2001<br><br>USA | NHANES (III), 1988-1994<br><br>n=5,200 for children 2-7 years old;<br>n=3,986 for children 8-16 years old | <p>FS=Food Sufficient; FI=Food Insufficient<br/>Prevalence (%) of overweight by age, sex, ethnicity and family food sufficiency status:</p> <table border="1" data-bbox="800 475 1442 792"> <thead> <tr> <th rowspan="2"></th> <th colspan="2">2-7 Years Old</th> <th colspan="2">8-16 Years Old</th> </tr> <tr> <th>FS</th> <th>FI</th> <th>FS</th> <th>FI</th> </tr> </thead> <tbody> <tr> <td>Non-Hispanic, White</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>  Boys</td> <td>16.0</td> <td>19.1</td> <td>27.8</td> <td>19.3</td> </tr> <tr> <td>  Girls</td> <td>19.6</td> <td>7.5</td> <td>23.0</td> <td>41.3</td> </tr> <tr> <td>African-American</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>  Boys</td> <td>17.6</td> <td>19.4</td> <td>24.9</td> <td>24.9</td> </tr> <tr> <td>  Girls</td> <td>21.5</td> <td>15.4</td> <td>33.8</td> <td>27.7</td> </tr> <tr> <td>Mexican-American</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>  Boys</td> <td>28.3</td> <td>30.8</td> <td>34.8</td> <td>35.7</td> </tr> <tr> <td>  Girls</td> <td>23.7</td> <td>30.9</td> <td>32.7</td> <td>23.1</td> </tr> </tbody> </table> <p>Odds ratio for overweight by age, sex and ethnicity of food insufficient children:</p> <table border="1" data-bbox="800 902 1610 1333"> <thead> <tr> <th rowspan="2"></th> <th>2-7 Years Old</th> <th>8-16 Years Old</th> <th rowspan="2">p value</th> </tr> <tr> <th>OR (95% CI)</th> <th>OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>All Females</td> <td>0.64 (0.38, 1.08) †</td> <td></td> <td>&lt;0.10</td> </tr> <tr> <td>All Males</td> <td>0.91 (0.55, 1.51) †</td> <td></td> <td></td> </tr> <tr> <td>Non-Hispanic, White</td> <td></td> <td></td> <td></td> </tr> <tr> <td>  Boys</td> <td></td> <td>0.35 (0.05- 2.22) ‡</td> <td></td> </tr> <tr> <td>  Girls</td> <td></td> <td>3.55 (0.82- 15.40) ‡</td> <td>&lt;0.10</td> </tr> <tr> <td>African-American</td> <td></td> <td></td> <td></td> </tr> <tr> <td>  Boys</td> <td></td> <td>1.10 (0.5- 2.40) ‡</td> <td></td> </tr> <tr> <td>  Girls</td> <td></td> <td>0.90 (0.47- 1.71) ‡</td> <td></td> </tr> <tr> <td>Mexican-American</td> <td></td> <td></td> <td></td> </tr> <tr> <td>  Boys</td> <td></td> <td>1.33 (0.74- 2.39) §</td> <td></td> </tr> <tr> <td>  Girls</td> <td></td> <td>0.70 (0.36, 1.34) §</td> <td></td> </tr> </tbody> </table> |                      | 2-7 Years Old  |  | 8-16 Years Old |  | FS | FI | FS | FI | Non-Hispanic, White |  |  |  |  | Boys | 16.0 | 19.1 | 27.8 | 19.3 | Girls | 19.6 | 7.5 | 23.0 | 41.3 | African-American |  |  |  |  | Boys | 17.6 | 19.4 | 24.9 | 24.9 | Girls | 21.5 | 15.4 | 33.8 | 27.7 | Mexican-American |  |  |  |  | Boys | 28.3 | 30.8 | 34.8 | 35.7 | Girls | 23.7 | 30.9 | 32.7 | 23.1 |  | 2-7 Years Old | 8-16 Years Old | p value | OR (95% CI) | OR (95% CI) | All Females | 0.64 (0.38, 1.08) † |  | <0.10 | All Males | 0.91 (0.55, 1.51) † |  |  | Non-Hispanic, White |  |  |  | Boys |  | 0.35 (0.05- 2.22) ‡ |  | Girls |  | 3.55 (0.82- 15.40) ‡ | <0.10 | African-American |  |  |  | Boys |  | 1.10 (0.5- 2.40) ‡ |  | Girls |  | 0.90 (0.47- 1.71) ‡ |  | Mexican-American |  |  |  | Boys |  | 1.33 (0.74- 2.39) § |  | Girls |  | 0.70 (0.36, 1.34) § |  | <p>Limitations:</p> <p>It was necessary to divide the sample into age, sex, and race-ethnic groups therefore sample sizes for some subgroups were small. Small sample size can limit the power to detect significant differences between groups and can result in finding spurious relationships. Another limitation with this study is data regarding food availability fluctuations in NHANES(III) data</p> |
|                                   | 2-7 Years Old   |  |                      | 8-16 Years Old |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
|                                   | FS  | FI   | FS                   | FI             |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Non-Hispanic, White               |   |  |                      |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Boys                              | 16.0  | 19.1   | 27.8                 | 19.3           |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Girls                             | 19.6  | 7.5  | 23.0                 | 41.3           |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| African-American                  |   |  |                      |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Boys                              | 17.6  | 19.4   | 24.9                 | 24.9           |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Girls                             | 21.5  | 15.4   | 33.8                 | 27.7           |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Mexican-American                  |   |  |                      |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Boys                              | 28.3  | 30.8   | 34.8                 | 35.7           |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Girls                             | 23.7  | 30.9   | 32.7                 | 23.1           |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
|                                   | 2-7 Years Old   | 8-16 Years Old   | p value              |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
|                                   | OR (95% CI)   | OR (95% CI)  |                      |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| All Females                       | 0.64 (0.38, 1.08) †   |  | <0.10                |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| All Males                         | 0.91 (0.55, 1.51) †   |  |                      |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Non-Hispanic, White               |   |  |                      |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Boys                              |   | 0.35 (0.05- 2.22) ‡  |                      |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Girls                             |   | 3.55 (0.82- 15.40) ‡   | <0.10                |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| African-American                  |   |  |                      |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Boys                              |   | 1.10 (0.5- 2.40) ‡   |                      |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Girls                             |   | 0.90 (0.47- 1.71) ‡  |                      |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Mexican-American                  |   |  |                      |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Boys                              |   | 1.33 (0.74- 2.39) §  |                      |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |
| Girls                             |   | 0.70 (0.36, 1.34) §  |                      |                |  |                |  |    |    |    |    |                     |  |  |  |  |      |      |      |      |      |       |      |     |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |                  |  |  |  |  |      |      |      |      |      |       |      |      |      |      |  |               |                |         |             |             |             |                     |  |       |           |                     |  |  |                     |  |  |  |      |  |                     |  |       |  |                      |       |                  |  |  |  |      |  |                    |  |       |  |                     |  |                  |  |  |  |      |  |                     |  |       |  |                     |  |   |

|  |  |  |  |
|--|--|--|--|
|  |  | <p>† OR adjusted for: child's height, child's birth weight, mother's height and weight, father's height and weight, age squared, poverty-income ratio, household size, family head educational status, family head employment status, family head marital status, metropolitan location, health insurance coverage, regular source of health care, <i>smoke exposure during pregnancy, birth complications</i></p> <p>‡ OR adjusted for: child's height, child's birth weight, mother's height and weight, father's height and weight, age squared, poverty-income ratio, household size, family head educational status, family head employment status, family head marital status, metropolitan location, health insurance coverage, regular source of health care, <i>hours of television viewed per day, and hours spent exercising</i></p> <p>§ OR also adjusted for <i>language of interview</i></p> |  |
|--|--|--|--|

| Author, date and country               | Data Source(s)   | Results   | Limitations/Comments |      |      |      |  |      |      |       |  |
|--|--|---|----------------------|------|------|------|--|------|------|-------|--|
| Casey et al.,<br>2001<br><br>USA       | Continuing Survey of<br>Food Intakes by<br>Individuals (CSFII)<br>1994-1996<br><br>n=3,790 | FILI=Food Insufficient Low Income<br>FSLI=Food Sufficient Low Income<br>FSHI=Food Sufficient High Income<br><br><u>% Children <math>\geq</math> 85<sup>th</sup> percentile BMI by food security status:</u><br><br><table border="1" data-bbox="680 570 1276 630"> <thead> <tr> <th></th> <th>FILI</th> <th>FSLI</th> <th>FSHI</th> </tr> </thead> <tbody> <tr> <td>BMI <math>\geq</math> 85<sup>th</sup> Percentile</td> <td>46.7</td> <td>46.5</td> <td>31.5*</td> </tr> </tbody> </table><br>*Statistically significant difference between FILI and FSHI groups.<br>BMI calculations on children $\geq$ one year of age. |                      | FILI | FSLI | FSHI | BMI $\geq$ 85 <sup>th</sup> Percentile | 46.7 | 46.5 | 31.5* | Odds Ratios not reported.<br><br>CSFII questions household food insufficiency status, the authors therefore assumed children in food insufficient households experienced food insufficiency. Low income food insufficient group had a smaller sample size compared with the other food sufficient groups, decreased power may have resulted in important differences not being detected. |
|  | FILI   | FSLI  | FSHI                 |      |      |      |  |      |      |       |  |
| BMI $\geq$ 85 <sup>th</sup> Percentile | 46.7   | 46.5  | 31.5*                |      |      |      |  |      |      |       |  |

| Author, date and country                 | Data Source(s)   | Results  | Limitations/Comments |                               |       |                |             |              |             |                    |      |              |  |                    |       |              |  |                    |  |   |                               |         |             |    |              |  |  |    |              |      |   |
|--|--|--|----------------------|-------------------------------|-------|----------------|-------------|--------------|-------------|--------------------|------|--------------|--|--------------------|-------|--------------|--|--------------------|--|---|-------------------------------|---------|-------------|----|--------------|--|--|----|--------------|------|---|
| <p>Matheson et al., 2002</p> <p>USA</p>  | <p>Data collection occurred September 1999 to June 2000 among grade five students from eight elementary schools in N. California.</p> <p>n=123</p> | <p><u>Average weight status of sample by sex:</u></p> <table border="1" data-bbox="848 431 1493 574"> <thead> <tr> <th></th> <th>Mean BMI (kg/m<sup>2</sup>)</th> <th>Range</th> <th>BMI Percentile</th> </tr> </thead> <tbody> <tr> <td>Full Sample</td> <td>20.70 ± 4.17</td> <td>13.10-36.81</td> <td>73<sup>rd</sup>*</td> </tr> <tr> <td>Boys</td> <td>20.93 ± 4.50</td> <td></td> <td>75<sup>th</sup>*</td> </tr> <tr> <td>Girls</td> <td>20.44 ± 3.80</td> <td></td> <td>71<sup>st</sup>*</td> </tr> </tbody> </table> <p>*Adjusted for age and sex with the use of the CDC growth curves. The difference between girls' and boys' BMI was not statistically significant (p=0.51).</p> <p><u>Mean BMI by food security status:</u></p> <table border="1" data-bbox="848 768 1514 911"> <thead> <tr> <th></th> <th>n</th> <th>Mean BMI (kg/m<sup>2</sup>)</th> <th>p value</th> </tr> </thead> <tbody> <tr> <td>Food Secure</td> <td>80</td> <td>21.19 ± 4.69</td> <td></td> </tr> <tr> <td>Food Insecure with and/or without Hunger</td> <td>43</td> <td>19.80 ± 2.88</td> <td>0.04</td> </tr> </tbody> </table> <p>No statistically significant effect on BMI was seen when the child's sex was added to the model (p=0.73).</p> |                      | Mean BMI (kg/m <sup>2</sup> ) | Range | BMI Percentile | Full Sample | 20.70 ± 4.17 | 13.10-36.81 | 73 <sup>rd</sup> * | Boys | 20.93 ± 4.50 |  | 75 <sup>th</sup> * | Girls | 20.44 ± 3.80 |  | 71 <sup>st</sup> * |  | n | Mean BMI (kg/m <sup>2</sup> ) | p value | Food Secure | 80 | 21.19 ± 4.69 |  | Food Insecure with and/or without Hunger | 43 | 19.80 ± 2.88 | 0.04 | <p>Limitations:</p> <p>Small sample size can limit the power to detect significant differences between groups and can result in finding spurious relationships.</p> |
|  | Mean BMI (kg/m <sup>2</sup> )  | Range  | BMI Percentile       |                               |       |                |             |              |             |                    |      |              |  |                    |       |              |  |                    |  |   |                               |         |             |    |              |  |  |    |              |      |   |
| Full Sample                              | 20.70 ± 4.17   | 13.10-36.81  | 73 <sup>rd</sup> *   |                               |       |                |             |              |             |                    |      |              |  |                    |       |              |  |                    |  |   |                               |         |             |    |              |  |  |    |              |      |   |
| Boys                                     | 20.93 ± 4.50   |  | 75 <sup>th</sup> *   |                               |       |                |             |              |             |                    |      |              |  |                    |       |              |  |                    |  |   |                               |         |             |    |              |  |  |    |              |      |   |
| Girls                                    | 20.44 ± 3.80   |  | 71 <sup>st</sup> *   |                               |       |                |             |              |             |                    |      |              |  |                    |       |              |  |                    |  |   |                               |         |             |    |              |  |  |    |              |      |   |
|  | n  | Mean BMI (kg/m <sup>2</sup> )  | p value              |                               |       |                |             |              |             |                    |      |              |  |                    |       |              |  |                    |  |   |                               |         |             |    |              |  |  |    |              |      |   |
| Food Secure                              | 80   | 21.19 ± 4.69   |                      |                               |       |                |             |              |             |                    |      |              |  |                    |       |              |  |                    |  |   |                               |         |             |    |              |  |  |    |              |      |   |
| Food Insecure with and/or without Hunger | 43   | 19.80 ± 2.88   | 0.04                 |                               |       |                |             |              |             |                    |      |              |  |                    |       |              |  |                    |  |   |                               |         |             |    |              |  |  |    |              |      |   |

| Author, date and country        | Data Source(s)  | Results   | Limitations/Comments |               |               |               |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
|---------------------------------|---|---|----------------------|---------------|---------------|---------------|--|---------------|--|----------|---------------|----------|---------------|----------|---------------|--------------|---------------|----------------|---------------|---------------|---------------|---------------|-------|---------------|--------------|---------------|---------------|---------------|---------------|-------|---------------|---------------|---------------|---------------|---------------|---------------|--------|--------------|---------------|---------------|---------------|---------------|---------------|-------|---------------|--------------|---------------|--------------|---------------|--------------|-------|---------------|---------------|---------------|---------------|---------------|---------------|-------------|---------------|---------------|---------------|---------------|---------------|---------------|-------|---------------|---------------|---------------|---------------|---------------|--------------|-------|---------------|---------------|---------------|---------------|---------------|--------------|--------|---------------|---------------|---------------|---------------|---------------|---------------|-------|---------------|---------------|---------------|---------------|---------------|---------------|-------|---------------|---------------|---------------|---------------|---------------|---------------|---|
| Rose and Bodor, 2006<br><br>USA | Early Childhood Longitudinal Study - Kindergarten Cohort (ECLS-K), 1999<br><br>n=16,889 | <p data-bbox="835 352 1633 402"><u>Mean BMI and prevalence of overweight by sex, ethnicity and food security status:</u></p> <table border="1" data-bbox="835 430 1612 1117"> <thead> <tr> <th rowspan="2"></th> <th colspan="2">All</th> <th colspan="2">Food Secure</th> <th colspan="2">Food Insecure</th> </tr> <tr> <th>Mean BMI</th> <th>% over-weight</th> <th>Mean BMI</th> <th>% over-weight</th> <th>Mean BMI</th> <th>% over-weight</th> </tr> </thead> <tbody> <tr> <td><b>Girls</b></td> <td>16.4<br/>±0.03</td> <td>11.2<br/>± 0.43</td> <td>16.4<br/>±0.03</td> <td>11.2<br/>±0.46</td> <td>16.5<br/>±0.10</td> <td>11.8<br/>±1.14</td> </tr> <tr> <td>  White</td> <td>16.2<br/>±0.04</td> <td>9.5<br/>±0.52</td> <td>16.4<br/>±0.04</td> <td>11.2<br/>±0.53</td> <td>16.5<br/>±0.14</td> <td>11.8<br/>±1.62</td> </tr> <tr> <td>  Black</td> <td>16.6<br/>±0.08</td> <td>14.3<br/>±1.13</td> <td>16.7<br/>±0.10</td> <td>14.2<br/>±1.29</td> <td>16.6<br/>±0.21</td> <td>15.2<br/>±2.50</td> </tr> <tr> <td>  Latino</td> <td>16.7<br/>±.07</td> <td>13.8<br/>±1.02</td> <td>16.7<br/>±0.07</td> <td>14.1<br/>±1.10</td> <td>16.6<br/>±0.19</td> <td>12.5<br/>±2.22</td> </tr> <tr> <td>  Asian</td> <td>16.0<br/>±0.17</td> <td>8.1<br/>±1.83</td> <td>16.0<br/>±0.18</td> <td>8.3<br/>±1.93</td> <td>16.7<br/>±0.39</td> <td>5.4<br/>±3.30</td> </tr> <tr> <td>  Other</td> <td>16.6<br/>±0.17</td> <td>13.9<br/>±2.07</td> <td>16.6<br/>±0.16</td> <td>13.9<br/>±2.17</td> <td>16.7<br/>±0.49</td> <td>13.8<br/>±4.55</td> </tr> <tr> <td><b>Boys</b></td> <td>16.5<br/>±0.03</td> <td>11.8<br/>±0.41</td> <td>16.5<br/>±0.03</td> <td>11.7<br/>±0.42</td> <td>16.6<br/>±0.10</td> <td>13.7<br/>±1.39</td> </tr> <tr> <td>  White</td> <td>16.3<br/>±0.04</td> <td>10.0<br/>±0.50</td> <td>16.3<br/>±0.03</td> <td>10.0<br/>±0.51</td> <td>16.2<br/>±0.13</td> <td>8.9<br/>±1.81</td> </tr> <tr> <td>  Black</td> <td>16.4<br/>±0.06</td> <td>10.2<br/>±0.90</td> <td>16.5<br/>±0.07</td> <td>10.3<br/>±0.90</td> <td>16.3<br/>±0.14</td> <td>9.7<br/>±2.90</td> </tr> <tr> <td>  Latino</td> <td>17.0<br/>±0.07</td> <td>18.4<br/>±1.06</td> <td>16.9<br/>±0.07</td> <td>18.0<br/>±1.00</td> <td>17.2<br/>±0.22</td> <td>20.7<br/>±2.75</td> </tr> <tr> <td>  Asian</td> <td>16.4<br/>±0.14</td> <td>14.8<br/>±1.68</td> <td>16.4<br/>±0.15</td> <td>15.2<br/>±1.80</td> <td>16.3<br/>±0.34</td> <td>10.9<br/>±4.77</td> </tr> <tr> <td>  Other</td> <td>16.6<br/>±0.15</td> <td>13.1<br/>±1.58</td> <td>16.6<br/>±0.31</td> <td>12.7<br/>±1.51</td> <td>16.6<br/>±0.31</td> <td>16.0<br/>±5.71</td> </tr> </tbody> </table> |                      | All           |               | Food Secure   |  | Food Insecure |  | Mean BMI | % over-weight | Mean BMI | % over-weight | Mean BMI | % over-weight | <b>Girls</b> | 16.4<br>±0.03 | 11.2<br>± 0.43 | 16.4<br>±0.03 | 11.2<br>±0.46 | 16.5<br>±0.10 | 11.8<br>±1.14 | White | 16.2<br>±0.04 | 9.5<br>±0.52 | 16.4<br>±0.04 | 11.2<br>±0.53 | 16.5<br>±0.14 | 11.8<br>±1.62 | Black | 16.6<br>±0.08 | 14.3<br>±1.13 | 16.7<br>±0.10 | 14.2<br>±1.29 | 16.6<br>±0.21 | 15.2<br>±2.50 | Latino | 16.7<br>±.07 | 13.8<br>±1.02 | 16.7<br>±0.07 | 14.1<br>±1.10 | 16.6<br>±0.19 | 12.5<br>±2.22 | Asian | 16.0<br>±0.17 | 8.1<br>±1.83 | 16.0<br>±0.18 | 8.3<br>±1.93 | 16.7<br>±0.39 | 5.4<br>±3.30 | Other | 16.6<br>±0.17 | 13.9<br>±2.07 | 16.6<br>±0.16 | 13.9<br>±2.17 | 16.7<br>±0.49 | 13.8<br>±4.55 | <b>Boys</b> | 16.5<br>±0.03 | 11.8<br>±0.41 | 16.5<br>±0.03 | 11.7<br>±0.42 | 16.6<br>±0.10 | 13.7<br>±1.39 | White | 16.3<br>±0.04 | 10.0<br>±0.50 | 16.3<br>±0.03 | 10.0<br>±0.51 | 16.2<br>±0.13 | 8.9<br>±1.81 | Black | 16.4<br>±0.06 | 10.2<br>±0.90 | 16.5<br>±0.07 | 10.3<br>±0.90 | 16.3<br>±0.14 | 9.7<br>±2.90 | Latino | 17.0<br>±0.07 | 18.4<br>±1.06 | 16.9<br>±0.07 | 18.0<br>±1.00 | 17.2<br>±0.22 | 20.7<br>±2.75 | Asian | 16.4<br>±0.14 | 14.8<br>±1.68 | 16.4<br>±0.15 | 15.2<br>±1.80 | 16.3<br>±0.34 | 10.9<br>±4.77 | Other | 16.6<br>±0.15 | 13.1<br>±1.58 | 16.6<br>±0.31 | 12.7<br>±1.51 | 16.6<br>±0.31 | 16.0<br>±5.71 | <p data-bbox="1654 352 1906 841">Authors note no statistical significant differences (<math>p &lt; .05</math>) between food secure and food insecure status in mean BMI or prevalence of overweight for any of the gender/ethnicity groupings. Parents reported on household food security status in the 12 months prior to the interview, so a food-insecure condition would have preceded the child's weight status.</p> <p data-bbox="1654 873 1885 922">Odds Ratios for females not reported.</p> |
|                                 | All   |   |                      | Food Secure   |               | Food Insecure |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
|                                 | Mean BMI  | % over-weight   | Mean BMI             | % over-weight | Mean BMI      | % over-weight |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
| <b>Girls</b>                    | 16.4<br>±0.03   | 11.2<br>± 0.43  | 16.4<br>±0.03        | 11.2<br>±0.46 | 16.5<br>±0.10 | 11.8<br>±1.14 |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
| White                           | 16.2<br>±0.04   | 9.5<br>±0.52  | 16.4<br>±0.04        | 11.2<br>±0.53 | 16.5<br>±0.14 | 11.8<br>±1.62 |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
| Black                           | 16.6<br>±0.08   | 14.3<br>±1.13   | 16.7<br>±0.10        | 14.2<br>±1.29 | 16.6<br>±0.21 | 15.2<br>±2.50 |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
| Latino                          | 16.7<br>±.07  | 13.8<br>±1.02   | 16.7<br>±0.07        | 14.1<br>±1.10 | 16.6<br>±0.19 | 12.5<br>±2.22 |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
| Asian                           | 16.0<br>±0.17   | 8.1<br>±1.83  | 16.0<br>±0.18        | 8.3<br>±1.93  | 16.7<br>±0.39 | 5.4<br>±3.30  |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
| Other                           | 16.6<br>±0.17   | 13.9<br>±2.07   | 16.6<br>±0.16        | 13.9<br>±2.17 | 16.7<br>±0.49 | 13.8<br>±4.55 |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
| <b>Boys</b>                     | 16.5<br>±0.03   | 11.8<br>±0.41   | 16.5<br>±0.03        | 11.7<br>±0.42 | 16.6<br>±0.10 | 13.7<br>±1.39 |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
| White                           | 16.3<br>±0.04   | 10.0<br>±0.50   | 16.3<br>±0.03        | 10.0<br>±0.51 | 16.2<br>±0.13 | 8.9<br>±1.81  |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
| Black                           | 16.4<br>±0.06   | 10.2<br>±0.90   | 16.5<br>±0.07        | 10.3<br>±0.90 | 16.3<br>±0.14 | 9.7<br>±2.90  |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
| Latino                          | 17.0<br>±0.07   | 18.4<br>±1.06   | 16.9<br>±0.07        | 18.0<br>±1.00 | 17.2<br>±0.22 | 20.7<br>±2.75 |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
| Asian                           | 16.4<br>±0.14   | 14.8<br>±1.68   | 16.4<br>±0.15        | 15.2<br>±1.80 | 16.3<br>±0.34 | 10.9<br>±4.77 |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |
| Other                           | 16.6<br>±0.15   | 13.1<br>±1.58   | 16.6<br>±0.31        | 12.7<br>±1.51 | 16.6<br>±0.31 | 16.0<br>±5.71 |  |               |  |          |               |          |               |          |               |              |               |                |               |               |               |               |       |               |              |               |               |               |               |       |               |               |               |               |               |               |        |              |               |               |               |               |               |       |               |              |               |              |               |              |       |               |               |               |               |               |               |             |               |               |               |               |               |               |       |               |               |               |               |               |              |       |               |               |               |               |               |              |        |               |               |               |               |               |               |       |               |               |               |               |               |               |       |               |               |               |               |               |               |   |

Odds Ratio results on the relationship between overweight status and food insecurity, sex and race/ethnicity

|                           | OR   | 95%CI      | p value |
|---------------------------|------|------------|---------|
| Food Insecure             | 0.80 | 0.66- 0.98 | .027    |
| Male                      | 0.98 | 0.85- 1.14 | .831    |
| Age                       | 1.00 | 0.98- 1.01 | .645    |
| <b>Race/ethnicity</b>     |      |            |         |
| Black                     | 1.39 | 1.08- 1.79 | .011    |
| Latino                    | 1.10 | 1.10- 1.66 | .004    |
| Asian                     | 0.86 | 0.53- 1.38 | .523    |
| Other                     | 1.38 | 0.97- 1.98 | .072    |
| <b>Sex-race/ethnicity</b> |      |            |         |
| Male x Black              | 0.68 | 0.48- 0.95 | .026    |
| Male x Latino             | 1.36 | 1.09- 1.69 | .006    |
| Male x Asian              | 2.08 | 1.21- 3.56 | .008    |
| Male x Other              | 0.95 | 0.64- 1.42 | .802    |

| Author, date and country             | Data Source(s)   | Results   | Limitations/Comments |                       |                         |                    |              |       |      |      |      |     |         |      |      |      |     |         |      |      |      |      |  |
|--------------------------------------|--|---|----------------------|-----------------------|-------------------------|--------------------|--------------|-------|------|------|------|-----|---------|------|------|------|-----|---------|------|------|------|------|--|
| Tanasescu et al.,<br>2000<br><br>USA | Case/control study conducted through the U. of Connecticut with an inner city sample of Puerto Rican children living in Hartford, Connecticut.<br><br>n=53 | <p data-bbox="770 375 1255 402"><u>Prevalence of obesity by food security status:</u></p> <table border="1" data-bbox="770 430 1451 602"> <thead> <tr> <th data-bbox="770 430 892 513"></th> <th data-bbox="892 430 1050 513">Household food secure</th> <th data-bbox="1050 430 1207 513">Household food insecure</th> <th data-bbox="1207 430 1344 513">Caretaker insecure</th> <th data-bbox="1344 430 1451 513">Child hunger</th> </tr> </thead> <tbody> <tr> <td data-bbox="770 513 892 540">Obese</td> <td data-bbox="892 513 1050 540">28.6</td> <td data-bbox="1050 513 1207 540">46.4</td> <td data-bbox="1207 513 1344 540">25.0</td> <td data-bbox="1344 513 1451 540">0.0</td> </tr> <tr> <td data-bbox="770 540 892 568">Control</td> <td data-bbox="892 540 1050 568">17.4</td> <td data-bbox="1050 540 1207 568">39.1</td> <td data-bbox="1207 540 1344 568">34.8</td> <td data-bbox="1344 540 1451 568">8.7</td> </tr> <tr> <td data-bbox="770 568 892 596">p value</td> <td data-bbox="892 568 1050 596">0.35</td> <td data-bbox="1050 568 1207 596">0.60</td> <td data-bbox="1207 568 1344 596">0.45</td> <td data-bbox="1344 568 1451 596">0.11</td> </tr> </tbody> </table> |                      | Household food secure | Household food insecure | Caretaker insecure | Child hunger | Obese | 28.6 | 46.4 | 25.0 | 0.0 | Control | 17.4 | 39.1 | 34.8 | 8.7 | p value | 0.35 | 0.60 | 0.45 | 0.11 | Small sample size and self-selection of participants into the study suggest that these findings cannot be generalized for this or other populations. |
|                                      | Household food secure  | Household food insecure   | Caretaker insecure   | Child hunger          |                         |                    |              |       |      |      |      |     |         |      |      |      |     |         |      |      |      |      |  |
| Obese                                | 28.6   | 46.4  | 25.0                 | 0.0                   |                         |                    |              |       |      |      |      |     |         |      |      |      |     |         |      |      |      |      |  |
| Control                              | 17.4   | 39.1  | 34.8                 | 8.7                   |                         |                    |              |       |      |      |      |     |         |      |      |      |     |         |      |      |      |      |  |
| p value                              | 0.35   | 0.60  | 0.45                 | 0.11                  |                         |                    |              |       |      |      |      |     |         |      |      |      |     |         |      |      |      |      |  |

| Author, date and country            | Data Source(s)   | Results  | Limitations/Comments |   |         |                   |      |      |                      |     |      |                     |    |      |  |                       |                       |                      |                   |      |      |      |                      |      |      |      |                     |      |     |      |         |     |      |     |   |
|-------------------------------------|--|--|----------------------|---|---------|-------------------|------|------|----------------------|-----|------|---------------------|----|------|--|-----------------------|-----------------------|----------------------|-------------------|------|------|------|----------------------|------|------|------|---------------------|------|-----|------|---------|-----|------|-----|---|
| Whitaker and Orzol, 2006<br><br>USA | Fragile Families (unmarried parents) and Child Well-Being Study, birth cohort study (births occurring from 1998 to 2002<br><br>n=2,452 | <p data-bbox="749 349 1365 381"><u>Prevalence of preschooler obesity by food security status:</u></p> <table border="1" data-bbox="758 406 1350 522"> <thead> <tr> <th></th> <th>n</th> <th>% Obese</th> </tr> </thead> <tbody> <tr> <td>Fully food secure</td> <td>1939</td> <td>18.6</td> </tr> <tr> <td>Reduced diet quality</td> <td>402</td> <td>17.7</td> </tr> <tr> <td>Reduced food intake</td> <td>97</td> <td>13.4</td> </tr> </tbody> </table> <p data-bbox="749 544 1155 576">Obesity = BMI(kg/m<sup>2</sup>) at 95<sup>th</sup> percentile</p> <p data-bbox="749 600 1606 633"><u>Prevalence (%) of preschooler obesity by food security status and race/ethnicity:</u></p> <table border="1" data-bbox="758 657 1602 836"> <thead> <tr> <th></th> <th>Whites (Non-Hispanic)</th> <th>Blacks (Non-Hispanic)</th> <th>Hispanics (Any Race)</th> </tr> </thead> <tbody> <tr> <td>Fully food secure</td> <td>14.1</td> <td>17.5</td> <td>25.3</td> </tr> <tr> <td>Reduced diet quality</td> <td>18.3</td> <td>11.6</td> <td>28.4</td> </tr> <tr> <td>Reduced food intake</td> <td>25.0</td> <td>7.4</td> <td>22.6</td> </tr> <tr> <td>p value</td> <td>.24</td> <td>.006</td> <td>.84</td> </tr> </tbody> </table> |                      | n | % Obese | Fully food secure | 1939 | 18.6 | Reduced diet quality | 402 | 17.7 | Reduced food intake | 97 | 13.4 |  | Whites (Non-Hispanic) | Blacks (Non-Hispanic) | Hispanics (Any Race) | Fully food secure | 14.1 | 17.5 | 25.3 | Reduced diet quality | 18.3 | 11.6 | 28.4 | Reduced food intake | 25.0 | 7.4 | 22.6 | p value | .24 | .006 | .84 | <p data-bbox="1631 349 1894 511">Sample was drawn from 15 states but all children lived in large metropolitan areas and many were born to unwed mothers.</p> <p data-bbox="1631 544 1894 787">While the sample contained a broad range of household incomes and maternal educational attainment, the analysis for this study was stratified by race resulting in some small sample sizes.</p> <p data-bbox="1631 820 1894 1015">The study involved only half the original birth cohort, those who at 3 years of age were measured for height and weight at a maternal survey.</p> |
|                                     | n  | % Obese  |                      |   |         |                   |      |      |                      |     |      |                     |    |      |  |                       |                       |                      |                   |      |      |      |                      |      |      |      |                     |      |     |      |         |     |      |     |   |
| Fully food secure                   | 1939   | 18.6   |                      |   |         |                   |      |      |                      |     |      |                     |    |      |  |                       |                       |                      |                   |      |      |      |                      |      |      |      |                     |      |     |      |         |     |      |     |   |
| Reduced diet quality                | 402  | 17.7   |                      |   |         |                   |      |      |                      |     |      |                     |    |      |  |                       |                       |                      |                   |      |      |      |                      |      |      |      |                     |      |     |      |         |     |      |     |   |
| Reduced food intake                 | 97   | 13.4   |                      |   |         |                   |      |      |                      |     |      |                     |    |      |  |                       |                       |                      |                   |      |      |      |                      |      |      |      |                     |      |     |      |         |     |      |     |   |
|                                     | Whites (Non-Hispanic)  | Blacks (Non-Hispanic)  | Hispanics (Any Race) |   |         |                   |      |      |                      |     |      |                     |    |      |  |                       |                       |                      |                   |      |      |      |                      |      |      |      |                     |      |     |      |         |     |      |     |   |
| Fully food secure                   | 14.1   | 17.5   | 25.3                 |   |         |                   |      |      |                      |     |      |                     |    |      |  |                       |                       |                      |                   |      |      |      |                      |      |      |      |                     |      |     |      |         |     |      |     |   |
| Reduced diet quality                | 18.3   | 11.6   | 28.4                 |   |         |                   |      |      |                      |     |      |                     |    |      |  |                       |                       |                      |                   |      |      |      |                      |      |      |      |                     |      |     |      |         |     |      |     |   |
| Reduced food intake                 | 25.0   | 7.4  | 22.6                 |   |         |                   |      |      |                      |     |      |                     |    |      |  |                       |                       |                      |                   |      |      |      |                      |      |      |      |                     |      |     |      |         |     |      |     |   |
| p value                             | .24  | .006   | .84                  |   |         |                   |      |      |                      |     |      |                     |    |      |  |                       |                       |                      |                   |      |      |      |                      |      |      |      |                     |      |     |      |         |     |      |     |   |

## **Appendices:**

Appendix 1: Search Strategy

Appendix 2: Hand-searched Journals

Appendix 3: Relevance Tool

Appendix 4: Quality Assessment Tool

Appendix 5: Data Extraction Tool

## ***Appendix 1: Search Strategy***

### **Key Words:**

Food Security  
Food Insecurity  
Food Insufficiency

### **Databases:**

Agricola  
Ovid (EMBASE, CINAHL)  
Scholar's Portal  
Web of Science  
PubMed  
Cochrane  
Biosis Preview  
PROQUEST

### **Date Parameters:**

Database inception to June 30, 2006

## ***Appendix 2: Hand-searched Journals***

Searched from January 2002 to June 30, 2006:

American Journal of Clinical Nutrition  
American Journal of Epidemiology  
American Journal of Health Promotion  
American Journal of Public Health  
British Medical Journal  
Canadian Journal of Dietetic Practice and Research  
Journal of Nutrition  
Canadian Journal of Public Health  
Canadian Medical Association Journal Health Education and Behaviour  
European Journal of Clinical Nutrition  
Health Promotion International  
Journal of the American Dietetic Association  
Journal of Health Care for the Poor and Underserved\*  
Journal of Nutrition Education and Behaviour\*  
Obesity Research  
Pediatrics

## Appendix 3: Relevance Tool

Previewing Only: You cannot submit data from this form



## Previewing at Level 3

Reviewer Comments ( [Add a Comment](#) )

On 17 Mar 2007, **marlene.mirza** said: Need to speak w/ SM re reference categories and OR, Table 2.  
 On 15 Mar 2007, **marlene.mirza** said: Need to do OR/RR

RefID: 5 // Author(s): Che, J // Chen, J

**Food insecurity in Canadian households**

Periodical: Health Rep. // Pub Date: 2001 // Volume: 12 // Issue: 4 // Pages:11 -- 22

State: Ok, Level: Level 6, Meta Analysis

Level 3: Relevance Criteria

|   |  |
|---|--|
| <p><b>Keywords:</b><br/>         Adolescent/Adult/Aged/Canada/Child/Child,Preschool/Com<br/>         Study/Cross-Sectional Studies/Data<br/>         Collection/Depression/Diet/epidemiology/Family<br/>         Characteristics/Female/Food/Food Deprivation/Food<br/>         Insecurity 2006/Food</p> <p><b>Abstract:</b><br/> <b>OBJECTIVES:</b> This article examines the prevalence of food insecurity in Canada, the characteristics of people most likely to live in households lacking sufficient funds for food, and several related health problems. <b>DATA SOURCE:</b> The data are from the cross-sectional household component of the 1998/99 National Population Health Survey and the Food Insecurity Supplement to that survey. <b>ANALYTICAL TECHNIQUES:</b> Cross-tabulations were used to estimate the percentage of Canadians experiencing food insecurity and the prevalence of five selected health outcomes among people who were and were not food insecure. Multivariate logistic regression was used to assess the association of several socio-demographic and economic factors with food insecurity and to determine the association of food insecurity with the selected health outcomes. <b>MAIN RESULTS:</b> In 1998/99, 10% of Canadians, or about 3 million people, were living in food-insecure households. Low-income households, households depending on social assistance, lone-parent families headed by women, tenants, children, and Aboriginal people had significantly high odds of experiencing food insecurity. Food insecurity was significantly associated with poor/fair health, multiple chronic conditions, obesity, distress and depression</p> <p><a href="#">Increase Font Size</a><br/> <a href="#">Decrease Font Size</a></p> | <p style="text-align: center;"><a href="#">Submit Data</a></p> <p><b>PHRED/EPHPP Food Insecurity Review</b></p> <p><b>Level 3 - Relevance Criteria</b></p> <p>1.</p> <p><b>Relevance assessor's name:</b><br/> <input type="text" value="Marlene Mirza"/></p> <p>2. Is there enough information to determine status?<br/> <input checked="" type="radio"/> Yes<br/> <input type="radio"/> No<br/> <a href="#">Clear Selection</a></p> <p>3. Is there a comparison group? A comparison group can be the general population.<br/> <input checked="" type="radio"/> Yes<br/> <input type="radio"/> No<br/> <input type="radio"/> Unsure/Can't Tell <input type="text" value=""/></p> <p><a href="#">Clear Selection</a></p> <p>4. Did the author(s) define food insecurity OR food insufficiency OR food security? Poverty and/or SES are not, in and of themselves, adequate for inclusion.<br/> <input checked="" type="radio"/> Yes<br/> <input type="radio"/> No<br/> <input type="radio"/> Unsure/Can't Tell <input type="text" value=""/></p> <p><a href="#">Clear Selection</a></p> <p>5. Did the author(s) include a measure of obesity? For example, BMI, height/weight ratio, etc.<br/> <input checked="" type="radio"/> Yes<br/> <input type="radio"/> No<br/> <input type="radio"/> Unsure/Can't Tell <input type="text" value=""/></p> <p><a href="#">Clear Selection</a></p> <p>6. Comments? (This question is optional.)</p> |
|---|--|

Stats Canada data; measures & definitions  
well-defined;  
Check for refs 53, 54, 55

[Enlarge](#) [Shrink](#)

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Appendix 4: Quality Assessment Tool

Previewing Only: You cannot submit data from this form



Previewing at Level 4

Reviewer Comments ( [Add a Comment](#) )

On 17 Mar 2007, **marlene.mirza** said: Need to speak w/ SM re reference categories and OR, Table 2.  
 On 15 Mar 2007, **marlene.mirza** said: Need to do OR/RR

RefID: 5 // Author(s): Che, J // Chen, J

**Food insecurity in Canadian households**

Periodical: Health Rep. // Pub Date: 2001 // Volume: 12 // Issue: 4 // Pages:11 -- 22

State: Ok, Level: Level 6, Meta Analysis

Level 4: Quality Assessment

**EFFECTIVE PUBLIC HEALTH PRACTICE PROJECT (EPHPP)**

**Public Health and Community Services**

**Hamilton, Ontario**

**Quality Assessment Tool for Quantitative Studies**

**Modified from it's original format for the**

**Food Insecurity Review (2006)**

**SELECTION BIAS**

|   | Very Likely                      | Somewhat Likely       | Not Likely              |  |
|---|----------------------------------|-----------------------|-------------------------|--|
| 1. Are the individuals selected to participate in the study likely to be representative of the target population (the target population being the participants within each individual study)? Consider non-responders and volunteers. | <input checked="" type="radio"/> | <input type="radio"/> | <input type="radio"/>   | <a href="#">Clear</a>                                  |
|   | 80-100% Agreement                | 60-79% Agreement      | Less than 60% Agreement | Not Reported / Not Applicable                          |
| 2. What percentage of selected individuals agreed to participate? In federally mandated surveys citizens must respond or face some form of discipline. If this is the case mark it as not applicable (not asked, no choice).          | <input type="radio"/>            | <input type="radio"/> | <input type="radio"/>   | <input checked="" type="radio"/> <a href="#">Clear</a> |

Strong Moderate Weak

3. [Rate Selection Bias Section](#)    [Clear](#)

4. [Selection Bias Section Comment](#)

Statistics Canada National Population Health Survey NPHS 1998/99 (cycle3) household component

[Enlarge](#) [Shrink](#)

**ALLOCATION BIAS**

5.

Indicate the study design. Note that only RCTs can be ranked strong; all others to be rated weak.

- RCT
- Case-Control
- Cross-Sectional
- Quasi-Experimental

[Clear Selection](#)

Strong Moderate Weak

6. [Rate Allocation Bias Section](#)    [Clear](#)

7. [Allocation Bias Section Comment](#)

[Enlarge](#) [Shrink](#)

**CONFOUNDERS**

8. Enter all relevant confounders reported in the study (use a semi-colon (;) to separate your list):

gender; age group; income; household type; marital satus; immigration status; aboriginal status;

[Enlarge](#) [Shrink](#)

Yes - Refer to your Review Group list of confounders and enter them here:

No  Can't Tell

Not Applicable - Score Weak in Rate Confounders Section

9. Prior to the intervention, were there between group differences for important confounders reported in the paper?



[Clear](#)

10. If there were differences between groups for important confounders, were they adequately managed in the analysis?

Yes  No  Not Applicable

[Clear](#)

Yes - Enter relevant confounders NOT reported in the No

11. Were there important confounders not reported in the paper?

study:



Clear

Strong Moderate Weak

12. [Rate Confounders Section](#)    Clear

13. [Confounders Section Comment](#)

National survey data; see limitations section of paper

[Enlarge](#) [Shrink](#)

**DATA COLLECTION METHODS**

Yes No

14.

Were data collection tools used for measuring **FOOD INSECURITY** shown or are they known to be **VALID?** For example: FSSM, Radimer-Cornell Scale, 18 Item USDA Food Security Scale.

Clear

15.

Were data collection tools used for measuring **FOOD INSECURITY** shown or are they known to be **RELIABLE?** Consider reliability of self-reported data.

Clear

16.

Were data collection tools used for measuring **OBESITY** shown or are they known to be **VALID?** For example, BMI, height for age, weight for height.

Clear

17.

Were data collection tools used for measuring **OBESITY** shown or are they known to be **RELIABLE?** Consider reliability of self-reported data.

Clear

Strong Moderate Weak

18. [Rate Data Collection Methods Section](#)    Clear

19. [Data Collection Methods Section Comment](#)

Canadian National Population Health Survey (1998/99, cycle 3 cross-sectional household component) with supplement on Food Insecurity

[Enlarge](#) [Shrink](#)

**ANALYSIS**

Yes Partially No

20. Is there a sample size calculation or power calculations?    Clear

Yes No Not Reported

21. Is there a statistically significant difference between groups?    Clear

22. Are the statistical methods appropriate (e.g. t-test, chi squared)?    Clear

Community Organization/Institution Group Provider Individual

23. Indicate the unit of analysis:      Clear

24. Analysis Section Comment



[Enlarge](#) [Shrink](#)

## **Final Ranking of All Components**

**Strong** (four STRONG ratings with no WEAK ratings)

**Moderate** (less than four STRONG ratings and one WEAK rating)

**Weak** (two or more WEAK ratings)

25.

Indicate the final ranking of all components for this citation:

- Strong
- Moderate
- Weak

[Clear Selection](#)

---

This is the end of the Quality Assessment Data Input.

Make sure you "Save to finish later" or "Submit Data" prior to inputting another Quality Assessment form.

Web form completion date: 08/17/05/mm

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## ***Appendix 5: Data Extraction Tool***

The following data was extracted from each relevant article and presented in a narrative format in this review.

1. Study design
2. Population
3. Country where the survey took place
4. Funding source(s)
5. Description of data source(s)
6. Author's definition of food insecurity or food security or food insufficiency
7. Author's definition of obesity or overweight or BMI
8. Objective of the study
9. Theoretical framework
10. Overall sample description
11. Description of food secure group #1
12. Description of food secure group #2
13. Description of food secure group #3
14. Description of food insecure group #1
15. Description of food insecure group #2
16. Description of food insecure group #3
17. Description of food insecure group #4
18. Confounders
19. Logistic regression analysis
20. Food secure group #1 odds ratio
21. Food secure group #2 odds ratio
22. Food secure group #3 odds ratio
23. Food secure group #1 odds ratio
24. Food secure group #2 odds ratio
25. Food secure group #3 odds ratio
26. Food secure group #4 odds ratio
27. Outcome measures
28. Pass for meta-analysis