THE RELATIONS OF FOOD SECURITY WITH PHYSICAL AND MENTAL HEALTH IN CANADA

TRACY C. BARRETT

The Relations of Food Security with Physical and Mental Health in Canada

By

Tracy C. Barrett

A thesis submitted to the School of Graduate Studies in partial fulfillment of the requirements for the degree of Master of Science

Psychology Department

Memorial University of Newfoundland

April 2011

St. John's, Newfoundland and Labrador, Canada

Abstract

The relations of food security with indicators of physical and mental health of 22, 247 Canadians aged birth to 71+ were examined using data from the 2004 Canadian Community Health Survey (CCHS). Surprisingly, 43.2% of the food insecure population consisted of males, 19.6% were middle high income, and 41.9% graduated from post-secondary school. Food insecure adults, as compared to food secure adults, were more likely to smoke cigarettes and less likely to drink alcohol. Food insecure children and adults were less likely to eat fruits and vegetables, more likely to report other long term physical or mental illnesses, perceive their physical and mental health as poor, perceive themselves as more stressed, were less satisfied with their lives, and felt less attached to their communities. The relationships between food security and measures of mental health were particularly robust.

Acknowledgments

I would like to thank my supervisor, Micheal Rabinowitz for his guidance, patience and assistance, and my committee members, Kenneth Fowler and Barbara Roebothson for providing their insight and encouragement during the experimental design phase of the thesis. As well, I would like to extend my thanks to Darcy Hallet for helping me with the data analysis and the Newfoundland Center for Health Information for helping me become familiar with the database that was used in the study. Finally, I am thankful to my family for standing by me through this very difficult process. It would not have been possible without them.

Table of Contents

List of Tables

Appendices

Introduction

Food security is defined as adequate access to sufficient, safe, and nutritious food. It can be experienced at the community, household, or individual level (Tarasuk, 2005). Community food security is defined as a situation where all community residents obtain a safe, culturally acceptable, nutritionally adequate diet through a sustainable food system that maximizes self reliance and social justice. Household or individual food insecurity differs from community food insecurity in that it is associated with problems of food access rather than problems in the organization of the food system (Tarasuk, 2005). Household food insecurity is defined as limited, inadequate, or uncertain access of individuals and households to sufficient, safe, nutritious, and personally acceptable food to meet their dietary requirements for a productive and healthy life (Statistics Canada, 2004).

Although food security has been broadly defined, researchers have used different specific definitions. Those who published studies in the late 1990's and early 2000's used either one question, "In the past 30 days, have you been concerned about having enough food for you or your family?" (Townsend, Peerson, Love, Achterberg, & Murphy, 2001) or the Radmier/Cornell Scales to measure food security (Kendall, Olson, & Frongillo, 1995; Oh & Hong, 2003). The Radmier/Cornell Scales is a thirteen-item questionnaire that contains five items directed at the household, four questions pertaining to adults, and four questions pertaining to children in the household. All the questions cover qualitative and quantitative components of food security and it yields a scale with four categories; food secure, household insecure, individual insecure, and child hunger. It has been used

successfully to differentiate among groups of households experiencing a greater severity food insecurity and hunger (Kendall et al., 1995).

Researchers who published more recently used the US Department of Agriculture (USDA) Household Food Security Survey Module (Blumberg, Bialostosky, Hamiliton, & Briefel, 1999). This is an eighteen-item questionnaire that contains eight questions pertaining to children in the household and yields a child food security index. It also contains ten questions pertaining to adults and yields household food security index (see Appendix B). The child food security index is seen as identifying a more severe form of food insecurity than the household food security index. The survey also produces four categories of food security: food secure, food insecure without hunger, food insecure with moderate hunger, and food insecure with severe hunger (Bickel, Nord, Price, Hamilton, & Cook, 2000). Some researchers have used the short form of this survey, which excludes the eight questions pertaining to children, two items that indicate severe hunger in adults, and the first question which indicates the least severe level of food insecurity. This shortened survey generates three categories: food insecure without hunger, food insecure with hunger, and a food secure category (Blumberg et al., 1999). In the present study, the longer version was used.

Food insufficiency is the most severe form of food insecurity (Tarasuk, 2005). It is categorized within the food security scales, as food insecurity with moderate hunger or food insecurity with severe hunger. Food insufficiency means that households are actually going without food to some extent. Therefore, it does not include those who are food insecure without hunger. Some researchers just report food insufficiency.

Sometimes, food insecurity and food insufficiency have been used interchangeably in the literature even though they are not the same concept.

In 1998-1999, approximately three million Canadians (10.2%) reported being worried about not having enough food in the previous year (Che & Chen, 2001). Among these Canadians, 4.1% experienced the most severe form of food insecurity, hunger. Preliminary analysis of comparable data from the 2000-01 Canadian Community Health Survey (CCHS) shows an increase, with 14.7% of households reporting some degree of food insecurity (Kirkpatrick, unpublished). In a recent report from Health Canada (2007), it was found that 8.8% of Canadian households were food insecure in 2004.

Research Objectives

Food security has been studied in people of all ages but most of the information is about adults. Although there have been a large number of cross-sectional databases available containing information about food security, only a few investigators have taken advantage and produced cross-sectional lifespan reports (Dixon, Winkleby, & Radimer, 2001; Vozoris & Tarasuk, 2003; Gucciardi, DeMelo, Vogt, & Stewart, 2009). Lifespan research is important to see if the effects of food insecurity changes with age. There are several longitudinal studies based on a single database containing information on elementary school children. (Winicki, & Jemison, 2003; Jyoti, Frongillo, & Jones, 2005; Rose & Bodor, 2006; Bhargava, Jolliffe & Howard, 2008). Therefore, we have little information about the effects of food security on age, cohort, and time of measurement; the variables that define the influence of culture and development. Furthermore, based on the distribution of published studies, it appears that researchers have implicitly assumed

that food security effects are of principle interest in very low income women (Adams, Grummer-Strawn, & Chavez, 2003; Basiotis, 2003; Jones & Frongillo, 2007; Kaiser, Townsend, Melgar-Quinonez, Fuji, & Crawford, 2004; Olson, 2005; Townsend et al., 2001). Thus, we have limited information about the effects of food security on men and higher income people and it is important to determine whether food security interacts with gender and/or income. In an attempt to begin to remediate these deficiencies, a national Canadian database was selected in which cross-sectional lifespan information about food security can be garnered across gender and income. In the following sections, research relevant to the objectives is briefly reviewed.

Lifespan

Dixon et al. (2001) used cross-sectional data from the National Health and Nutritional Examination (NHANES) III survey, a national US study. They examined whether dietary intakes differed between adults from food insufficient families compared to adults from food sufficient families. Adults varied in age from 20 to 60+ and they were separated into two groups; 20-59 and ≥60 for statistical analysis. Younger adults from food insufficient households were compared to younger adults from food sufficient households. The same was done for older adults. They found that younger adults from food insufficient households reported lower intakes of calcium, vitamin E, milk, fruits and vegetables compared to their food sufficient counterparts. Older adults from food insufficient households had lower intakes of energy, vitamin B-6, magnesium, iron, and zinc compared to their food sufficient counterparts. Using only two age groups limited their ability to examine transitions across the adult lifespan. This is important because to

increase food security, one needs to know if there are particular age groups to focus on or if it is equally important to all age groups.

Cross-sectional data from the Canadian National Population Health Survey was used by Vozoris and Tarasuk (2003). They included children and adults aged 12 to 71+. Age and gender were variables in all analyses. The prevalence of food security in Canada and its relationship to physical, mental, and social health was studied. As expected, they found that individuals from food insufficient households were more likely to report poor/fair health, poor functional health, restricted activity, major depression and distress, and poor social support. In addition, they were more likely to report heart disease, diabetes, high blood pressure, and food allergies.

Food insecurity has a range of negative effects on physical and mental health. Gucciardi et al. (2009) used a cross-sectional database that included Canadian children and adults aged 12 to 65+. Participants were grouped four age categories; 12-45, 46-55, 56-65 and 65+ years. They investigated the proportion of people who were food insecure or food secure in diabetics compared to non-diabetics. The relationship between age of diabetic diagnosis and food insecurity was also examined. Those who were diagnosed with diabetes before age 40 were more likely to be food insecure. The proportion of people who were food insecure decreased as age increased in both diabetics and non-diabetics. Thus, the majority of people who were food insecure were aged 12-45 years. The remainder of the findings reported here by Gucciardi et al. (2009) were generated by collapsing across their entire population. People in food insecure households with diabetes were less likely to report eating five or more daily servings of fruit and

vegetables, having one or more alcoholic drinks per day, and being moderately active or active compared to food secure diabetics. In addition, they were less likely to be former smokers and more likely to be current smokers. Food insecure diabetics were more likely to rate their general health, mental health, satisfaction with life, and self perceived stress in negative or neutral terms.

Four sets of investigators used data from the Early Childhood Longitudinal Study containing information on children entering kindergarten through grade five. Winicki and Jemison (2003) explored whether food insecurity at kindergarten entry affected learning and growth during the kindergarten year. They found that food insecurity in the fall of kindergarten was not associated with physical growth across the kindergarten year, but it was associated with impaired learning in math from fall to spring of the kindergarten year. Jyoti et al. (2005) investigated whether food security status affected children's academic performance (math and reading), weight gain, and social skills from kindergarten to grade three. All variables were measured at the beginning of kindergarten and twice in each grade level to assess change over time. All analyses were stratified by gender. Overall, children who were persistently food insecure experienced a decline in learning compared to children who were persistently food secure. Children who transitioned from food insecure to food secure had a smaller increase in math skills compared to children from households who were persistently food secure. Children from households that transitioned from food secure to food insecure experienced a smaller increase in reading skills compared to those who transitioned to food secure and children from persistently food secure households.

Rose and Bodor (2006) also used data from the Early Childhood Longitudinal Study to asses the relationship between food insecurity and weight status. They used data that was collected at four time points from kindergarten to grade 1; fall and spring of 1998-99 and fall and spring of 1999-2000. There were not any differences in either BMI or overweight prevalence by food security status for any of the gender-race/ethnicity groupings. Food insecurity in the spring of 1999 was not predictive of overweight status or a high weight gain one year later. Bhargava et al. (2008) used the same database and selected children enrolled in the first, third, and fifth grades to assess how socio-economic, behavioral, and environmental factors predicted body weights and household food insecurity. Parental education and income were negatively associated with food insecurity. The number of siblings was positively associated with food insecurity. Children's body weight was not predicted by household food security status one year later.

In summary, there have been a few cross-sectional lifespan reports. Individuals from food insufficient households were more likely to report poor/fair health, poor functional health, restricted activity, major depression and distress, and poor social support. Food insecure, as compared to food secure diabetics, were less likely to report eating five or more daily servings of fruit and vegetables; having one or more drinks per day; being moderately active or active; to rate their general health, mental health, satisfaction with life as good; and were more likely to report experiencing stress. In addition, they were less likely to be former smokers and more likely to be current smokers. Children less than 12 years of age were not included in these cross-sectional

studies. Birth to age 12 encompasses most of a child's development and is therefore a crucial time span to study how food insecurity affects development.

Declines in learning in children from food insecure households have been reported in longitudinal studies. Information on children reported in longitudinal studies have all been based on the same data with a limited age range (kindergarten to grade 5). There is a need for more longitudinal studies that follow children from infancy to early adulthood to explore the effects of food insecurity on development.

Control Variables

Gender. The distribution and impact of food insecurity are associated with gender. Food insecurity is more common in women (Ledrou & Gervais, 2005; Tarasuk, 2001). Cutler-Triggs, Fryer, Miyoshi, and Weitzman (2008) found that although gender was not a significant predictor of food insecurity, males were more likely than females to suffer from severe child food insecurity. Jyoti et al. (2005) reported differences in the effects of food security status on learning; in girls persistent food insecurity was associated with a smaller increase in reading scores and increased weight gain compared to persistent food security. Boys who were food insecure at kindergarten experienced a greater decline in social skills compared to boys who were food secure at kindergarten. Transitioning to food insecurity was associated with greater weight and BMI gains among boys. For girls, transitioning to food insecurity was associated with a greater decline in social skills but with greater improvement in social skills score among boys.

Income. One obvious determinant of health that is related to food insecurity is income. As the adequacy of household income decreases, the likelihood that a household

will report food insecurity increases (Alaimo, Olson, Frongillo, & Briefel, 2001; Bhargava et al., 2008; Health Canada, 2007; McIntyre, Conner, & Warren, 2000). Low income households with smokers have the highest rates of adult food insecurity (Cutler-Triggs et al, 2008). In the 1998-1999 US National Population Health Survey, 58% of social assistance recipients reported experiencing food insecurity (Che & Chen, 2001). Consistent with these observations, more than half of those who seek charitable food assistance from food banks are social assistance recipients (Canadian Association of Food Banks, 2004). Larlio-Lahteenkorva and Lahelma (2001) found that low household income, recent unemployment, and economic problems in childhood were all strong predictors of food insecurity in adulthood. In 2000/2001 more than 40% of Canadians in low or lower middle income households reported being food insecure (Ledrou & Gervais, 2005). Food insecurity was also more common in families on Employment Insurance or Workers Compensation.

Casey, Szeto, Lensing, Bogle, and Weber (2001) found that children from low income, food insufficient families, spent more time watching television compared to children from higher income, food sufficient families. Rose and Bodor (2006), who compared low income food insecure and secure children using parental reports, found that food insecure children watched more television, and engaged in less activity during structured activities, free time periods, and in aerobic exercise. Gulliford, Nunes, and Rocke (2006) reported that food insecurity and low income were also associated with activities involving little physical effort in children of all ages.

Other Demographic Variables. In the National Longitudinal Survey on Children and Youth, families headed by single mothers were eight times more likely to report their children were hungry as compared to those who were married (McIntyre et al., 2000). There have been other reports of increased food insecurity in single parent households (Che & Chen, 2001). As expected, food insecurity is also related to low levels of maternal education and maternal age (Dubois, 2006). In 2004, food insecurity was more prevalent among Canadian adults than children (Health Canada, 2007). It was also more prevalent in Aboriginal households, those renting, and households with children. Among households with children, the prevalence of food insecurity was higher among those with three or more children, and those with children under six years of age. In households without children, the prevalence of food insecurity was higher among single individuals compared with couples (Health Canada, 2007). Hanson, Sobal, and Frongillo (2007) found that never married, cohabiting, separated, and divorced men and women, all reported lower levels of food security as compared to those who were married. Divorced and separated men and women were most likely to report very low food security. Thus, there are a number of variables that predict food security status with income being one of the primary variables.

Behaviours That Affect Physical Health

Other factors that may contribute to food security status are the behaviours of the individual. Behaviours that can affect physical health such as smoking, alcohol intake, the number of servings of fruits and vegetables per day, and BMI have been studied in adults in relation to food security status. Fruit and vegetable intake and BMI have also

been studied in children. Physical and sedentary activity levels in relation to food security status have only been investigated in children.

Smoking. Health status is affected by smoking. Adults from food insufficient households were more likely to smoke more cigarettes per day (Dixon et al., 2001) and more packs per week (Armour, Pitts, & Lee, 2008) than adults from food sufficient households. Food insecure individuals with diabetes were more likely to be smokers compared to food secure individuals with diabetes (Gucciardi et al., 2009). Smoking was more prevalent in food insecure households (Gao, Scott, Falcon, Wilde, & Tucker, 2009) and food insecurity was more prevalent and severe in children and adults in households with smokers (Culter-Triggs et al. 2008). Thus, smoking may contribute to poor health among food insecure individuals.

Alcohol. The consumption of alcohol is another important contributor to physical health and it has been found to be associated with food insecurity. In general, adults of all ages who were food insecure were less likely to drink alcohol on a daily basis than those who were food secure (Armour et al., 2008; McIntyre et al., 2000). The same trend has been found in adults 60 years of age and older (Dixon et al., 2001) and in diabetics aged 12 to 65+ (Gucciardi et al., 2009).

Nutrition. Nutrition also contributes to health status. As food insecurity increases, there is a significant decrease in the frequency of consumption of fruits and vegetables in women (Kendall, Olson, & Frongillo, 1996; Tarasuk, 2001), adults (Gulliford, Mahabir, & Rock, 2003), adolescents (Kirkpatrick & Tarasuk, 2008), children (Bowman & Harris, 2003; Casey et al., 2001), and diabetics (Gucciardi et al., 2009).

Dixon et al. (2001) found that younger adults aged 20-59 from food insufficient families reported lower intakes of calcium and vitamin E than younger adults from food sufficient families. They also reported lower consumption of milk products, fruits/fruit juices, and vegetables. Older food insecure adults, aged 60+, had lower intakes of energy as measured by megajoules (MJ), vitamin B-6, magnesium, iron, and zinc.

Food insecurity has been associated with decreased meat consumption (Kirkpatrick & Tarasuk, 2008; Matheson, Varady,Varady, & Killen, 2002), and increased tortilla consumption in Latinos (Kaiser, Melgar-Quinonez, Lamp, Johns, Sutherlin, & Harwood, 2002), and decreased milk consumption in Latinos (Kaiser et al,, 2002), as well as in Canadians (Kirkpatrick & Tarasuk, 2008). Food insecure Latino children aged 2 to 6 were less likely to receive the number of servings for each food group recommended by the USDA Food Guide Pyramid as compared to food secure children the same age (Kaiser et al., 2002). Food insecure Korean children (Oh & Hong, 1003) and Canadian adolescents (Kirkpatrick & Tarasuk, 2008) consumed a higher intake of calories compared to their food secure counterparts. Food insecure US children (Bowman & Harris, 2003) and youths (Widorne, Neumark-Sztainer, Hannon, Haines, & Story, 2009) consumed a higher amount of fat compared to their food secure counterparts. Other investigators have found that US women from food insecure households who were overweight had poorer diet quality (Adams et al., 2003; Basiotis, 2003). In summary, it is likely that poor nutrition is a contributor to the poorer health that is experienced in food insecure children and adults.

Physical Activity/Sedentary Activity. There were not any significant differences in the number of times food insecure children aged 3-17 exercised each week compared to food secure children (Casey et al., 2001). There were no differences in recreational exercise habits (i.e., walking) in food insecure children compared to those who were food secure (Gulliford et al., 2006). Food insecure children were more likely to report that most of their free time was spent doing things that involved little physical effort and they were rated by their parents as being less active than other children the same age during structured activities, free time, and aerobic exercise (Rose & Bodor, 2006). Household food insecurity in diabetics aged 12-65+ was associated with physical inactivity (Gucciardi et al., 2009). The amount of sedentary activity each day can indirectly affect health status. Increased television viewing has been found in food insecure children aged 3 to 17 (Casey et al., 2001), aged 5-8 (Rose & Bodor, 2006), and in preschool children living in single parent households (Bowman & Harris, 2003). Thus, decreased physical activity and increased sedentary activity may contribute to the poorer physical health in food insecure children.

Measured and Self Reported BMI. Body Mass Index (BMI) is calculated by dividing weight in kilograms by height in meters squared (kg/m^2). Some researchers have used BMI calculated from self reported height and weight, while others have used BMI calculated from measured height and weight. Lyons, Park, and Nelson (2008) found that when self-reported height and weight data were used, BMI was significantly higher among food insecure respondents than among food secure respondents. In contrast, when measured height and weight data were used, there were no significant differences in food

security status overall. However, female respondents classified as food insecure with mild hunger were at greater risk of obesity than were food secure female respondents when measured height and weight were used. Thus, it appears prudent to use measured BMI.

The results obtained in studies relevant to the relationship between food insecurity and BMI with adults and children have been inconsistent; with some investigators finding that BMI is greater in those who are food insecure, some finding that BMI is lower in food insecure people, and others not finding any differences in BMI. Self report and measured data have yielded different results. There have also been differences found for the effects of food insecurity on BMI in boys and girls and men and women. A summary of the BMI findings is displayed in Table 1. Self report data was not included.

Insert Table 1 about here

In summary, behaviors that have an adverse affect on health such as smoking and failing to consume enough fruits and vegetables are more common in food insecure than food secure people. On the other hand, food insecure people consume less alcohol. Compared to food secure children, food insecure children engaged in less physical activity and more sedentary activity. Studies on BMI have been inconsistent, with some researchers reporting higher, lower, or similar BMI in food insecure as compared to food secure people. Given the data available, on balance, with the possible exception of lower fruit and vegetable consumption, behavioral differences between food insecure and food secure people do not seem to be substantial.

Food Security and Physical Health Outcomes

It is important to know the effects of food insecurity on the physical health of the food insecure individual. Most researchers have investigated the effects of food insecurity on direct physical health outcomes such as high blood pressure, and heart disease in adults. A few researchers have focused on young children and physical aliments such as colds, and stomachaches.

Direct Health Measures. In some instances, food security has been associated with direct measures of health. Alaimo et al. (2001) investigated health outcomes in preschool and school age children in the US. Food insufficient children were significantly more likely to have poorer health and to experience more frequent stomachaches and headaches than food sufficient children at similar family income levels. Pre-school food insufficient children had more frequent colds. Other researchers have found that children from houses with low food security were almost twice as likely to have iron deficiency anaemia (Park, Kersey, Geppert, Story, Cutts, & Himes, 2009; Skalicky, Meyers, Adams, Yang, Cook, & Frank, 2006). Casey et al. (2001) reported that 3-17 year old children from food insufficient households had higher cholesterol levels.

Vozoris and Tarasuk (2003) investigated household food insufficiency and health outcomes in those aged 12 to 71+. They found that individuals from food insufficient households reported poor/fair health, poor functional health, restricted activity, and multiple chronic conditions compared to individuals from food sufficient households. Individuals in food insufficient households were also more likely to report heart disease, diabetes (Holben & Pheley, 2006), high blood pressure, and food allergies. Stuff, Casey,

Szeto, Gossett, Robbins, Simpson, Connell, and Bogle (2004) found that adults aged 18 to 65+ in food insecure households scored lower on the physical scale of the Short Form Health Survey compared to those from food secure households. Gunderson and Kreider (2009) reported that children aged 2-19 in food insecure households were more likely to be in poor health as indicated by their weight status. Food insecure individuals with diabetes were more likely to have suffered from a stroke compared to food secure individuals with diabetes (Gucciardi et al., 2009).

Children aged 0-3 years in food insecure households had a higher number of hospital admissions as compared to children from food secure households. This relationship existed after controlling for potential confounding variables such as child's ethnicity, child's daycare attendance, caregiver's age, employment and marital status. (Cook, Frank, Berkowitz, Black, Casey, Cutts, Meyers, Zaldivar, Skalicky, Levenson, Heeren, & Nord, 2004. The receipt of food stamps attenuated the association between food insecurity and fair/poor health in children (Cook, Frank, Levenson, Neault, Heeren, Black, Berkowitz, Casey, Meyers, Cutts, & Chilton, 2006). Food insecure households were more likely to include a chronically ill parent, a child requiring multiple visits to a health care provider, or a child with a disability (Racine, Jemison, Huber, & Arif, 2008). Individuals in food insecure households with diabetes were more likely to have unmet health care needs and to have been an overnight patient (Gucciardi et al., 2009). Thus, it appears that food insecure children and adults do actually experience poorer physical health.

Perceived Health. There have not been many studies in which the relationship between food security and perceived health was described but the results reported are consistent. Food insecurity is associated with poor perceived health among mothers (Siefert, Heflin, Corcoran, & Williams, 2001), adults aged 18 to 65+ (Stuff et al., 2004), children and adults aged 12 to 71+ (Vozoris & Tarasuk, 2003), and in diabetics aged 12 to 65+ (Gucciardi et al., 2009).

Food Security and Mental Health

Research reports on food insecurity and mental health outcomes have usually contained information about adult women. There is little, if any research on food insecurity and men and either perceived mental health or perceived stress. A few researchers have investigated food security and actual stress levels in adults.

Socio-Emotional Outcomes. Some socio-emotional factors appear to be associated with food insecurity. More specifically, food insecure children are more likely to exhibit higher levels of aggression, be destructive, withdrawn, and display distressed behaviors than food secure children (Reid, 2000). In contrast, some researchers have found food insecure children to be more apathetic, withdrawn, unresponsive to their environment, and passive compared to food secure children (Grantham-McGregor, 1995). Alaimo, Olson, and Frongillo (2001b) reported that after adjusting for confounding variables such as income, 6 to 11 year old food-insufficient children had significantly lower arithmetic scores and were more likely to have repeated a grade, have seen a psychologist, and have difficulty getting along with other children compared to food sufficient children. Food insufficient teenagers were more likely to have seen a

psychologist, have been suspended from school, and have difficulty getting along with other children.

Infants and toddlers in food insecure households were found to be more at risk for developmental delays compared to children in food secure households (Rose-Jacobs, Black, Casey, Cook, Cutts, Chilton, Heeren, Levenson, Meyers & Frank, 2008). Food insecure children learned slower than food secure children over the kindergarten year (Winicki & Jemison, 2003). Jyoti et al. (2005) added that learning from kindergarten to grade three was slower in children from persistent food insecure households. Food insecure children under age 18 were more likely a have a recently divorced parent, suffer from a learning disability (Racine et al., 2008), and lower cognitive performance than food secure children (Gao et al., 2009).

Olson (1999) investigated health outcomes associated with food insecurity and hunger in children. She found that in low-income school-age children in grades 3-5, hunger was associated with poorer psychosocial functioning as measured by the Pediatric Symptom Checklist (PSC), a parent-completed questionnaire, and both the risk of hunger and hunger itself were both associated with poorer PSC scores after controlling for education. Only hunger was related to PSC scores after controlling for income.

Food insufficiency and depression are positively associated in low income women after controlling for factors known to increase the risk of depression (Heflin, Siefert, & Williams, 2005; Laraia, Siega-Riz, Gunderson, & Dole, 2006; Weinreb, Wehler, Perloff, Scott, Hasmer, Sager, & Gunderson, 2002). Laraia et al. (2006) also reported that after controlling for income, race, and age; perceived stress and trait anxiety were positively

associated with food insecurity while self-esteem was negatively associated with household food insecurity. Mothers who report food insecurity with hunger were more likely to suffer from post-traumatic stress disorder (Weinreb et al., 2002), major depression and distress (Gao et al., 2009; Hadley & Patil, 2006; Seifert et al., 2001; Vozoris & Tarasuk, 2003), and either a major depressive episode or generalized anxiety disorder (Whitaker, Phillips, & Orzol, 2006) compared to those who were food secure.

Food insecurity was associated with symptoms of depression, anxiety and post-traumatic stress in African men and women after controlling for confounding variables (Hadley, Tegegn, Tessema, Cowan, Asefa, & Galea, 2008). Alaimo, Olson, and Frongillo (2002) found that food insufficient adolescents were significantly more likely to have experienced depression, thoughts of death, a desire to die, and to have attempted suicide than food sufficient adolescents. Diabetics aged 12 to 65+ from food insecure households reported more mood disorders, lower life satisfaction, poorer perceived mental health and higher perceived stress than did food secure diabetics (Gucciardi et al., 2009).

In summary, food insecurity is associated with poorer socio-emotional and cognitive outcomes in children despite their income. Food insecure women are more likely to report depression, stress and anxiety than food secure women, while food insecure adults are more likely to report depression, anxiety and post-traumatic stress compared to food secure adults.

Possible Moderators of Mental Health. Vozoris and Tarasuk (2003) reported that individuals from food insufficient households had poor social support as measured by having someone to confide in, count on, to give them advice, and to make them feel

loved compared to those from food sufficient households. Hadley, Mulder, and Fitzherbert (2007) found instrumental social support as measured by the ability to borrow money or food, was negatively associated with food insecurity among two ethnic groups in rural Tanzania. However, Marco and Thorburn (2009) reported no evidence of an association between social support and food insecurity among Oregon residents, nor any evidence that social support acts as a moderator between income and food security, regardless of the measure of social support used. They investigated community level social support which included faith community attendance and organization membership as well as intimate partner social support and social network support.

One promising measure of social support, a sense of community belonging, was not used in Marco and Thorburn's (2009) study. Shields (2008) found that sense of community belonging affects both mental and physical health status. More people who reported a very strong or somewhat strong sense of community belonging also reported excellent or very good general and mental health compared to people who reported a very weak sense of community belonging (Shields, 2008). Because sense of belonging is a promising variable and available in the present database, the relationship between food insecurity and sense of community belonging was investigated.

Expected Findings

In the present study, a national database containing lifespan information was used to explore the effects of food security on physical and mental health across gender and income and to see how food security status changes with age. There is little information about the interaction of income, or gender with food security in affecting the outcomes of

a large number of dependent variables. If these variables produced additive effects, then it would be a mistake for researchers to focus on low income women and exclude the remainder of the population. In order to explore this possibility, the effects of food security, gender, and income on eighteen different measures of physical and mental health were examined using cross-sectional lifespan data.

Based on the literature review, a number of results are expected: a positive association between food security with perceived and physical health in adults, a negative association between food security and high blood pressure, heart disease and diabetes as well as other long-term physical and mental illnesses. Prevalence of smoking is expected to be lower in food secure adults and alcohol consumption higher. A positive association between fruit and vegetable intake and food security is expected in children and adults. The relationship between food security, sedentary activity, physical activity, BMI varies with ages and the dependent measure used. At younger ages food insecure children were expected to engage in more sedentary activity, less physical activity, and have a higher BMI than food secure children. Food security was expected to be negatively related to BMI in children and adults using measured data.

Many investigators report poorer mental health in women who are food insecure but the relationship between perceived mental health/stress and food insecurity is unknown. If perceived mental health and perceived stress are correlated with actual mental health then a positive association between food security and perceived mental health is expected as is a negative association between food security and self-perceived stress.

Method

Participants

There were 45,889 households selected to participate in the CCHS (Cycle 2.2). Out of these 38,725 responded, a household-level response rate of 84.4%. One person from each household was selected to participate in the survey; a total of 35,107 participated, a person-level response rate of 90.7%. The combined response rate was 76.5%. However, only 63.3% of these individuals answered all the questions (N=22247). The data of this compliant group, consisting of 50.1% females, was used in the present study.

The CCHS (2004) was a national survey that targeted people of all ages who were living in private dwellings in the ten provinces in Canada. Residents of the three territories, people living on Indian Reserves or Crown lands, persons living in institutions, full time members of the Canadian Forces and residents of certain remote regions were excluded from the survey. The CCHS covered approximately 98% of the population in the ten provinces. A detailed description of the sampling procedures and variables can be found at http://www.ssc.uwo.ca/idls/. The earlier cycle, Cycle 2.1 included a much larger sample size than Cycle 2.2 but did not contain data on young children. This population was also excluded in the most recent cycle, Cycle 3.1 Therefore, Cycle 2.2 was used here because it is the most recent cycle containing lifespan data.

Data Collection Method

Data Collection. The CCHS (Cycle 2.2) questionnaire was administered by a Statistics Canada employee using a computer-assisted interviewing (CAI) application

which is an interview technique where a person is interviewed face-to-face with the use of a computer. Data collection began in January 2004 and was completed over 12 consecutive months. Only one member of each household was selected as the primary participant in the survey. Some participants received two interviews. The first interview consisted of two components: the "24-hour dietary recall" and the "general health questionnaire". It occurred in the respondent's home. Some 30% of respondents were asked to complete a second 24-hour dietary recall over the phone, within 3 to 10 days after the initial interview. A proxy interview was used in cases where the respondent was younger than 11 years of age. The parent assisted with the interview for children 6 to 11 years of age. For children under 6 years of age, the parent was the only person that provided information.

Minimizing non-response. Prior to initial contact, letters were mailed from Statistics Canada to each household explaining the importance of the survey and giving examples of how the data collection would be used. A national response rate of 76.5% was achieved.

Special circumstances during data collection. In prior cycles of the survey, self-reported information on respondent's weight and height were collected. Since people do not have a tendency to report this information accurately, the interviewers measured consenting respondents' weight and height. For those refusing to be measured, a self-report method was used.

Interviewing children and youth. Cycle 2.2 is the first CCHS cycle that included children younger than 12 years of age. When interviewing youth (12-17),

parents or guardians were provided with an introductory letter explaining the purpose of collecting information from youth and the list of topics to be covered during the survey. Verbal permission was obtained from the parent/guardian to interview the selected youth without the parent present. For children age 6-11, both parent and child were at the interview and the child answered the questions with the parents' guidance.

Weighting. A survey weight was given to each person included in the final sample. This weight corresponds to the number of persons in the entire population that are represented by the respondent. For example, in a simple random 2% sample, each person in the sample represents 50 people in the population. The weighting phase is a step that calculates, for each record, what the number is. The weights appear on the microdata file and were used to derive meaningful estimates from the survey. If the number of people who smoke daily was to be estimated, it is done by selecting the records referring the individuals in the sample having that characteristic and summing the weights entered on the records. In order for these estimates to be representative of the covered population, one must include the survey weights into their calculations.

Suppression of confidential information. The public-use microdata file includes all respondents but not all of the variables. Some of the variables were removed, capped, or regrouped to protect confidentiality of respondents.

Modules

Socio-Demographic Module. This module included questions about immigrant status, country of birth, ethnic origin, age, gender, martial status, language, and school or university attendance and was asked of all participants. Gender was categorized as 1

(male) or 2 (female). As originally done in the database, age was grouped into 16 categories starting with those under 1 and ending with those 71+. The age ranges in each category appear in Table 2.

Insert Table 2 about here

Income Module. This module included a series of questions about personal and household income. These questions were asked to a knowledgeable member of the household. Income was originally classified into five categories by number of individuals in household as well as the total income: lowest income (<$10,000 if 1 to 4 people, <$15,000 if >/5 people), lower middle income ($10,000 to $14,999 if 1 or 2 people, $10, 000 to $19,999 if 3 or 4 people, $15,000 to $29,999 if >/ 5 people), middle income ($15,000 to $29,999 if 1 or 2 people, $20,000 to $39,999 if 3 or 4 people, $30,000 to $59,999 if >/5 people), upper middle ($30,000 to $59,999 if 1 or 2 people, $40,000 to $79,999 if 3 or 4 people, $60,000 to $79,999 if >/5 people) and highest (>/$60,000 if 1 or 2 people, >/$80,000 if >/3 people). In the present study, the first two categories of income were collapsed into one and named low income because there were not many people in the lowest income category. The last two income categories were collapsed into one and named middle high income due to a low number of food insecure people in the highest income category. The middle income category was not changed. Thus, there were three categories of income used in the present study: 1 (low income), 2 (middle income) and 3 (middle high income).

Food Security Module. The USDA food security module was administered to a knowledgeable member of all households. This module included questions about the food situation in each household in the previous 12 months and yielded four categories: 0 (food secure), 1 (food insecure without hunger), 2 (food insecure with moderate hunger), and 3 (food insecure with severe hunger). The three food insecure categories were collapsed into one category called food insecure due to the small number of individuals that were food insecure with moderate or severe hunger. Thus, two categories of food security were used in the present study: 1 (food secure) and 2 (food insecure).

Smoking Module. Questions about current and past smoking habits were asked to those older than 12. Type of smoker was classified into six groups: 1 (daily smoker), 2 (presently an occasional smoker), 3 (always an occasional smoker), 4 (former daily smoker), 5 (former occasional smoker), and 6 (never smoked). Due to the small numbers in some of these categories, both presently occasional and always occasional smokers were collapsed into one category. Both types of former smokers were also collapsed into one category. Thus, smoking data was analyzed using four categories: 1 (daily), 2 (occasional), 3 (former), and 4 (never).

Alcohol Module. This module included questions about the frequency and amount of alcohol consumption in the previous 12 months. They also were asked to those older than 12. Frequency of alcohol consumption was classified into seven groups: 1 (less than once a month), 2 (once a month), 3 (two or three times a month), 4 (once per week) 5 (two or three times a week), 6 (four to six times a week), and 7 (every day).

Fruit and Vegetable Consumption Module. Information about the consumption of juice, fruit, and vegetables was collected for individuals aged 6 months and older. It was coded into three groups: 1 (less than five servings per day), 2 (5 to 10 servings per day), and 3 (more than 10 servings per day).

Physical Activities Module. The physical activities module contained questions about leisure time activities for those aged 12+. It was used to calculate the physical activity index and classified as: 1 (active), 2 (moderate), or 3 (inactive).

Sedentary Activities Module. The sedentary activities module contained questions about how many hours per week were spent sitting at a computer, playing videogames, watching television, and reading for leisure in youth aged 12 to 17. Categories ranged from less than 5 hours (1) to more than 45 hours (10).

Chronic Conditions Module. This module was used to collect information about long-term health conditions and diseases which lasted or were expected to last 6 months or more, diagnosed by a health professional. All questions were presented to people aged 12 and up with the exception of the question about osteoporosis which was asked to those aged 49 and older. For children aged 5-12, parents assisted with the questions, while they provided the information for children younger than 5 years of age. These questions included whether or not the individual experienced cancer, high blood pressure, diabetes, stomach or intestinal ulcers, or bowel disorders. All other diseases were grouped into "other long term physical or mental illness". Answers were categorized as 1 (yes) or 2 (no).

Measured Height and Weight Module. Height and weight were measured for those who gave consent. Self report data were obtained for the rest of the participants. Measured or self reported BMI was calculated from the height and weight data (kg/m^2) for participants age 2 and up and categorized according to age. Self report BMI data were not used in this study. For children under 18 years of age, BMI was classified into three categories using the US Centre for Disease Control and Prevention (CDC) child growth charts. These charts allow a comparison of a child's height and weight to other children of the same age, gender, and ethnicity by displaying a series of percentile curves that illustrate the distribution of body measurements in children from birth to age 18 (National Centre for Health Statistics, 2000). A child was considered overweight or obese using Cole, Bellizzi, Flegal, & Dietz's (2000) definitions of overweight (BMI$\geq 85^{th}$ percentile for age and gender) and obesity (BMI$\geq 95^{th}$ percentile for age and gender). Any child with a BMI $<85^{th}$ percentile was classified as neither overweight nor obese. Adults 18 years and older were classified into four categories: underweight (BMI<20), normal weight ($20 \leq$BMI<25), overweight (BMI ≥ 25), and obese (BMI ≥ 30). The BMI classifications have recently changed in Canada but did not affect the classifications in the present study.

General Health Module. The physical health component of this module contained a question about how one perceived his or her health. Only children and adults older than 12 years answered this question. Perceived health was coded in five categories as assessed by the question, "In general would you say your health is: 1 (excellent), 2 (very good), 3 (good), 4 (fair), or 5 (poor)?"

The mental health component of this module contained five questions about perceived mental health, perceived stress, satisfaction with life, and sense of belonging to community. People aged 12 and older were asked those questions except for the question about stress. Perceived mental health was coded into five categories as assessed by the question, "In general, would you say your mental health is: 1 (excellent), 2 (very good), 3 (good), 4 (fair), or 5 (poor)?" Self-perceived stress was coded into five categories as assessed by the question, "Thinking about the amount of stress in your life, would you say that most days are: 1 (not at all stressful), 2 (not very stressful), 3 (a bit stressful), 4 (quite a bit stressful) or 5 (extremely stressful)?" This question was asked only to participants 15 years of age and older. Satisfaction with life was coded into five categories as assessed by the question, "How satisfied are you with your life in general: 1 (very satisfied), 2 (satisfied), 3 (neither satisfied nor dissatisfied), 4 (dissatisfied), or 5 (very dissatisfied)?" Sense of belonging to community was coded into four categories as assessed by the question, "How would you describe your sense of belonging to your local community: 1 (very strong), 2 (somewhat strong), 3 (somewhat weak), or 4 (very weak)?"

Results and Discussion

The CCHS was a Canadian nationally representative study in which sample weights were provided. Weighted data were used in all analyses and appear in all Tables. The statistical package SPSS was used to analyze the data. With the exception of the demographic data analyzed according to the category of interest using chi squared tests of independence, the remaining dependent variables were examined at each of sixteen age levels displayed

in Table 2. When similar trends in the data were observed at two or more adjacent age groups, the data were collapsed over these ages and re-analyzed. Income, gender and food security served as either predictors or independent variables in all analyses with the exception of the chi-square analysis of the demographic data. Gender and income were chosen because of their strong relationship with food security. Perceived health, blood pressure, other long term physical or mental illness, stomach or intestinal disorders, heart disease, diabetes, cancer, bowel disorders, osteoporosis, smoking behaviour, alcohol use, fruit/vegetable intake, physical/sedentary activity, BMI, perceived mental health, perceived stress, satisfaction with life, and sense of belonging served as either predicted or dependent variables.

Demographic Data.

Age. As can be seen in Table 2, the rate of food insecurity varies across ages, χ^2 (15) = 360.45, $p < 0.001$. There were two age ranges in which food insecurity was high, birth to 14 and 19 to 40. The birth to 14 group constituted 17.7% of the total population, 22.3% of the food insecure population, and had a food insecurity rate of 13.1%. The 19 to 40 group accounted for 30.6% of the total population, 41.6% of the food insecure population, and had a food insecurity rate of 14.1%. It is likely that people bear and raise most of their children in the 19 to 40 age range. Therefore, it may be that parents and children share access to food and the food insecurity data is reflective of this shared access. In order to further test this hypothesis, single parents and their children, and married parents and their children were compared. Parents and children in each group are expected to have similar levels of food insecurity if this hypothesis is correct. As can be

seen in Tables 3 and 4, single parents and their children had similar rates of food insecurity (average 18.5%) as did married parents and their children (average 8.8%), consistent with the hypothesis.

As also displayed in Tables 3 and 4, single parents living with children had a 2% lower rate of food insecurity than their children. In contrast, parents living with a spouse and children had a 2% higher rate of food insecurity compared to their children. It may be that some single parents are favoring themselves in terms of food access. On the other hand, married people may be protecting their children from some of the effects of food insecurity. The majority of the adult sample was married (see Table 5) and married people experienced higher levels of food insecurity than their children which might account for the higher rate of food insecurity in the 19 to 40 compared to birth to 14 year olds.

Insert Tables 3, 4 and 5 about here

The finding that single parents do not appear to protect their children from food insecurity does not support the claim of McIntyre et al. (2000). They found that low income single mothers reported protecting their children from food insecurity but suggested that these findings may be due to reporting bias. In their study, mothers were asked only about their children's experience of hunger. In contrast, in the CCHS survey used here, food security status was reported by an adult who was asked a wide variety of questions about the child. Perhaps this wide range of questions reduced or eliminated reporting bias.

The rate of food insecurity was lower at the ages of 41 to 60 compared to ages 19 to 40. There are several reasons that might explain why the rate of food insecurity dropped. Adults aged 41 to 60 may have more access to income because of salary increases, debt reduction associated with mortgage and student loan retirement, and their children leaving home. There was a monotonic decline in food insecurity after at age 60 attesting to the success of the Canadian Pension Plan and Canadian old age security.

There are three age groups that merit further comment; infants, 14 to 18 year-olds, and 71+ years old. Infants had a high rate of food insecurity (see Table 2) contrary to the hypothesis that they would be protected from food insecurity by their parents. The inability of some parents to feed their infants may be related to the failure to breastfeed. Mothers who breastfeed tend to be married, older, and have more education and income than mothers who do not breastfeed (Al-Sahab, Lanes, Feldman, & Tamim, 2010). Therefore, it may be that infants are not being breastfed by the younger, single, less educated, low income parents. Babies that are formula fed are likely to be denied access to enough food when family income is depleted at the end of many pay periods. Thus, there should be greater emphasis on health and economic benefits of breastfeeding.

Children aged 14 to 18 were more likely to be food secure than children of other ages. Teenagers may be spending more time away from their families at friend's houses and obtaining food there. They may also be working and earning some of their own money that permits independent access to food. Seniors aged 71+ had the lowest rate of food insecurity in the total population. Prior research does indicate that seniors aged 60-64 are more likely to be food insecure compared to seniors aged 84 and older (Meals on

Wheels Association of America Foundation, 2008). Some seniors aged 71+ may have been institutionalized and always fed. The low rate of food insecurity in seniors may be due to higher mortality rate of food insecure seniors. Why older seniors living at home appear to be more successful in obtaining food than other individuals at different ages merits further investigation.

Living Arrangement. As shown in Table 3, children living with one parent experienced a higher level of food insecurity than children living with both parents, χ^2 (1) =151.52, $p < 0.001$. Adult food insecurity status as a function of living arrangement is shown in Table 4. Single parents living with children experienced the highest degree of food insecurity, χ^2 (4) = 290.22, $p < 0.001$. Married people had a lower rate of food insecurity compared to others, a finding that is often documented in the literature (McIntyre et al., 2000; Health Canada, 2007). Furthermore, those who were married with children had a 5.4% higher food insecurity rate than those living only with a spouse. Even this higher rate was still below the remainder of the adult population. It is possible that married people have access to two incomes and have devised ways to successfully share their wealth.

Adults who were unattached living alone had a lower rate of food insecurity compared to those unattached living with others. Unattached single people living with others, including those living with their own children, reported the highest rate of food insecurity. People in this living arrangement probably share their income with others in the household. Thus, there should be improved social assistance programs and child benefits for single parents.

Marital Status. Table 5 displays adult food insecurity as a function of marital status, χ^2 (3) =146.55, $p < 0.001$. There are two categories of married people in Table 4 which are collapsed in Table 5. Thus, it is not surprising that married people also show the lowest rate of food insecurity in Table 5. Single people who had never been married or who were not living in common law relationships had the highest rate. There were little differences in the prevalence of food insecurity in those who live with a common law partner or those who were widowed, separated, or divorced. Members in each of these groups probably have more access to money than single people who have never had a partner. People who are widowed may have an inheritance, separated or divorced people may receive support, and those living in common law may have access to more than one income.

These findings are consistent with the data reported by Che and Chen (2001), Health Canada (2007), and McIntyre et al. (2000), who also found that food insecurity is highest among single people. However, Hanson et al. (2007) report data inconsistent with these findings. They found that divorced and separated men and women were more likely to report being hungry than single people. The reason for this discrepancy is not apparent.

Gender. In children 18 years of age and younger, males (12.9%) had a higher rate of food insecurity than did females (11.4%), χ^2 (1) = 4.68, $p < 0.05$. In contrast, adult females (10.8%) had a higher rate of food insecurity than did adult males (9.1%), χ^2 (1) =10.73, $p < 0.005$. Given that these differences are small and not sign, it seems counterproductive to include people from only one gender in food security studies.

Insert Table 6 about here

Income. As displayed in Table 7, the rate of food insecurity decreased as income increased, χ^2 (2) = 2089.49, $p < 0.001$. The low income group constituted only 15% of the total population but 44.2% of the food insecure population. The rate of food insecurity was substantially lower in middle income people. The middle high income group constituted 53.1% of the total population and a substantial 20% of the food insecure population. Even though only 3.9% of these people were food insecure, one would like to know why so many middle high income people have difficulty accessing food.

Insert Table 7 about here

Education. In Table 8 the rate of food insecurity appear as a function of the education level of adults aged 25+, χ^2 (3) = 31.49, $p < 0.001$. Most people complete their education by age 25. The relationship between food insecurity and education is not linear. Consistent with the expectation that earning power increases as education does, people who graduated from post-secondary school were less likely to be food insecure Nevertheless, post-secondary graduation constituted 41.9% of the food insecure population.

Those who attended post-secondary school but did not graduate reported the highest food insecurity rate. It may be that people who invest in post-secondary education without graduating have student loans that they cannot afford to pay back without access

to higher paying jobs. Thus, there should be more opportunities for interest relief of student loans and more affordable repayment plans.

Interestingly, those who graduated from high school reported a slightly higher food insecurity rate than those who did not. Thus, there is no evidence that having a high school diploma helps people access food unless they complete a post-secondary degree. The finding is inconsistent with the emphasis placed on competing high school in Canadian culture unless a post-secondary education is pursued and completed.

Insert Table 8 about here

Statistical Analyses

Measured BMI was the only continuous variable examined and was analyzed using analysis of variance and linear regression. All remaining dependent variables were categorical including the qualitative assessments of BMI. The categorical variables were subject to multiway frequency analysis (also known as loglinear analysis) and linear, logistic, or nominal regression. Four variables were used in the multiway frequency analyses: gender, income, food security, and the particular dependent variable. Gender, income and food security were the independent variables in the analysis of variance and predictor variables in all regression analyses with the dependent variables serving as predicted variables. Nominal regression was used with categorical variables having three or more categories. Logistic regression only was used with the low probability variables having two categories (like diabetes) and yielded the same results as the multiway frequency analysis. Dependent categorical variables with four or more ordered categories

were analyzed using simple linear regression. Gender, income, and food security were used as predictors in the simple regression models and the two and three way interactions between these variables were added as predictors in the complex models. The interaction terms did not yield any additional information of interest, so only the simple models are reported. When the data were consistent over a block of ages, only the analysis on the data collapsed across these ages are reported. Because the database was large and many statistical tests were conducted, a significance level of 0.001 was used in an attempt to control the experiment-wise error rate. Similarly, all the important data is either reported in the text or appears in tables. However, some of the statistical information is not included to improve clarity and save space.

Behaviours That Affect Physical Health and its Relation to Food Security

Type of Smoker. At every age surveyed (12 to 71+) food insecure people were more likely to report smoking daily and occasionally and less likely to be former smokers and to have never smoked than were food secure individuals, χ^2 (3) = 222.53, $p < 0.001$, multiway frequency analysis; F (3, 16,713) = 129.94, $p < 0.001$, $r^2 = 0.023$, regression analysis. The data associated with the four categories of smoking appear in Table 9. Both gender (χ^2 (3) = 32.94, $p < 0.001$) and income (χ^2 (6) = 25.64, $p < 0.001$) significantly interacted with food security and type of smoker (see Tables A1 and A2 in Appendix A). However, the same patterns persisted at all levels of gender and income. Similar findings have been reported in the US (Cutler-Triggs et al., 2008; Dixon et al., 2001; Armour et al., 2008) and in a Canadian diabetic population (Gucciardi et al., 2009). Thus, smoking is more commonly reported in food insecure than food secure households at all ages. To

date, no satisfactory explanation for the association has been offered. There should be greater emphasis by the government on anti-smoking campaigns aimed to reduce the amount of money spent on cigarettes.

Insert Table 9 about here

Frequency of Alcohol Use. Food insecure people between ages 31 to 71+ were more likely to report drinking less than once per month, and 2 to 3 times per month, and less likely to report drinking every day compared to those who were food secure, χ^2 (6) = 59.81, $p < 0.001$, multiway frequency analysis; F (3, 7610) = 167.28, $p < 0.001$, r^2 = 0.062, regression analysis. The data associated with alcohol use appear in Table 10. Income (χ^2 (12) = 51.73, $p < 0.001$) significantly interacted with food security and frequency of alcohol use (see Table A3 in Appendix A). However, the described 31 to 71+ year-olds pattern was obtained at all levels of income. Using US samples, McIntyre et al. (2000), Dixon et al. (2001), and Armour et al. (2008) report similar findings as did Gucciardi et al. (2009) using a Canadian sample. Thus, food insecure adults report less alcohol consumption than do food secure adults. It is not apparent why the opposite pattern was obtained when comparing food insecure with food secure teenagers.

Insert Table 10 about here

Fruit and Vegetable Intake. Food insecure children under age 9 did not differ from food secure children the same age in terms of their fruit and vegetable intake (χ^2 (2)

= 5.82, $p < 0.055$), multiway frequency analysis. However, they were less likely to report eating less than 5 servings of fruits and vegetables per day (57.7% verses 81.2%) compared to food insecure children above age 9. Similarly, food secure children under age 9 were also less likely to report eating less than 5 servings of fruits and vegetables per day (52% verses 68.9%) compared to food secure children above age 9. In contrast, food insecure as compared to food secure people above the ages of 9 are more likely to report eating less than five servings of fruits and vegetables per day (81.2% verses 68.9%), less likely to report eating 5 to 10 servings per day (17.9% verses 29.8%), and less likely to report eating more than ten servings per day (0.9% verses 1.3%), χ^2 (2) = 95.81, $p < 0.001$, multiway frequency analysis. There was one higher order interaction; income significantly interacted with food security and fruit and vegetable intake, χ^2 (4) = 19.63, $p < 0.001$. However, the described pattern was maintained at all income levels (see Table A4 in Appendix A). Furthermore, a similar pattern has been obtained in Canadian (Tarasuk, 2001; Kirkpatrick & Tarasuk, 2008, Gucciardi et al., 2009), US (Kendall et al., 1996; Casey et al., 2001; Dixon et al., 2001; Gulliford et al., 2003; Bowman & Harris, 2003) and Mexican populations (Kaiser et al., 2002; Kaiser, Melgar-Quinonez, Townsend, Nicholson, Fuji, Martin, & Lamp, 2003).

Thus, it appears that health care professionals are doing a good job educating parents on the importance of fruit and vegetable intake for young children. When children get old enough to choose their own food, they choose less fruits and vegetables. It may be that the perception that fruits and vegetables do not satisfy hunger and are not well liked which accounts for why these foods are under consumed by food insecure people over the

age of 9. This dietary choice may adversely affect their health given that reduced fruit and vegetable intake increases the risk of various conditions such as bowel cancer, high blood pressure, and osteoporosis (Lanham-New, 2006). Therefore, there needs to be more education on the importance of choosing healthy food in elementary and high schools.

Physical Activity Index. Questions were asked about the number of times people exercised per week in those aged 12 and older. Food security status did not differ by physical activity levels except at ages 55 to 65. Food insecure people this age were less active (16.9% verses 18%), $\chi^2 = 9.15$, $p < 0.001$. Similarly, Gucciardi et al. (2009) found, using a population that was mainly 45 to 55, food insecure diabetics were less physically active compared to food secure diabetics. In general, the present findings are consistent with earlier reports in which an association between physical activity and food insecurity was not obtained in children (Casey et al., 2001) or in adults (Gulliford et al., 2006). Rose and Bodor (2006) reported, in exception to this generalization, that food insecure preschool children were less active as rated by their parents.

Sedentary Activity. Questions were asked about the number of hours spent per week engaged in sedentary activities only to youths aged 12 to 17. Sedentary activity was the only measure examined here that was qualitatively influenced by the interaction of income and food security as can be seen in Table 11, (χ^2 (18) = 95.63, $p < 0.001$). All children that were food secure and low-income food insecure children showed a similar pattern of frequencies. Approximately 55% of the children in each of these groups spent more than 20 hours per week engaged in sedentary activity. In contrast, over 72% of middle-income and 86% of middle-high-income food insecure children spent more than

20 hours per week engaged in sedentary activity. Why middle and middle-high income food insecure children spent substantially more time engaged in sedentary activity compared to the rest of the population is unclear.

Insert Table 11 about here

Body Mass Index. The quantitative and qualitative BMI data at four age groupings are summarized in Tables 12 and 13. There was a tendency for food insecure children to have greater BMIs and obesity percentages than did the food secure children. However, these differences were statistically significant. Similar differences were larger and statistically significant in the 18 to 40 year-old grouping (quantitative data: F (3, 2484) = 11.94, $p < 0.001$, $r^2 = 0.014$, regression analysis; F (1, 2484) = 13.28, $p < 0.001$, analysis of variance; qualitative data: F (3, 2759) = 14.31, $p < 0.001$, $r^2 = 0.015$, regression analysis; χ^2 (3) = 21.50, $p < 0.001$, multiway frequency analysis). In those aged 41 to 55, there were no significant differences in BMI as a function of food security. However, as can be seen in Table 13, over 9% more people who were food secure were overweight as compared to people who were food insecure. This difference increased in the BMI data of those 56+ years. In this age group, food secure individuals, compared to those who were food insecure, had greater BMIs and were more like to be overweight (qualitative data: χ^2 (3) = 51.87, $p < 0.001$, multiway frequency analysis).

Thus, it appears that BMI is affected by age and food security. In order to further document this possibility, the adult data were re-examined. As shown in Table 12, BMI is fairly constant in food insecure people above age 18 while mean BMI increases in the

comparable food secure group (age by food security interaction, $F(2,10911) = 92.35$, $p < 0.001$ analysis of variance, the three adult age groupings). The trends are more striking in the qualitative data (see Table 13). The percentage of food insecure adults in each of the four BMI categories is fairly constant across the three adult age groupings. On the other hand, there is a marked decrease in the percentage of food secure adults in the normal category and corresponding increases in the overweight and obese categories across the age groupings (age by food security by BMI interaction, $\chi^2(6) = 23.82$, $p < 0.001$, multiway frequency analysis, the three adult age groupings). The reason why BMI remains relatively stable in the food insecure population across the adult years, unlike the remainder of the population, merits study and may be related to limited food access.

Insert Tables 12 and 13 about here

In Table 1, the outcomes obtained in BMI research with children and adults using qualitative measured data are summarized. As seen in this table, most of the researchers examined data using participants who were below 55 years-old. Results were variable, but the majority of researchers found that food insecure participants were heavier than food secure participants. Based on the current findings, the information in the table is not surprising. Food insecure people should tend to have higher BMI's than food secure people in mixed age populations largely consisting of people less than 40 years of age. In future, if the relationship between food security and BMI is to be clarified, researchers should only use mixed age populations when age is an independent or control variable.

Food Security and Direct Physical Health Outcomes

Blood Pressure. After age 51 more food insecure people reported having high blood pressure compared to food secure people, (43.5% verses 35.5%), χ^2 (2) = 30.41, $p < 0.001$, multiway frequency analysis. Gender significantly interacted with food security and blood pressure, χ^2 (1) = 12.82, $p < 0.001$ but both male and female food insecure people reported having higher blood pressure than comparable food secure people (see Table A5 in Appendix A). Vozoris and Tarasuk (2003) found that individuals 12+ in food insufficient households were more likely to report having higher blood pressure. Since they collapsed across ages, they probably failed to detect that food insecurity is only associated with higher blood pressure in older adults.

Stomach or Intestinal Ulcers. Individuals above age 31 who were food insecure were more likely to report having a stomach ulcer compared to those who were food secure, (6.3% verses 3.1%), χ^2 (1) = 10.99, $p < 0.001$, multiway frequency analysis. This relationship might reflect dietary differences or the extreme stress that sometimes is associated with hunger.

Bowel Disorders, Crohn's Disease or Colitis. People aged 36 and older were asked whether they suffered from a bowel disorder such as Crohn's or colitis. A greater percentage of food insecure people responded positively (5.2% verses 3.1%), χ^2 (1) = 6.31, $p < 0.001$. Since high levels of fruit and vegetable intake is associated with a reduced risk of bowel disorders and food insecure people have lower intake of fruits and vegetables, this finding would be expected.

Heart Disease. People above age 31 who were food insecure as compared to food secure were more likely to report heart disease (7.4% verses 6.5%), $\chi^2(1) = 11.77$, $p < 0.001$. Although this percentage difference is small, it might have significant health implications across the population. Vozoris and Tarasuk (2003) also found that heart disease was more common in food insecure individuals using a larger Canadian sample.

Osteoporosis. The likelihood of having osteoporosis was significantly related to food insecurity only at age 61 to 65 (40.0% verses 12.8%), $\chi^2(1) = 14.98$, $p < 0.001$. Surprisingly, this difference was not found in all older age groups. High fruit and vegetable intake and calcium may reduce the risk of osteoporosis (Lanham-New, 2006) and people who are food insecure have lower calcium and fruit and vegetable intake than do food secure people (Dixon et al., 2001).

Diabetes. Food insecure as compared to food secure individuals were more likely to report having diabetes at ages 25 to 30 (4.3% verses 0.9%) and 56 to 60 (17.0% verses 6.6%), and less likely to report having diabetes at ages 61 to 65, (5.5% verses 13.9%), (χ^2's < 9.83, p's < 0.003). Even though these differences are not significant, the reversal is interesting as it might reflect changing rates of overweight as a function of age in food insecure and food secure populations (see Tables 12 and 13).

Cancer. Food security was not significantly related to the likelihood of having cancer at any age. There does not seem to be any prior reports on the relationship between food security and cancer. Given that food insecure people were more likely to report smoking, the lack of an association between food insecurity and cancer, particularly lung cancer, is somewhat surprising.

Other Long Term Physical or Mental Illnesses. At ages 12 to 71+, food insecure as compared to food secure, individuals were more likely to report having other long term physical or mental illness excluding high blood pressure, heart disease, cancer, diabetes, stomach or intestinal ulcers, bowel disorders, and osteoporosis (40.4% verses 27.1%), χ^2 (1) = 80.71, $p < 0.001$.Given the magnitude of this difference and its significance to public health, it is surprising that it does not appear in the earlier literature. However, more focused health studies provide information consistent with these findings. For example, Fe-deficiency anaemia (Skalicky et al., 2006; Park et al., 2009) and higher cholesterol levels (Casey at al., 2001) are more common in food insecure as compared to food secure children. Food insecure adults were more likely to report food allergies (Vozoris & Tarasuk, 2003) and to have suffered from a stroke (Gucciardi et al., 2009).

Self-Perceived Health. People aged 12 and up were asked how they perceived their health. As seen in Table 14, food insecure individuals across this age span were more likely to perceive their health as poor, fair or good, and less likely report their health as very good or excellent than were food secure people, χ^2 (4) = 161.56, $p < 0.001$, multiway frequency analysis; F (3, 3638) = 42.63, $p < 0.001$, $r^2 = 0.034$, regression analysis. Income (χ^2 (8) = 35.39, $p < 0.001$) significantly interacted with food security and perceived health (see Table A6 in Appendix A). The same pattern was obtained at all levels of income. Given the magnitude of these differences, it is not surprising that a number of investigators have reported similar findings (Siefert et al., 2001; Stuff et al., 2004; Gucciardi et al., 2009).

Insert Table 14 about here

It is likely that food insecure people accurately perceive their health as relatively poor. For example, they report having more stomachaches, flus/viruses, and catch more viruses than food secure people (Alaimo et al., 2001; Cook et al., 2004; Skalicky et al., 2006). They also report more long-term physical illnesses like higher blood pressure, stomach or intestinal ulcers, bowel disorders, heart disease and diabetes (Holben & Pheley, 2006; Gucciardi et al., 2009; present study). A number of possible mechanisms have been proposed to account for the finding that food insecurity can lead to poorer health including; malnutrition exacerbates disease and decreases resistance to infection, and stress induces high blood pressure and produces hormonal imbalance (Alaimo et al., 2001). It is also possible that poorer health leads to food insecurity by decreasing earnings and increasing household expenses, leaving less money for food.

Food Security and Mental Health Outcomes

Satisfaction with Life. As shown in Table 15, food insecure people aged 12 to 71+ were more than 4 times as likely to report being dissatisfied or very dissatisfied with their lives as compared to food secure people, $\chi^2\,(4) = 442.58,\ p < 0.001$, multiway frequency analysis; $F\,(3,16698) = 328.33,\ p < 0.001,\ r^2 = 0.056$, regression analysis. Gucciardi et al. (2009) reported similar findings with a diabetic population.

Insert Table 15 about here

Sense of Belonging. As can be seen in Table 16, those who were food insecure aged 12 to 71+ were more likely to report feeling a very weak sense of belonging and less likely to report feeling a very strong sense of belonging to their community compared to those who were food secure, χ^2 (3) = 115.55, $p < 0.001$, multiway frequency analysis. Although the relationship between sense of belonging and food security has not been described in the literature, it may be significant given Shields (2008) report that people who had a weak sense of community belonging also had poorer physical and mental health.

Insert Table 16 about here

Self-Perceived Stress. At all ages surveyed, people who were food insecure were more likely to report strong or extreme stress and were less likely to report not being stressed compared to those who were food secure, χ^2 (4) = 442.35, $p < 0.001$, multiway frequency analysis; F (3, 15135) = 188.46, $p = < 0.001$, $r^2 = 0.036$, regression analysis (see Table 17). This is the first report using a Canadian sample but other researchers have reported that increased food insecurity is associated with increased stress (Laraia et al., 2006; Gucciardi et al., 2009) and increased likelihood of posttraumatic stress disorder (Weinreb et al., 2002; Hadley et al., 2008).

Insert Table 17 about here

Self-Perceived Mental Health. As can be seen in Table 18, food insecure people were less likely to report excellent or very good mental health and were more likely to report good, fair or poor mental health at all ages surveyed compared to those who were food secure, $\chi^2(4) = 393.57$, $p < 0.001$, multiway frequency analysis; $F(3, 16698) = 219.15$, $p < 0.001$, $r^2 = 0.038$, regression analysis. Both gender ($\chi^2(4) = 19.78$, $p < 0.001$) and income ($\chi^2(8) = 41.91$, $p < 0.001$) significantly interacted with food security and perceived mental health in the multiway frequency analysis (see Tables A7 and A8 in Appendix A). However, the same trend held at all levels of gender and income. In the only paper describing this relationship, Gucciardi et al. (2009) found that food insecure diabetics were less likely to report good mental health and were more likely to suffer from a mood disorder compared to food secure diabetics.

Insert Table 18 about here

There have been a number of reports linking food security and the mental health of pregnant women and mothers. Laraia et al. (2006) reported that perceived stress, trait anxiety, and depressive symptoms were more common among pregnant women in food insecure households. Food insecure mothers as compared to food secure mothers, were more likely to suffer from posttraumatic stress disorder (Weinreb et al., 2002), major depression and distress (Siefert et al., 2001), and generalized anxiety disorder (Whitaker et al., 2006). Based on the present finding, it appears that there is a link between food security and mental health that spans gender, income, and lifespan. The relationships obtained here are robust and may be economically, medically, and politically significant.

Summary and Conclusions

Limitations. The database used in the current study did not represent the entire Canadian population as homeless people and aboriginals living on reserves were not included in the survey. It was found that 9.2% of Canadian households were food insecure and that off-reserve aboriginal households experience a higher (33.3%) prevalence of food insecurity compared to the general population (8.8%). If aboriginals living on reserves are as likely or more likely to be food insecure than those living off reserves, and almost all homeless people are food insecure, than the prevalence of food insecurity in the Canadian population is probably underestimated. Furthermore, it is likely that many homeless people experience the more extreme forms of food insecurity. If so, the myriad of effects of food insecurity documented here may under-represent the extent of problems in Canada.

Control Variables. Gender and income were the control variables used in the present study. The trends held at all levels of gender and income for all the dependent variables except sedentary activity. Hours of sedentary activity increased in middle and middle high income food insecure children aged 9-17 as compared to low income food insecure and all food secure children. There is no obvious explanation as to why food insecure middle and middle high income food insecure children spend more time engaged in sedentary activities than do comparable food secure children. Nevertheless, it is surprising that sedentary activity is the only measure associated with food security that changes qualitatively with income level.

Demographics. The prevalence of food insecurity obtained across the demographic variables investigated was sometimes unexpected and often striking. Particularly noteworthy are the following:(a) 19.6% of the children living with a single parent were food insecure; (b) in contrast, only 1.9% of those 71+ were food insecure; (c) 52.9% of the food insecure below age 18 were male while 43.2% of the food insecure above age 19 were male; (d) although only 3.9% of the middle high income group were food insecure, the group constituted 19.6% of the entire food insecure population; (e) the relationship between food security and education was complex with the individuals who attended a post-secondary school and did not graduate having the highest rate, 12.5%; and (f) those who attended and graduate from a post-secondary school had the lowest rate of food insecurity, 7.9%, but constituted 41.9% of the food insecure population. Thus, it would appear that children from single parent families merit special attention because they are vulnerable to environmental insult and more likely to be food insecure than other groups. Furthermore, researchers interested in accurately portraying food insecurity must include males, post-secondary graduates, and middle high income people in their samples.

Behaviours That Affect Physical Health. Behavioural differences between food insecure and food secure people are unlikely to account for the massive negative effects of food insecurity on perceived physical and mental health. It would be premature, however, to dismiss the possible relationships between behaviours and bowel disorders, stomach ulcers, osteoporosis, heart disease, blood pressure and diabetes. Food insecure children are more likely to be sedentary than food secure children. Food insecure adults

are less likely to eat fruit and vegetables and more likely to smoke than food secure adults. These differences might be causal in producing the correlations between food security and bowel disorders, heart disease, high blood pressure, and osteoporosis. Similarly, because food secure adults were more likely to gain weight as they age, the relationship between food security and diabetes changed across adulthood with food secure individuals eventually becoming more likely to be diabetic than food insecure individuals. On the other hand, smoking did not appear to differentially affect the likelihood that individuals would develop lung cancer in this sample and there were no obvious correlations between food security and cancer. Food insecure adults were less likely to drink alcohol compared to food secure adults. Therefore, it is unlikely that alcohol plays a major role in determining their health status. There were no correlations between food security and other measures that might have been mediated by alcohol consumption.

Measures of Physical and Mental Health. There were marked associations between food security and other long term physical and mental illnesses, self-perceived health, and every measure of mental health with almost all correlations accounting for more than 3.5% of the variance. Clearly, food insecure individuals are more likely than food secure individuals to believe that they are afflicted with long term illnesses, poor physical health, stress, and poor mental health. Furthermore, they report a weaker sense of belonging to the community and less satisfaction with life. To the extent that their responses to the survey questions accurately reflect their lives, food insecurity is a key problem for many Canadian citizens. Stress induced by either perceived lack of access to

food and/or actual hunger (about 33% of the food insecure population reported moderate or severe hunger) is probably the key mediator that accounts for these relationships. If this conclusion is correct, than providing all citizens with guaranteed access to food should improve mental and physical health and, thus, reduce health costs substantially.

References

Adam, E. J., Grummer-Strawn, L., & Chavez, G. (2003). Food insecurity is associated with increased risk of obesity in California women. *The Journal of Nutrition, 133,* 1070-1074.

Al-Sahab, B., Lanes, A., Feldman, M., & Tamim, H. (2010). Prevalence and predictors of 6-month exclusive breastfeeding among Canadian women: a national survey. *Pediatrics, 10, 1-9.*

Alaimo, K., Olson, C..M., Frongillo, E. A., & Briefel, R. R. (2001). Food insufficiency, family income, and health in US preschool and school-aged children. *American Journal of Public Health, 91,* (5), 781-786.

Alaimo, K., Olson, C. M., & Frongillo, E. A. (2001a). Low family income and food insufficiency in relation to overweight in US children. *Archives of Pediatrics and Adolescent Medicine, 155,* 1161-1167.

Alaimo, K., Olson, C. M., and Frongillo, E. A. (2001b). Food insufficiency and American school-aged children's cognitive, academic, and psychosocial development. *Pediatrics, 108*, (1), 44-53.

Alaimo, K., Olson, C. M., and Frongillo, E. A. (2002). Family food insufficiency, but

not low family income, is positively associated with dysthymia and suicide symptoms in adolescents. *The Journal of Nutrition, 132,* 719-725.

Armour, B. S., Pitts, M. M., Lee, C. (2008). Cigarette smoking and food insecurity among low-income families in the United States, 2001. *American Journal of Health Promotion, 22*, (6), 386-390.

Basiotis, P. (2003). Food insufficiency and prevalence of overweight among adult women. *Family Economics and Nutrition, 15*, (2), 55-57.

Bickel, G., Nord, M., Price, C., Hamilton, W., & Cook, J. (2000). Guide to measuring household food security. U.S. Department of Agriculture, Food, and Nutrition Service, Alexandria V A.

Bhargava, A., Jolliffe, D., & Howard, L. L. (2008). Socio-economic, behavioral and environmental factors predicted body weights and household food insecurity scores in the early childhood longitudinal study-kindergarten. *British Journal of Nutrition, 100*, 438-444.

Blumberg, S.J., Bialostosky, K., Briefel, R.R., & Hamilton, W.L. (1999). The effectiveness of a short-form of the household food security scale. *American Journal of Public Health, 89*, (8) 1231-1234.

Bowman, S.A., & Harris, E. W. (2003). Food security, dietary choices, and television-viewing status of preschool-aged children living in single-parent or two-parent households. *Family Economics and Nutrition Review, 15*, (2), 29-34.

Canadian Association of Food Banks. *Hunger Count 2004. Poverty in a Land of plenty: Towards a Huger-free Canada:* Toronto, Ontario, Canada: Canadian Association of Food Banks; 2004.

Casey, P. H., Simpson, P. M., Gossett, J. M., Bogle, M. L., Champagne, C. M., Connell, C., Harsha, D., McCabe-Sellers, B., Robbins, J. M., Stuff, J. E., & Weber, J. (2006). The association of child and household food insecurity with childhood overweight status. *Pediatrics, 118*, (5), e1406-e1413.

Casey, P. H., Szeto, K., Lensing, S., Bogle, M., & Weber, J. (2001). Children in food-insufficient, low-income families. *Archives of Pediatrics and Adolescent Medicine, 155*, (4), 508-514.

Che, J., & Chen, J. (2001). Food insecurity in Canadian households. *Health Reports, 12* (4) 11-22.

Cole, T.J., Bellizzi,M. C., Flegel, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity wordwide: International survey. *British Medical Journal, 320*, 1240-1243.

Cook, J. T., Frank, D. A., Berkowotz, C., Black, M. M., Casey, P.H., Cutts, D.B., Meyers, A. F. Zaldivar, N., Skalicky, A., Levenson, S. M., Heeren, T. C., & Nord, M. (2004). Food insecurity is associated with adverse health outcomes among human infants and toddlers. *The Journal of Nutrition, 134*, 1432-1438.

Cook, J. T., Frank, D. A., Levenson, S. M., Neault, N. B., Heeren, T. C., Black, M. M., Berkowitz, C., Casey, P. H., Meyers, A. F., Cutts, D. B., & Chilton, M. (2006). Child food insecurity increases risks posed by household food insecurity to young children's health. *The Journal of Nutrition, 136*, 1073-1076.

Cutler-Triggs, C., Fryer, G. E., Miyoshi, T. J., & Weitzman, M. (2008). Increased rates and severity of child and adult food insecurity in households with adult smokers. *Archives of Pediatric and Adolescent Medicine, 162*, (11), 1056-1062.

Dixon, L. B., Winkleby, M. A., & Radimer, K. L. (2001). Dietary intakes and serum

nutrients differ between adults from food insufficient and food sufficient families: Third national health and nutrition examination survey, 1988-1994. *The Journal of Nutrition, 131*, 1232-1246.

Dubois, L. (2006). Food nutrition and population health: From scarcity to social inequalities. In: Heyman, J., Hertzman, C., Barer, M. L., & Evans, R. G., Editors, *Healthier Societies: From analysis to action,* Oxford University Press, New York.

Dubois, L., Farmer, A., Girard, M., & Porcherie, M. (2006). Family food insufficiency is related to overweight among preschoolers. *Social Sciences & Medicine, 63*, (6), 1503-1516.

Gao, X., Scott, T., Falcon, L. M., Wilde, P. E., & Tucker, K. L. (2009). Food insecurity and cognitive function in Puerto Rican adults. *American Journal of Clinical Nutrition, 89*, (4), 1197-1203.

Grantham-McGregor, S. (1995). A review of studies of the effect of severe malnutrition on mental development. *Journal of Nutrition, 125*, 2233S-2238S.

Gucciardi, E., DeMelo, M., Vogt, J., & Stewart, D. (2009). Exploration of the

relationship between household food insecurity and diabetes in Canada. *Diabetes Care, 32*, (12), 2218-2224.

Gulliford, M. C., Mahabir, D., & Rocke, B. (2003). Food insecurity, food choices, and body mass index in adults: nutrition transition in Trindad and Tobago. *International Journal of Epidemiology, 32*, 508-516.

Gulliford, M., Nunes, C., & Rocke, B. (2006). Food insecurity, weight control practices and body mass index in adolescents. *Public Health Nutrition, 9*, 570-574.

Gunderson, C. & Kreider, B. (2009). Bounding the effects of food insecurity on children's health outcomes. *Journal of Health Economics, 10*, 1-13

Gunderson, C., Lohman, B. J., Garasky, S., Stewart, S., & Eisenmann, J. (2009). Food security, maternal stressors, and overweight among low-income US children: Results from the national health and nutrition. *Pediatrics, 122*, (3) 529-540.

Hadley, C., Mulder, M., & Fitzherbert, E. (2007). Seasonal food insecurity and perceived social support in rural Tanzania. *Public Health Nutrition, 10*, (6), 544-551.

Hadley, C., & Patil, C. L. (2006). Food insecurity in rural Tanzania is associated with

maternal anxiety and depression. *American Journal of Human Biology, 18*, 359-368.

Hadley, C., Tegegn, A., Tessema, F., Cowan, J. A., Asefa, M., & Galea, S. (2008). Food insecurity, stressful life events, and symptoms of anxiety and depression in east Africa: evidence from the Gilgel Gibe growth and development study. *Journal of Epidemiology and Community Health, 62*, 980-986.

Hanson, K. L., Sobal, J., & Frongillo, E. A. (2007). Gender and martial status clarify associations between food insecurity and body weight. *The Journal of Nutrition, 137*, 1460-1465.

Health Canada (2007). Income related household food security in Canada. *Canadian Community Health Survey Cycle 2.2, Nutrition (2004).*

Heflin, C., Siefert, K., & Williams, D. (2005). Food insufficiency and women's mental health: findings from a 3-year panel of welfare recipients. *Social Science and Medicine, 61*, (9), 1971-1982.

Holben, D., & Pheley, A. M. (2006). Diabetes risk and obesity in food-insecure households in rural Appalachian Ohio. *Public Health Research, Practise, and Policy, 3*, (3), 1-9.

Jimenez-Cruz, A., Bacardi-Gascon, & Spindler, A. (2003). Obesity and hunger among Mexican- Indian migrant children on the US-Mexico border. *International Journal of Obesity, 27*, 740-747.

Jones, S.J., Jahns, L., Laraia, B.A., & Haughton, B. (2003). Lower risk of overweight in school-aged food insecure girls who participate in food assistance. *Archives of Pediatrics and Adolescent Medicine, 157*, 780-784.

Jyoti, D. F. Frongillo, E.A., & Jones, S. J. (2005). Food insecurity affects school children's academic performance, weight gain, and social skills. *The Journal of Nutrition, 135*, 2831-2839.

Kaiser, L.L., Melgar-Quinonez, H. R., Lamp, C.L., Johns, M. C., Sutherlin, J. M., & Harwood, J. O. (2002). Food security and nutritional outcomes of preschool-age Mexican-American children. *Journal of the American Dietetic Association,* (102) 924- 929.

Kaiser, L. L., Melgar-Quinonez, H., Townsend, M. S., Nicholson, Y., Fuji, M.L., Martin, A.C., & Lamp, C.L. (2003). Food insecurity and food supplies in Latino households with young children. *Journal of Nutrition and Education Behavior,* (35) 148-153.

Kaiser, L. L., Townsend, M. S., Melgar-Quinonez, H. R., Fujii, M. L., & Crawford, P. B. (2004). Choice of instrument influences relations between food insecurity and obesity in Latino women. *The American Journal of Clinical Nutrition, 80*, (5), 1372-1378.

Kirkpatrick, S. (Unpublished). Analysis of the 2000-01 CCHS food security indicator questions. Toronto: Department of Nutritional Sciences, University of Toronto.

Kirkpatrick, S., & Tarasuk, V. (2008). Food insecurity is associated with nutrient inadequacies among Canadian adults and adolescents. *The Journal of Nutrition, 138*, 604-612.

Kendall, A., Olson, C.M., & Frongillo, E. A. (1995). Validation of the Radimer/Cornell measures of hunger and food security. *The Journal of Nutrition, 125*, 2793-2801.

Kendell, A., Olson, C. M., & Frongillo, E. A. (1996). Relationship of hunger and food insecurity to food availability and consumption. *Journal of the American Dietetic Association, 96*, (10), 1019-1024.

Lamham-New, S. A. (2006). Fruit and vegetables: The unexpected natural answer to the question of osteoporosis prevention. *American Journal of Clinical Nutrition, 23,* (6) 1254-1255.

Laraia, B., Siega-Riz, A. M., Gunderson, C. & Dole, N. (2006). Psychosocial factors and socio-economic indicators are associated with household food insecurity among pregnant women. *The Journal of Nutrition, 136*, 177-182.

Larlio-Lahteenkorva,S.,& Lahelma, E. (2001). Food insecurity is associated with past and present economic disadvantage and body mass index. *The Journal of Nutrition, 131*, 2880-2884.

Ledrou, I., & Gervais J. (2005). Food insecurity. *Health Reports, 16* (3) 47-50.

Lyons, A., Park, J., & Nelson, C. H. (2008). Food insecurity and obesity: A comparison of self-reported and measured height and weight. *American Journal of Public Health, 98*, (4) 751-757.

Marco, M., & Thorburn, S. (2009). The relationship between income and food insecurity among Oregon residents: Does social support matter? *Public Health Nutrition, 136*, 1-9.

Martin, K. S., & Ferris, A.M. (2007). Food insecurity and gender are risk factors for obesity. *Journal of Nutrition and Education Behavior, 39*, 31-36.

Matheson, D. M., Varady, J., Varady, A., & Killen J. D. (2002). Household food security and nutritional status of Hispanic children in the fifth grade. *American Journal of Clinical Nutrition, 76*, (1) 210-217.

McIntyre, L., Conner, S. K., & Warren, J. (2000). Child hunger in Canada: Results of the 1994 national longitudinal survey of children and youth. *Canadian Medical Association Journal, 163* (8), 961-965.

Meals on Wheels Association of America Foundation. (2008).The causes, consequences, and future of senior hunger in America.

Oh, S.Y., & Hong, M. J. (2003). Food insecurity is associated with dietary intake and body size of Korean children from low-income families in urban areas. *European Journal of Clinical Nutrition, 57*, 1598-1604.

Olson, C. M. (1999). Nutrition and health outcomes associated with food insecurity and hunger. *The Journal of Nutrition, 129*, 521-524.

Olson, C. (2005). Food insecurity in women. *Topics in Clinical Nutrition, 20,* (4), 321-328.

Park, K., Kersey, M., Geppert, J., Story, M., Cutts, D., & Himes, J. H. (2009). Household food insecurity is a risk factor for iron-deficiency anaemia in a multi-ethnic, low income sample of infants and toddlers. *Public Health Nutrition, 10*, 1-9.

Racine, E. F., Jemison, K., Huber, L. R., & Arif, A. A. (2008). The well-being of children in food insecure households: Results from The eastern Caribbean child vulnerability study 2005. *Public Health Nutrition, 12*, (9), 1443-1450.

Reid, L. (2000). *The Consequences of Food Insecurity for Child Well-Being. An Analysis of Children's School Achievement , Psychological Well-Being, and Health.* (Joint Center for Poverty Research Working Paper 137).

Rose-Jacobs, R., Black, M., Casey, P., Cook, J., Cutts, D., Chilton, M., Heeren, T., Levenson, S., Meyers, A., & Frank, D. (2008). Household food insecurity: Associations with at-risk infant and toddler development. *Pediatrics, 121*, (1), 65- 72.

Rose, D. & Bodor, N. (2006). Household food insecurity and overweight status in young school children: Results from the early childhood longitudinal

study. *Pediatrics, 117*, (2), 464-473.

Sarlio-Lahteenkorva, S., & Lahelma, E. (2001). Food insecurity is associated with past and present economic disadvantage and body mass index. *The Journal of Nutrition, 131*, 2880-2884.

Sheilds, M. (2008). Community belonging and self perceived health. *Health Reports, 19*, (2), 1-10.

Siefert, K., Heflin, C.M., Corcoran, M. E., & Williams, D. R. (2001). Food insufficiency and the physical and mental health of low income women. *Women & Health, 32,* 159-177.

Skalicky, A., Meyers, A. F., Adams, W.G., Yang, Z., Cook, J. T. & Frank, D. A. (2006). Child food insecurity and iron-deficiency anemia in low-income infants and toddlers in the United States. *Maternal Child Health, 10*, 177-185.

Statistics Canada (2004). Canadian Community Health Survey Cycle 2.2 [Userguide for the Public Use Microdata File] First Edition, Ottawa, ON: Statistics Canada.

Stuff, J. E., Casey, P.H., Szeto, K. L., Gossett, J. M., Robbins, J.M., Simpson, P. M.,

Connell, C., & Bogle, M. L. (2004). Household food insecurity is associated with adult health status. *The Journal of Nutrition, 134*, 2330-2335.

Tarasuk, V. (2001). A critical examination of community-based responses to household food insecurity in Canada. *Health Education & Behavior, 28* (4), 487-499.

Tarasuk, V. (2005). Household food insecurity in Canada. *Topics in Clinical Nutrition, 20*, (4), 299-312.

Tayie, F. A., & Zizza, C. A. (2009). Height differences and the associations between food insecurity, percentage body fat and BMI among men and women. *Public Health Nutrition, 12,* (10) 1855-1861.

Townsend, M. S., Peerson, J., Love, B., Achterberg, C., & Murphy, S. P. (2001). Food insecurity is positively related to overweight in women. *American Society of Nutrition Science, 131*, 1738-1745.

Vozoris, N. T., & Tarasuk, V. S. (2003). Household food insufficiency is associated with poorer health. *The American Society for Nutritional Sciences, 133*, 120-126.

Weinreb, L., Wehler, C., Perloff, J., Scott, R., Hosmer, D., Sagor, L, & Gunderson, C. (2002). Hunger: Its impact on children's health and mental health. *Pediatrics, 110*, 41-45.

Whitaker, R., Phillips, S., & Orzol, S. (2006). Food insecurity and the risks of depression and anxiety in mothers and behavior problems in their preschool aged children. *Pediatrics, 118*, e859-868.

Whitaker, R. & Sarin, A. (2007). Change in food security status and change in weight are not associated in urban women with preschool children. *The Journal of Nutrition, 137*, 2134-2139.

Widorne, R., Neumark-Sztainer, D., Hannan, P. J., Haines, J., & Story, M. (2009). Eating when there is not enough food to eat: Eating behaviors and perceptions of food among food insecure youths. *American Journal of Public Health, 99*, (5) 822-828.

Wilde, P. E., & Peterman, J. N. (2006). Individual weight change is associated with household food security status. *The Journal of Nutrition, 136*, 1395-1400.

Winicki, J. & Jemison, K. (2003). Food security and hunger in the kindergarten

classroom: Its effect on learning and growth. *Contemporary Economic Policy, 21*, 145-157.

Table 1

Summary of the Literature on Food Insecurity and BMI in Children and Adults.
**Quantitative Data*

BMI Measured	Women	Men	Girls	Boys
BMI greater or a larger percentage of overweight/ obese in food insecure	Basiotis (2003), age=19 to 55 years, N=5241	Hanson et al. (2007), age=20+, N=8510	Alaimo, Olson, & Frongillo (2001a), age 12 to 16 yrs, N= 9196	Casey et al. (2006), age=3 to 17 yrs, N=6995
	Hanson et al. (2007), age=20+, N=8510	Holben & Pheley (2006), age=18 years, N=2580	Casey, Simpson, Gossett, Bogle, Champagne,	Dubois et al. (2006), age=1.5 to 4.5 yrs, N=2103
	Holben & Pheley (2006), age= 18 years, N=2580	Martin & Ferris (2007), age= 18 to 66 yrs, N=200	Connell, Harsha, McCabe-Sellers, Robbins, Stuff, & Weber (2006), age=3 to 17 yrs, N=6995	Gunderson & Kreider (2009), age 2 to 19, N=6056
	Kaiser et al. (2004), age=18+ years, N=561			*Jyoti, et al. (2005), age=5 thru 8 yrs, N=21260
	Martin & Ferris (2007), age= 18 to 66 yrs, N=200		Dubois, Farmer, Girard, & Porcherie, (2006), age=1.5 to 4.5 yrs, N=2103	*Oh & Hong (2003), age 4 to 12 years, N=370
	*Olson (1999), age=20-39 yrs, N=193		Gunderson & Kreider (2009), age 2 to 19, N=6056	Widorne et al. (2009), age=12 to 17, N=4746
	*Tayie & Zizza (2009), age=18 to 50 yrs, N=4026		*Jyoti, Frongillo, & Jones (2005), age=5 thru 8 yrs, N=21260	

	Townsend et al. (2001), age=20+ years, N=9541		*Oh & Hong (2003), age=4 to 12 yrs, N=370	
	Wilde & Peterman (2006), age=18+, N=9698		Widorne et al. (2009), age=12 to 17, N=4746	
No significant differences	Whitaker & Sarin (2007), age 18+ years, N=1751	Basiotis & Lino (2003), age=19 to 55 years, N=5241	*Bhargava et al. (2008), age=6 to 10 yrs, N=19684	Alaimo, Olson & Frongillo (2001a), age 12 to 16 yrs, N= 9196
		Holben & Pheley (2006), age= 18 years, N=2580	Gulliford et al. (2006), age=16 yrs, N=1903	Bhargava et al. (2008), age=6 to 10 yrs, N=19684
		*Olson (1999), age=20-39 yrs, N=193	Gundersen et al. (2008), age=2 to 19, N=6056	Gulliford et al. (2006), age=16 yrs, N=1903
		Townsend et al. (2001), age=20+ years, N=9541	Gundersen, Lohman, Garasky, Stewaer & Eisenmann (2009), age=3 to 17 yrs, N=841	Gundersen et al. (2008), age=2 to 19, N=6056
		Whitaker & Sarin (2007), age 18+ years, N=1751	Kaiser et al. (2002), age=3 to 6 yrs, N=211	Gundersen et al. (2009), age=3 to 17 yrs, N=841
			Martin & Ferris	Kaiser et al. (2002), age=3 to 6 yrs, N=211

		(2007), age=2 to 12 yrs, N=212	Martin & Ferris, (2007), age= 18 to 66 yrs, N=200
BMI greater or a larger percentage of overweight/ obese in food secure	Hanson et al. (2007), age=20+, N=8510 *Tayie & Zizza (2009), age=18 to 50 yrs, N=4026	Jimenez-Cruz, Bacardi-Gascon, & Spindler (2003), age 8 to 10 yrs, N=1776 Matheson et al. (2002), age =10, N=124; Rose & Bodor (2006), age=5 thur7 yrs, N=12890	Jimenez-Cruz, Bacardi-Gascon, & Spindler (2003), age=8 to 10 yrs, N=1767 Matheson et al. (2002), age =10, N=124 Rose & Bodor (2006), age=5 thur7 yrs, N=12890

Table 2

The Estimated Percentages and Frequencies in Four Categories by Age.

Age Group (Years)	Frequency of Each Age Group in the Sample	Percentage of the Total Population	Percentage of the Food Insecure Population	Percentage of Food Insecure Within Each Age Group
Under 1	277	1.2%	1.6%	13.4%
1-3	780	3.5%	4.5%	13.3%
4-8	1428	6.4%	7.3%	11.9%
9-13	1477	6.6%	8.9%	14.1%
14-18	1198	5.4%	4.5%	8.8%
19-24	1993	9.0%	13.3%	15.6%
25-30	1756	7.9%	10.1%	13.4%
31-35	1425	6.4%	7.1%	11.6%
36-40	1616	7.3%	11.1%	16.1%
41-45	1951	8.8%	7.6%	9.1%
46-50	1674	7.5%	6.7%	9.3%
51-55	1243	5.6%	5.4%	10.2%
56-60	1211	5.4%	5.6%	10.8%
61-65	1076	4.8%	2.6%	5.7%
66-70	878	3.9%	1.8%	4.7%
71+	2264	10.2%	1.8%	1.9%
Total	22247	100%	100%	

Table 3

The Estimated Percentages and Frequencies in Four Categories by Children's Living Arrangement.

Living Arrangement for Children	Frequency at each Living Arrangement in the Sample	Percentage of Total Population of Children	Percentage of the Food Insecure Population of Children	Percentage of Food Insecure Within Each Living Arrangement
Child Living with One Parent	1324	24.1%	44.8%	19.6%
Child Living with Both Parents	4160	75.9%	55.2%	7.7%
Total	5484	100%	100%	

Table 4

The Estimated Percentages and Frequencies in Four Categories by Adult Living Arrangement.

Living Arrangement for Adults	Frequency at Each Living Arrangement	Percentage of Total Population of Adults	Percentage of the Food Insecure Population of Adults	Percentage of Food Insecure Within Each Living Arrangement
Unattached Living Alone	3315	22.9%	28.9%	12.9%
Unattached Living with Others	1360	9.4%	15.2%	16.5%
Living with Spouse	3985	27.5%	12.0%	4.4%
Parent living with Spouse/Children	4805	33.1%	31.8%	9.8%
Single Parent Living with Children	1040	7.2%	12.1%	17.3%
Total	14505	100%	100%	60.9%

Table 5

The Estimated Percentages and Frequencies in Four Categories by Martial Status in Ages 19+.

Marital Status	Frequency at Each Category in the Sample	Percentage of the Total Population of Adults	Percentage of the Food Insecure Population of Adults	Percentage of Food Insecure Within Each Category
Married	6493	48.9%	34.4%	7.0%
Common Law	1289	9.7%	10.9%	11.2%
Widowed, Separated, or Divorced	2406	18.1%	20.3%	11.2%
Single	3097	23.3%	34.3%	14.7%
Total	13285	100%	100%	

Table 6

The Estimated Percentages and Frequencies in Four Categories by Gender From Birth to 18 and 19+.

Gender	Frequency at Each Category in the Sample	Percentage of the Population of Either Children or Adults	Percentage of the Food Insecure Population of Either Children or Adults	Percentage of Food Insecure Within Each Category
Male (≤18)	4458	49.9%	52.9%	12.9%
Female (≤18)	4481	50.1%	47.1%	11.4%
Total Birth to 18	8939	100%	100%	
Male (19+)	6334	47.6%	43.2%	9.1%
Female (19+)	6973	52.4%	56.8%	10.8%
Total 19+	13307	100%	100%	

Table 7

The Estimated Percentages and Frequencies in Four Categories by Income.

Income	Frequency at Each Category in the Sample	Percentage of the Total Population	Percentage of the Food Insecure Population	Percentage of Food Insecure Within Each Category
Low Income	3288	14.8%	44.2%	31.4%
Middle Income	7148	32.1%	36.0%	11.7%
Middle High Income	11810	53.1%	19.8%	3.9%
Total	22246	100%	100%	

Table 8

The Estimated Percentages and Frequencies in Four Categories by Education in Adults Aged 25+.

Education	Frequency at Each Category in the Sample	Percentage of the Total Population of Adults	Percentage of the Food Insecure Population of Adults	Percentage of Food Insecure Within Each Category
Less than Secondary School Graduation	3092	26.0%	28.2%	10.1%
Secondary School Graduation	2174	18.2%	21.4%	10.9%
Some Post-secondary	753	6.3%	8.5%	12.5%
Post-Secondary Graduation	5894	49.5%	41.9%	7.9%
Total	11913	100%	100%	

Table 9

The Percentages and Frequencies of Individuals who Report Smoking in Various Categories in Ages 12-71+.

Type of Smoker	Percent of Food Insecure	Frequency of Food Insecure	Percent of Food Secure	Frequency of Food Secure
Daily	37.5	625	20.3	3042
Occasional	6.4	103	3.8	565
Former	16.0	270	25.7	3836
Never Smoked	40.2	673	50.3	7599
Total N		1671		15042

Table 10

The Percentages and Frequencies of Individuals who Reported Drinking Alcohol in Various Categories in Ages 14 to18 and 31 to 71+.

Age	Frequency of Alcohol	Percent of Food Insecure	Frequency of Food Insecure	Percent of Food Secure	Frequency of Food Secure
14 to 18	<1 per Month	46.5	53	46.1	576
	1 per Month	13.2	15	18.5	231
	2 to 3 Month	11.4	13	19.1	239
	1 per Week	21.9	25	10.2	127
	2 to 3 Week	5.3	6	4.7	59
	4 to 6 Week	0.9	1	1.2	15
	Every Day	0.9	1	0.2	2
	Total N		114		1249
31 to 71+	<1 per Month	32.2	183	25.9	1824
	1 per Month	17.2	98	11.5	612
	2 to 3 Month	15.3	65	11.8	1323
	1 per Week	17.6	100	15.5	1089
	2 to 3 Week	8.6	48	18.8	1323
	4 to 6 Week	2.6	16	5.9	413
	Every Day	6.5	26	10.7	757

Total N	536	7341

Table 11

The Percentages and Frequencies of the Number of Hours per Week Spent Engaged in Sedentary Activity in Various Income Categories in Ages 12-17.

	Number of hours of Sedentary Activity	Percent of Food Insecure	Frequency of Food Insecure	Percent of Food Secure	Frequency of Food Secure
Low Income	0-19 hrs.	46.0	69	44.8	146
	20-29 hrs.	34.0	51	37.4	122
	30+ hrs.	20.0	30	17.8	58
	Total N		150		326
Middle Income	0-19 hrs.	26.5	30	46.2	431
	20-29 hrs.	47.8	54	32.0	299
	30+ hrs.	25.7	29	21.8	203
	Total N		113		933
Middle High Income	0-19 hrs.	13.7	7	44.4	628
	20-29 hrs.	45.1	23	31.4	445
	30+ hrs.	41.2	21	24.2	342
	Total N		51		1415

Table 12

The Mean BMI for Individuals Aged 2 to 71+.

*Quantitative data

Age	Mean BMI for Food Insecure	Mean BMI for Food Secure
2 to 18	19.7	19.6
19 to 40	26.7	25.9
41 to 55	27.4	27.7
56+	26.5	27.7

Table 13

The Percentages and Frequencies for Each BMI Classification in Individuals Aged 2 to 71+.

**Qualitative data*

Age	Body Mass Index	Percent of Food Insecure	Frequency of Food Insecure	Percent of Food Secure	Frequency of Food Secure
2 to 17	Neither Overweight or Obese	68.5%	501	73.4%	5839
	Overweight	20.7%	151	17.8%	1400
	Obese	10.8%	79	7.9%	622
18 to 40	Underweight	3.8%	16	3.9%	119
	Normal	45.2%	190	48.3%	1893
	Overweight	28.1%	118	31.2%	1223
	Obese	22.9%	96	17.4%	683
41 to 55	Underweight	3.3%	5	0.9%	26
	Normal	40.5%	62	34.8%	956
	Overweight	28.1%	43	37.6%	1034
	Obese	28.1%	43	26.6%	732
56+	Underweight	1.2%	3	1.4%	68
	Normal	46.3%	114	29.2%	1431
	Overweight	26.8%	66	42.9%	2104
	Obese	25.6%	63	26.6%	1303

Table 14

The Percentages and Frequencies of Individuals who Rate Their Health in Various Categories in Ages 12 to 71+.

Perceived Health	Percent of Food Insecure	Frequency of Food Insecure	Percent of Food Secure	Frequency of Food Secure
Excellent	9.5	159	19.8	2976
Very Good	26.6	446	35.4	5327
Good	39.1	655	32.2	4837
Fair	16.5	276	9.8	1481
Poor	8.3	139	2.8	420
Total N		1675		15041

Table 15

The Percentages and Frequencies of Individuals who Rate Their Satisfaction with Life in Various Categories in Ages 12 to 71+.

Satisfaction with Life	Percent of Food Insecure	Frequency of Food Insecure	Percent of Food Secure	Frequency of Food Secure
Very Satisfied	13.2	220	34.3	5152
Satisfied	58.6	978	56.0	8423
Neither	13.7	228	6.8	1028
Dissatisfied	11.4	190	2.5	369
Very Dissatisfied	3.2	54	0.4	60
Total N		1670		15032

Table 16

The Percentages and Frequencies of Individuals who Rate Their Sense of Belonging to Their Community in Various Categories in Ages 12-71+.

Sense of Belonging	Percent of Food Insecure	Frequency of Food Income	Percent of Food Secure	Frequency of Food Secure
Very Strong	14.4	243	22	3305
Somewhat Strong	40.8	672	41.7	6240
Somewhat Weak	22.5	355	24.1	3599
Very Weak	22.5	375	12.4	1851
Total N		1645		14995

Table 17

The Percentages and Frequencies of Individuals who Rate Their Stress in Various Categories in Ages 15-71+.

Perceived Stress	Percent of Food Insecure	Frequency of Food Insecure	Percent of Food Secure	Frequency of Food Secure
None	6.4	96	12.6	1713
Weak	11.9	178	26.6	3633
Moderate	37.7	564	39.7	5415
Strong	34.4	515	17.8	2433
Extreme	9.7	145	3.3	446
Total N		1498		13640

Table 18

The Percentages and Frequencies of Individuals who Rate Their Mental Health in Various Categories in Ages 12-71+.

Perceived Mental Health	Percent of Food Insecure	Frequency of Food Insecure	Percent of Food Secure	Frequency of Food Secure
Excellent	20.2	337	37.2	5588
Very Good	28.9	482	35.3	5309
Good	33.9	564	23.1	3469
Fair	12.5	208	3.9	590
Poor	4.4	74	0.5	81
Total N		1665		15037

Appendix A

Table A1

The Percentages and Frequencies of Males and Females who Report Smoking in Various Categories in Ages 12 to 71+.

Gender	Type of Smoker	Percent of Food Insecure	Percent of Food Secure	Frequency of Food Insecure	Frequency of Food Secure
Male	Daily	37.8	22.6	278	1642
	Occasional	8.4	4.1	62	298
	Former	14.9	29.8	110	2170
	Never	38.9	43.5	286	3169
	Total N			736	7279
Female	Daily	37.1	18	347	1400
	Occasional	4.4	3.4	41	267
	Former	17.1	21.5	160	1666
	Never	41.4	57.1	387	4430
	Total N			935	7763

Table A2

The Percentages and Frequencies of Individuals who Report Smoking in Various Categories at Different Incomes in Ages 12 to 71+.

Income	Type of Smoker	Percent of Food Insecure	Percent of Food Secure	Frequency of Food Insecure	Frequency of Food Secure
Low Income	Daily	40.4	21.4	299	353
	Occasional	5.1	4.7	38	77
	Former	12.7	21.6	94	356
	Never	41.8	52.3	309	863
	Total N			740	1649
Middle Income	Daily	38.0	21.1	221	995
	Occasional	4.1	3.6	24	168
	Former	17.5	24.3	102	1146
	Never	40.4	51.0	235	2403
	Total N			582	4712
Middle High Income	Daily	30.0	19.5	105	1693
	Occasional	12.0	3.7	42	321
	Former	21.1	26.9	74	2335
	Never	36.9	49.9	129	4333

Total N	350	8682

Table A3

The Percentages and Frequencies of Individuals who Report Drinking Alcohol in Various Categories and at Different Incomes in Ages 31 to 71+.

Income	Frequency of Alcohol	Percent of Food Insecure	Percent of Food Secure	Frequency of Food Insecure	Frequency of Food Secure
Low Income	<1 per Month	39.3	38.9	95	244
	1 per Month	19.4	14	47	88
	2 to 3 per Month	16.9	6.1	41	38
	1 per Week	9.5	12.3	23	77
	4 to 6 per Week	2.5	4.8	6	30
	Every Day	6.2	10.5	15	66
	Total N			227	543
Middle Income	<1 per Month	32.8	30.8	61	620
	1 per Month	18.3	12.4	34	249
	2 to 3 per Month	7	12.4	13	250
	1 per Week	17.2	14.2	32	286
	2 to 3 per Week	12.9	14.7	24	296

	4 to 6 per Week	3.2	4.5	6	90
	Every Day	8.6	11	16	222
	Total N			186	2013
Middle High Income	<1 per Month	19.4	21.8	28	960
	1 per Month	12.5	10.8	18	475
	2 to 3 per Month	22.9	12.2	33	539
	1 per Week	31.3	16.5	45	725
	2 to 3 per Week	6.9	21.4	10	944
	4 to 6 per Week	2.8	6.6	4	292
	Every Day	4.2	10.6	6	468
	Total N			144	4403

Table A4

The Percentages and Frequencies of Individuals who Report Eating Fruits and Vegetables in Various Categories at Different Incomes in Ages 9 to 71+.

Income	Servings of fruits and vegetables	Percent of Food Insecure	Percent of Food Secure	Frequency of Food Insecure	Frequency of Food Secure
Low Income	< 5	82.2	72.6	681	1306
	5 to 10	16.8	25.8	139	465
	10+	1.0	1.6	8	29
	Total N			828	1800
Middle Income	<5	76.1	69.7	494	3575
	5 to 10	22.7	28.6	147	1466
	10+	1.2	1.8	8	90
	Total N			649	5131
Middle High Income	<5	87.7	67.8	335	6354
	5 to 10	12.0	31.3	46	2932
	10+	0.3	1.0	1	92

Total N	382	9378

Table A5

The Percentages and Frequencies of Males and Females who Report Whether or Not They had High Blood Pressure in Ages 51 to 70.

Gender	High Blood Pressure	Percent of Food Insecure	Percent of Food Secure	Frequency of Food Insecure	Frequency of Food Secure
Male	Yes	12.3	12.5	130	1193
	No	87.7	87.5	926	8359
	Total N			1056	9552
Female	Yes	9.6	14.8	119	1501
	No	90.4	85.2	1122	8659
	Total N			1241	10160
Collapsed	Yes	10.9	13.6	249	2694
	No	89.1	86.4	2048	17018
	Total N			2297	19712

Table A6

The Percentages and Frequencies of Individuals who Rate Their Health in Various Categories at Different Incomes in Ages 12 to 71+.

Income	Perceived Health	Percent of Food Insecure	Percent of Food Secure	Frequency of Food Insecure	Frequency of Food Secure
Low Income	Excellent	9.6	14.8	71	244
	Very Good	25.8	29.8	191	491
	Good	33.4	35.8	247	590
	Fair	19.6	14.4	145	237
	Poor	11.6	4.2	86	85
	Total N			740	1647
Middle Income	Excellent	10	18.6	58	877
	Very Good	27.8	33.3	162	1569
	Good	42.3	41.6	246	1489
	Fair	13.2	12.7	77	597
	Poor	6.7	3.9	39	185
	Total N			582	4717
Middle High Income	Excellent	8.6	21.4	30	1856
	Very	26.3	37.6	92	3267

Good				
Good	46	31.8	161	2758
Fair	15.4	7.5	54	647
Poor	3.7	1.7	13	151
Total N			350	8679

Table A7

The Percentages and Frequencies of Males and Females who Rate Their Mental Health in Various Categories in Ages 12 to 71+.

	Perceived Mental Health	Percent of Food Insecure	Percert of Food Secure	Frequency of Food Insecure	Frequency of Food Secure
Male					
	Excellent	22.9	38.1	168	2773
	Very Good	26.1	34.8	191	2529
	Good	35.6	22.7	261	1654
	Fair	10	4	73	292
	Poor	5.5	0.4	40	27
	Total N			733	7275
Female					
	Excellent	18.1	36.3	169	2815
	Very Good	31.2	35.8	291	2780
	Good	32.5	23.4	303	1815
	Fair	14.5	3.8	135	298
	Poor	3.6	0.7	34	54
	Total N			932	7762

Table A8

The Percentages and Frequencies of Individuals who Rate Their Mental Health in Various Categories at Different Incomes in Ages 12 to 71+.

Income	Perceived Mental Health	Percent of Food Insecure	Percent of Food Secure	Frequency of Food Insecure	Frequency of Food Secure
Low Income	Excellent	21.4	33.2	157	547
	Very Good	31.8	33.3	233	549
	Good	29.6	27.5	217	453
	Fair	13	5.4	95	89
	Poor	4.2	0.6	31	10
	Total N			733	1648
Middle Income	Excellent	18.7	33.2	109	1564
	Very Good	28.1	35.7	164	1682
	Good	35.3	25.5	206	1199

	Fair	12	5	70	235
	Poor	5.8	0.6	34	28
	Total N			583	4708
Middle High Income	Excellent	20.3	40	71	3477
	Very Good	24.4	35.5	85	3079
	Good	40.4	20.9	141	1817
	Fair	12.3	3.1	43	267
	Poor	2.6	0.5	9	42
	Total N			349	8682

Appendix B

The USDA Household Food Security Survey Module

1. "[I/We] worried whether [my/our] food would run out before [I/we] got money to buy more. "Was that often, sometimes, or never true for you in the last 12 months?

2. "The food that [I/We] bought just did not last, and [I/we] didn't have money to get more. "Was that often, sometimes, or never true for you in the last 12 months?

3. "[I/We] couldn't afford to eat balanced meals." Was that often, sometimes, or never true for you in the last 12 months?

4. "[I/We] relied on only a few kinds of low-cost food to feed the children because [I was/we were] running out of money to buy food." Was that often, sometimes, or never true for you in the last 12 months?

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

6. "[I/We} couldn't feed the children a balanced meal, because {I/we] couldn't afford that." Was that often, sometimes, or never true for you in the last 12 months?

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

8. [Ask only if # 5 = YES] How often did this happen-almost every month, some months but not every month, or in only 1 or 2 months?

9. "The children were not eating enough because [I/we] just couldn't afford enough food." Was that often, sometimes, or never true for you in the last 12 months?

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

11. Sometimes people lose weight because they don't have enough to eat. In the last 12 months, did you lose weight because there wasn't enough food?

12. In the last 12 months, did you ever cut the size of any of the children's meals because there wasn't enough money for food?

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

14. In the last 12 months, were the children ever hungry but you just couldn't afford more food?

15. [Ask only if #13=YES] How often did this happen-almost every month, some months, but not every month, or in only 1 or 2 months?

16. In the last 12 months, did any of the children ever skip a meal because there wasn't enough money for food?

17. [Ask only if #16 = YES] How often did this happen-almost every month, some months, some months but not every month, or in only 1 or 2 months?

18. In the last 12 months, did any of the children ever not eat for a whole day because there was not enough money for food?