

The Relationship of Food Insecurity to Health Parameters in Adult Women with
Polycystic Ovary Syndrome (PCOS)

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This thesis titled

The Relationship of Food Insecurity to Health Parameters in Adult Women with
Polycystic Ovary Syndrome (PCOS)

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Abstract

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The Relationship of Food Insecurity to Health Parameters in Adult Women with Polycystic Ovary Syndrome (PCOS)

Director of Thesis: David H. Holben

Polycystic Ovary Syndrome (PCOS) may increase the risk for high blood glucose, infertility, depression, and overweight/obesity. Food insecurity or other nutrition and health factors may precipitate or result from PCOS. This study was designed to examine the relationship of household food security to fasting blood glucose, body mass index (BMI), produce intake, and depression in adult females with PCOS living in rural Appalachian Ohio. Females aged 18 years and older who attended a clinic for the care and management of PCOS were recruited by mailed invitation. A survey included questions from the U.S. Department of Agriculture household adult food security module, a depression scale, and a validated produce intake and behavior survey. Anthropometrics and biochemical indicators for blood glucose and lipid panel results were obtained from the clinics. Pearson's *r* and Kendall's Tau-*b* correlations were used to assess the relationship of household food security to other parameters. Participants ($n = 54$) were 32 ± 9 years and had a BMI of $34.5 \pm 8.8\text{kg/m}^2$ ($n = 39$). Participants were primarily fully food secure and lived in households characterized by high household food security ($n = 35$, 64.8%). However, 19 (35.2%) participants were not fully food secure, and of these women, 7 (13.0%), 9 (16.7%), and 3 (5.6%) lived in households characterized by marginal, low, and very low household food security, respectively. According to the

depression scale, 27 of 54 (50.0%) respondents had some degree of depression, with 18 (33.3%) having major depression. Daily vegetable, fruit, and total produce servings ($n = 52$) were 2.6 ± 1.8 , 1.9 ± 0.9 , 4.4 ± 2.3 , respectively. For all participants with produce intake data ($n = 52$), 34 (65.4%), 37 (71.2%), and 36 (69.2%) met vegetable, fruit, and, total produce intake recommendations, respectively. Food insecure participants showed significantly higher rates of depression than the food secure participants ($r = 0.466, p < .001$). Lower food security was also associated with smoking ($r = 0.285, p = .026$), poorer daily vegetable intake ($r = -0.337, p = .015$), poorer total daily produce intake ($r = -0.315, p = .023$), lower perceived benefits of produce ($r = -0.293, p = .032$), lower predisposing domain score ($r = -0.278, p = .042$), and a smaller change in all domains ($r = -0.280, p = .041$). Additionally, the 7-item fruit and vegetable scores were significantly higher in food secure women ($r = -0.297, p = .029$). Other parameters were not significantly related to household food security. Overall, in females with PCOS, food insecurity was related to depression, smoking, and poorer produce intakes and behaviors. Further exploration is warranted in a larger sample to clarify these trends.

Dedication

I lovingly dedicate this thesis to my family for their unconditional love during school and life, always giving me full support, endless guidance, and encouragement. My sincerest gratitude to my parents Paula and Hal Hamilton and grandmother Angela Romano whose encouragement and examples have taught me to work hard for what I aspire to achieve, thank you for always believing in me. My siblings Hal, Christina, and Toni Sophia Hamilton, thank you for your continued support and for pushing me to never give up on my dreams, I would not be where I am without all you have done for me.

I also dedicate this thesis to my advisor Dr. David H. Holben who supported me throughout the entire process and went above and beyond in helping me reach my future goals. I am truly thankful to have met you and for the opportunity to learn from you. I will always appreciate everything you have done for me and hope to inspire a future dietitian the way you have me.

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To the entire College of Health Sciences and Professions, thank you to everyone who helped me in many ways to excel during my time at Ohio University. I would like to also acknowledge and thank the College for allowing me to conduct my research through Ohio University. A special thank you to the entire dean's office, especially Dr. Jennifer Horner, Mrs. Deborah Brewer, and Mrs. Tia Barrett for your continued guidance and support. I also would like to share my appreciation to Ms. Hannah Griswold for her help while collecting surveys and lab values.

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Chapter 1: Introduction

Overview and Background

Food security is defined as access by all people at all times to enough food to live an active healthy lifestyle (Anderson, 1990). According to the U.S. Department of Agriculture (USDA) Economic Research Service (ERS), 14.3% of households were food insecure at least some time during the year 2013 (Coleman-Jensen, Gregory, & Singh, 2014). There are several studies, especially among women, that have found food insecurity to be associated with overweight, obesity, and type 2 diabetes mellitus (Adams, Grummer-Strawn, & Chavez, 2003; Basiotis & Lino, 2003; Seligman, Davis, Schillinger, & Wolf, 2010; Townsend, Peerson, Love, Achterberg, & Murphy, 2001). However, many other chronic diseases, such as polycystic ovary syndrome (PCOS), also referred to as polycystic ovarian syndrome, Stein-Leventhal syndrome, hyperandrogenic chronic anovulation, functional ovarian hyperandrogenism, and polycystic ovary (or ovarian) disease, have not been explored.

PCOS is a condition that affects approximately 5-10% of women of reproductive age in the United States (Trivax & Azziz, 2007). PCOS is difficult to diagnose and presently is not completely understood. Original diagnostic criteria were established in 1990 by the National Institutes of Health (NIH) and have since been revised. In 2003, the European Society of Human Reproduction and Embryology/American Society for Reproductive Medicine (ESHRE/ASRM) established the “Rotterdam criteria.” The Rotterdam criteria define PCOS as a women who has two of the following three characteristics: (a) high levels of androgens; (b) missed or irregular periods; and (c)

several small ovarian cysts (Rotterdam ESHRE/ASRM, 2004). Women with PCOS are at an increased risk for many health problems, including insulin resistance, cancer, and cardiovascular diseases (Knowler et al., 2002; Lorenz & Wild, 2007). According to the U.S. Department of Health and Human Services (USDHHS), half of the women diagnosed with PCOS will have developed diabetes or prediabetes before the age of 40 (USDHHS, 2012).

Statement of the Problem

Previous studies have shown food insecurity to be associated with overweight, obesity, and an increased incidence of diabetes (Adams et al., 2003; Basiotis & Lino, 2003; Biros, Hoffman, & Resch, 2005; Harrison, DiSogra, & Brown, 2004; Seligman et al., 2010; Townsend et al., 2001), including one study in Appalachian Ohio (Holben & Pheley, 2006). Studies have also shown that females with PCOS are at an increased risk for developing diabetes (Knowler et al., 2002; Lorenz & Wild, 2007). The links between food insecurity and type 2 diabetes, as well as PCOS and diabetes, have been studied. However, as previously noted, the relationship of food insecurity and PCOS has not been explored; therefore, further research is needed.

Women with PCOS typically have hyperandrogenism and ovulatory dysfunction, though the exact cause is unknown. Eating a healthy diet and engaging in regular exercise can help in the management of PCOS; however, there is no cure for this disease. Having access to adequate food for a healthy, active life, including fresh produce, is essential to consuming a healthy diet and could have a positive impact on the symptoms seen in females with PCOS. Further research is needed, however, to gain a deeper

understanding of PCOS and how food security status could be an important factor in this disease.

Significance and Purpose/Research Question and Research Hypothesis

The purpose of this study was to assess the relationship of food security to PCOS-related health parameters, including body mass index (BMI), biochemical indicators of glucose metabolism, and other health and dietary parameters in adult females who were using a clinic for the management of PCOS. Participants were females clinically-diagnosed with PCOS and 18 years and older. It was hypothesized that food insecurity is related to poorer blood glucose control, as well as poorer health related outcomes.

Relationships between food security status and the following variables were assessed: (a) BMI; (b) total, HDL, and LDL cholesterol; (c) hemoglobin A1c; (d) diabetes related parameters; (e) fasting blood glucose; (f) produce intakes and behaviors; (g) infertility; and (h) depression. The research question and hypothesis for this study are listed below (see Table 1).

Table 1

Research Question and Hypothesis

Research question	Research hypothesis
What is the relationship of food insecurity to health parameters in adult women with PCOS?	Food insecurity will be related to poorer glucose control and management, as well as poorer health-related outcomes.

Limitations of the Study

One of the main limitations of this study was that it is a cross-sectional study. A cross-sectional study takes place at only one point in time. In addition, a convenience sample was used, and those responding might not have been representative of the population as a whole.

Another limitation of this study was the lack of previous research on food insecurity and PCOS with which to compare our study. This research was based upon studies of women with related conditions.

Chapter 2: Review of Literature

Food Security and Related Definitions

In 1990, the Expert Panel on Core Indicators of Nutritional State for Difficult-to-Sample Populations, in 1990, the Life Sciences Research Office, and the Federation of American Societies for Experimental Biology released an American Institute of Nutrition report (Anderson, 1990). This report defined food security, food insecurity, and hunger (Anderson, 1990). Food security is the term used to express access by all people at all times to enough food to live a healthy and active lifestyle (Anderson, 1990). This definition for food security also incorporates the idea that the individual is obtaining nutritionally adequate and safe food in ways that are socially acceptable (Anderson, 1990). Although having access to food is a basic human need and right, millions of U.S. households are considered to be food insecure (Nord, Andrews, & Carlson, 2008). This means the individual or household has a limited or uncertain availability of food that is considered to be both safe and nutritionally adequate or has a limited or uncertain ability to acquire these foods in ways that are found to be socially acceptable (Anderson, 1990).

In 1995, the USDA began measuring the food security status of the U.S. population. Subsequently, the USDA introduced new classification for food security in two categories: (a) high food security, and (b) marginal food security. Food insecurity was also stratified into two categories: (a) low food security, and (b) very low food security (Coleman-Jensen, Nord, Andrews, & Carlson, 2012). Low food security was previously referred to as food insecurity without hunger, and very low food security had

the previous label of food insecurity with hunger (Coleman-Jensen et al., 2012). Detailed definitions for these terms are provided in Table 2.

Table 2

Definition of Food Security and Related Terms

Term	Definition
Food security	Access by all people at all times to enough nutritionally adequate and safe foods (meaning foods that have not expired or been exposed to unsafe temperatures for an extended period of time), acquired in socially acceptable ways (e.g., without resorting to food scavenging, stealing, begging, use of emergency food supplies, or use of food assistance programs to obtain foods), leading to an active and healthy life. ^a Includes high food security and marginal food security categories. ^b
Food insecurity	Having a limited or an uncertain availability of nutritionally adequate and safe foods, or the ability to acquire these foods in socially acceptable ways is limited or uncertain, usually due to economic resource constraints. ^a Includes low food security and very low food security categories. ^b
High food security	Households had no reported problems or limitations of consistently accessing adequate food. ^b

Table 2 (continued)

Term	Definition
Marginal food security	Households had one or two reported problems or anxiety about accessing adequate food, but changes in diets or food intake were not substantially changed. ^b
Low food security	Households reported reduced quality, variety, or desirability of their diets, but the quantity of food intake and normal eating patterns were not substantially changed. ^b
Very low food security	Households reported at multiple times during the year of reduced food intake and one or more household members had disrupted eating patterns. ^b
Hunger	Having an uneasy and/or painful feeling caused by the lack of food, or having lack of access to food that may further lead to an individual being malnourished. ^a Possible result of food insecurity that may cause a physiological condition in an individual. ^b
Food insufficiency	Due to a lack of money and/or other resources an individual has an inadequate amount of food intake. ^c

Note. Adapted from (a) "Core Indicators of Nutritional State for Difficult-to-Sample Populations," by S. A. Anderson, 1990, *Journal of Nutrition*, 120(Suppl 11), p. 1575-1576; (b) "Definitions of Food Security." Retrieved October 8, 2014, from U.S. Department of Agriculture website: <http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/definitions-of-food-security.aspx#.VDTKoEv-Jg0>; and (c) "Development of the Food Sufficiency Questions for the Third National Health and Nutrition Examination Survey," by R. R. Briefel and C. E. Woteki, 1992, *Journal of Nutrition Education*, 24(Suppl 1), p. 24S.

Food Security Measurement Project

Building upon previous research, the USDA worked to develop a necessary survey measurement tool for food insecurity (Bickel, Nord, Price, Hamilton, & Cook, 2000). Working closely with experts and the U.S. Census Bureau, in 1992 the USDA formed the federal group, the Food Security Measurement Project (Bickel et al., 2000). The food-security survey needed to be completed in a way that was not only appropriate but also feasible in developing a standard measure of food insecurity at the national, state, and local levels (Bickel et al., 2000). This measure includes questions that helped gain a deeper understanding of the different levels of food security that are experienced in the United States (Bickel et al., 2000).

Using these measurement tools, data are collected once annually in the Current Population Survey (CPS) Food Security Supplement (Nord et al., 2008; Nord & Coleman-Jensen, 2009). Starting in 1995, the USDA has published an annual statistical report that summarizes the estimates of food insecurity in the United States using data from the CPS Food Security Supplement (Nord & Coleman-Jensen, 2009). Based on a survey measure developed by the U.S. Food Security Measurement Project, The Food Security Supplement contains both national and state statistics on food insecurity. This is an ongoing partnership among federal agencies, private organizations, and academic researchers (Nord et al., 2008). (Several other national surveys, including the National Health and Nutrition Examination Survey (NHANES), utilize the food security survey module; however, the CPS is used for food security national estimates.)

History of food security measurement project. In 1946, the United States launched the National School Lunch Program, contributing to the nutrition-assistance programs we have today (Bickel et al., 2000). Along with the School Lunch Program, other initiatives including the Food Stamp Program have been successful at almost eliminating extreme forms of hunger in the United States, in contrast to Third-World countries where extreme forms of hunger are common (Bickel et al., 2000). However, in the United States, other forms of food insecurity are seen and can contribute to an individual having poor nutrition and adverse health-related outcomes (Bickel et al., 2000).

In the 1980s, there was debate and little agreement about an actual definition for hunger and how it should be addressed in the United States (Radimer, Olson, & Campbell, 1990). There was also a lack of a means to properly measure hunger, and there was no official “hunger count” to know how many people could be classified as living with hunger (Bickel et al., 2000; Radimer et al., 1990).

Rising levels of hunger became a concern during the 1980s in the United States although the importance of taking action to fight this was disputed by some (Radimer, 2002). This denial of hunger in America could have been due to the lack of an accepted definition and definitive measurement tool (Bickel et al., 2000; Radimer et al., 1990). In 1990, Radimer described the status of hunger assessment as having widely varied definitions, generally based on indirect rather than direct measures of hunger, and definitions and measurements that lacked equivalence.

Cornell University was the first to use qualitative research to provide a definitive framework, description, definition, and survey of hunger (Radimer, 2002; Radimer et al., 1990). In the general population, there was a denial of the problem, but, as public concern grew, President Reagan appointed a Task Force on Food Assistance in the United States. to investigate the concern of increasing hunger. The findings were then summarized in a report from the Government Printing Office in 1984. From this Task Force Report, efforts to develop a measurement survey of hunger in the United States began (Bickel et al., 2000). An instrument to measure food insecurity was developed originally by The Community Childhood Hunger Identification Project (Margen & Neuhauser, 1987; Radimer, 2002).

Development of household food security survey module. From The Community Childhood Hunger Identification Project, definitions of hunger and food insecurity were constructed and gained wide acceptance. The U.S. Household Food Security Module was created (Margen & Neuhauser, 1987; Radimer, 2002).

The U.S. Household Food Security Module classifies households as food secure (high, marginal), low food security or very low food security, and also contains questions specific to households, adult, and child food security. Food security, low food security, very low food security, and other related terms are defined (see Table 2). This module has been included in the CPS since 1995 and gives annual estimates of food insecurity (Radimer, 2002). The 6-item short form of this module lacks child-specific items (see Appendix A). If the full 18-item survey (see Appendix B) is used, it can compare the results with the national data from the CPS (Radimer, 2002). Currently, national surveys

to measure food security are also conducted in Canada, New Zealand, and Australia (Radimer, 2002). The ERS also measures food security based on a survey measure developed by the U.S. Food Security Measurement Project (Nord & Coleman-Jensen, 2009). This measure was developed in response to the National Nutrition Monitoring and Related Research Act of 1990, stating there was a need for a better way to assess the nutritional health of people in the United States (Bickel et al., 2000). Federal agencies, academic researchers, and both private commercial and nonprofit organizations collaborated to develop this tool (Nord & Coleman-Jensen, 2009).

Food Security in the United States

Trends in the United States since 1995. Rates of food insecurity have varied since they were first measured (see Figure 1). Rates of food insecurity started to increase in 2000, and reached a high in 2004, dropping in 2005 (Nord & Coleman-Jensen, 2009). In 2008, 14.6% of households in the United States experienced some level of food insecurity, compared to 11.1% in 2007 (Nord & Coleman-Jensen, 2009). More than 49 million people living in the United States were reported to have experienced food insecurity in 2008 (Nord & Coleman-Jensen, 2009). Since it was first measured in 1995, rates of overall food insecurity were the highest in 2011 (Coleman-Jensen et al., 2014).

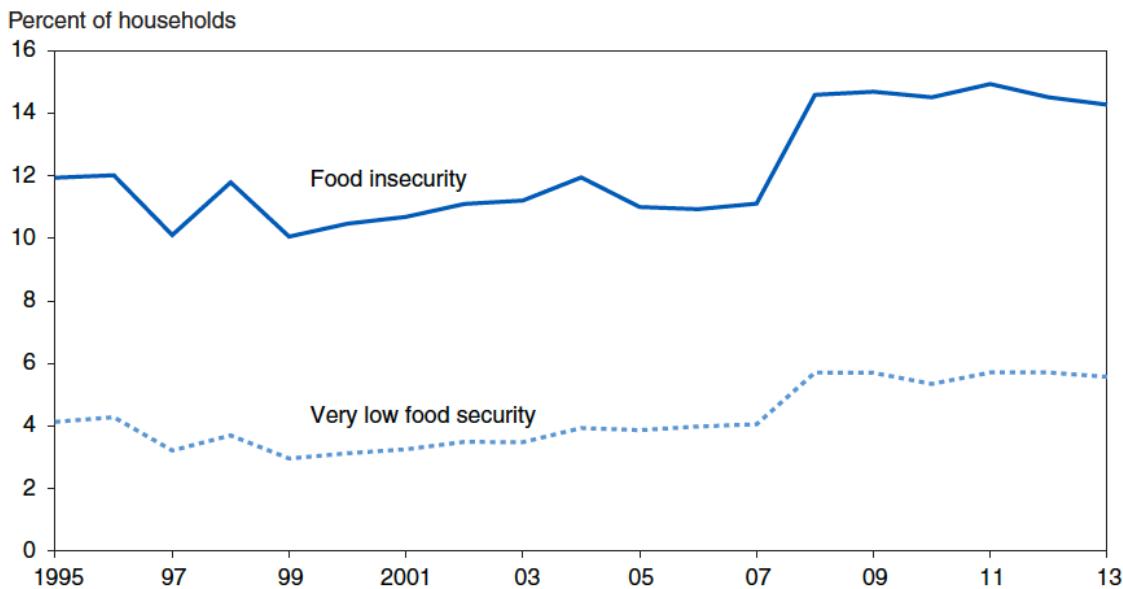


Figure 1. Trends in the prevalence of food insecurity and very low food security in U.S. households, 1995-2013. From the U.S. Department of Agriculture (2014, September). *Household Food Security in the United States in 2013*. Retrieved October 8, 2014, from <http://www.ers.usda.gov/media/1565415/err173.pdf> Reprinted with permission.

According to the USDA ERS, 14.3% of households were food insecure at least some time during 2013 (Coleman-Jensen et al., 2014). In 2013, 17.5 million people were reported to live in food-insecure households (Coleman-Jensen et al., 2014). Of the 14.3% of households that were food insecure, 5.6% had very low food security (see Figure 2) (Coleman-Jensen et al., 2014). These trends do not meet the Healthy People 2020 objectives, which include an objective of reducing household food insecurity to 6.0% (USDHHS, 2014).

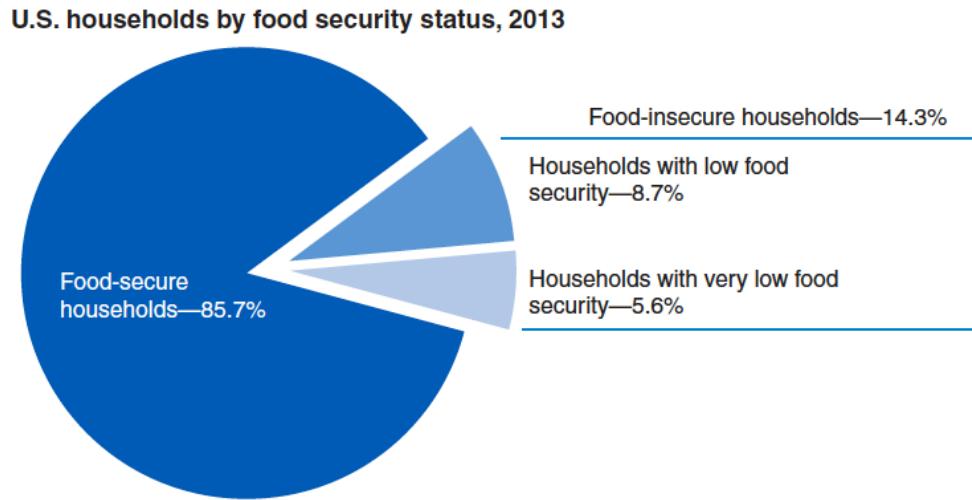


Figure 2. U.S. households by food security status, 2013. From the U.S. Department of Agriculture (2014, September). *Household Food Security in the United States in 2013*. Retrieved October 8, 2014, from <http://www.ers.usda.gov/media/1565415/err173.pdf>

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Food insecurity is strongly related to household income level (Coleman-Jensen et al., 2014). Rates of food insecurity are higher than the national average for households with children; households with children under the age of six; households with children lead by a single mother or father; Black, non-Hispanic households and Hispanic households; and, low-income households with incomes below the 185% of the poverty threshold (Coleman-Jensen et al., 2012). In 2013, 9.9% of households with children were food insecure at some time during the year (Coleman-Jensen et al., 2014).

Negative Outcomes of Food Insecurity

Several studies have found an inverse relationship between food insecurity and an individual's health status (Behringer & Friedell, 2006; Cristofar & Basiotis, 1992; Hazen, Holben, Holcomb, & Struble, 2008; Kendall, Olson, & Frongillo, 1996; Kevesdy, Holben, & Holcomb, 2008; Kropf, Holben, Holcomb, & Anderson, 2007; Pheley,

Holben, Graham, & Simpson, 2002; Rose & Oliveira, 1997; Tarasuk & Beaton, 1999; Walker, Holben, Kropf, Holcomb, & Anderson, 2007). Negative outcomes have been associated with food insecurity, including inadequate intake of key nutrients, poor health, an increased risk of developing various chronic diseases, poor disease management, and poor psychological and cognitive functioning (Holben, 2010). Food insecurity is also associated with overweight, obesity, and diabetes (Holben, 2010).

People from food-insecure households have significantly higher rates of major depression and anxiety, having poorer functional health, restricted activity, chronic conditions, and an overall incidence of poor health (Bickel, Carlson, & Nord, 1998). Studying the association of household food insecurity and adult health status, Stuff et al. (2004) found that food insecurity was associated with both poorer self-rated health status and lower scores on physical and mental health tests.

In the Appalachian region of Ohio, this inverse relationship between food insecurity and health status has been shown in several studies (Holben & Pheley, 2006; Holben, McClincy, Holcomb, Dean, & Walker, 2004; Pheley et al., 2002; Walker et al., 2007). Specifically, a study conducted by Pheley et al. (2002), found that the food-insecure participants had a lower perceived health score when compared to the food-secure participants. In 2006, Holben and Pheley further investigated the results of this study, using a sample of participants from rural Appalachian Ohio and found that BMI and rates of obesity were higher among food-insecure individuals.

Women

Studies have shown that single mothers experience some of the highest rates of food insecurity in the United States (Nord & Coleman-Jensen, 2009). Among married households with children, the prevalence of food insecurity was 12.8% in 2013, lower than the national average of 14.3% (Coleman-Jensen et al., 2014). In 2013, 34.4% of households headed by a single female were food insecure, compared to 23.1% of households headed by a single man (Coleman-Jensen et al., 2014). Also in 2013, of females living alone, 15.2% were food insecure, compared to 14.6% of men living alone who were food insecure (Coleman-Jensen et al., 2014).

According to data from the 2013 Census Bureau, the federal poverty line for a family of four, including two adults and two children under the age of 18, was \$23,624. Rates of food insecurity were shown to be substantially higher than the national average for those households with incomes near or below the federal poverty line, with children headed by either a single man or woman, and Black or Hispanic households (Coleman-Jensen et al., 2014). Among all adult women, Black and Hispanic women have a higher prevalence of food insecurity (Coleman-Jensen et al., 2014). The greatest increase of very low food security has been shown in women living alone, Black households, and households who have incomes below 185% of the poverty line (Coleman-Jensen et al., 2012). In 2013, very low food security was higher than the national average of 5.6% for households with children headed by a single woman (10.8%) compared to a single man (6.5%) and women living alone (7.4%) (Coleman-Jensen et al., 2014). The prevalence of food insecurity among households in 2012 and 2013 is summarized in Figure 3.

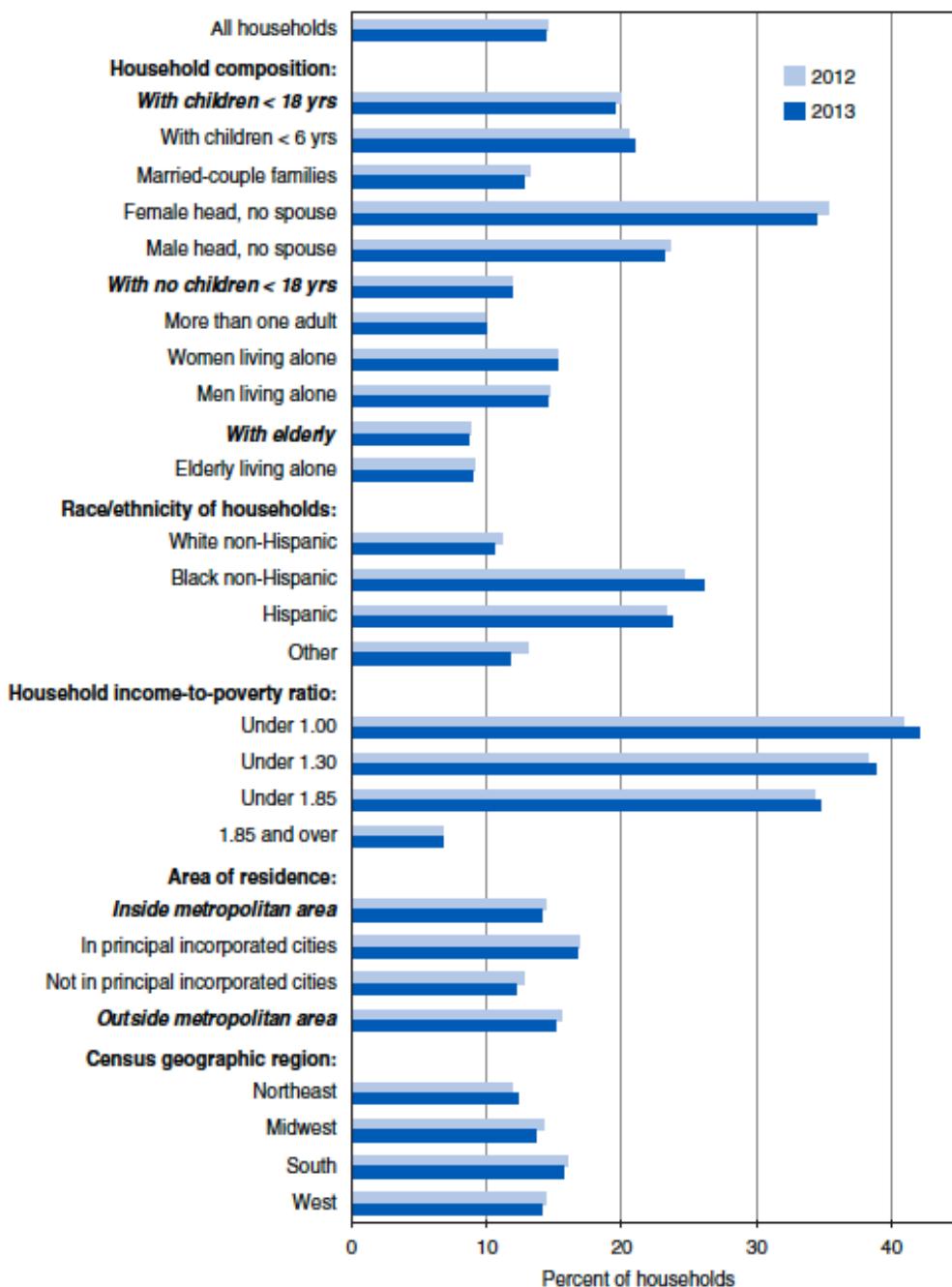


Figure 3. Prevalence of food insecurity among households, 2012 and 2013. From the U.S. Department of Agriculture (2014, September). *Household Food Security in the United States in 2013*. Retrieved October 8, 2014, from <http://www.ers.usda.gov/media/1565415/err173.pdf> Reprinted with permission.

Due to the fact that women are more likely to live in poverty than men, additional studies have found women to be at high risk for food insecurity (DeNavas-Walt, Proctor, & Smith, 2009; Hazen et al., 2008; Kropf et al., 2007; McIntyre & Matheson, 2013; Walker et al., 2007). An early study found that mothers restricted their own food intake if the household food supply was low to ensure that her children would have available food (Radimer, Olson, Green, Campbell, & Habicht, 1992). In a Canadian study, McIntyre and Matheson investigated possible contributing factors to explain why women experience consistently higher levels of household food insecurity than men (McIntyre & Matheson, 2013). Results from this study revealed that the higher rates of food insecurity in single households headed by a female could be attributed to the women's socioeconomic disadvantage (McIntyre & Matheson, 2013). This study also found that women living in a married household reported higher levels of food insecurity than men (McIntyre & Matheson, 2013).

McIntyre has authored or coauthored other studies examining the association between women and food insecurity (Fenton, Hatfield, & McIntyre, 2012). One study conducted in Canada examined the specific household food management behaviors of food-insecure single mothers (Fenton et al., 2012). The relationship between these behaviors and the mother's diet quality were explored (Fenton et al., 2012). From this study, five specific behaviors were identified including "authoritative, healthism, sharing, structured, and planning" behaviors (Fenton et al., 2012). Family behavior scores were used to measure food management and healthy plate scores were used to assess diet quality (Fenton et al., 2012). Overall, as the family behavior score increased so did the

healthy plate score, and strong predictors of a healthy plate score included authoritative, healthism, and planning food management behaviors (Fenton et al., 2012).

The social roles women take on when feeding and caring for their families include making sure the family has regular and balanced meals, dealing with family issues concerning food, and instituting shared nutrition goals and patterns of eating for the household (Olson, 2005). These roles may put women at a greater risk for experiencing food insecurity than men (Olson, 2005). Traditionally, mothers take care of the children and possibly might skip meals in order to protect her child or children from food deprivation in the household (Fitchen, 1998; Olson, 2005). Findings from a study conducted in Appalachian Ohio (Denham, 2004) suggest that women are gatekeepers of health information, and interventions that use women as the central role of the health of their families may be useful. In a Canadian study, it was found that single mothers living in poor households experienced greater food insecurity and are at a higher risk of developing nutrient deficiencies than their children (McIntyre et al., 2002). Using weekly 24-hour dietary recalls for one month, McIntyre and colleagues examined the diet quality of single mothers and their children (McIntyre et al., 2002). The diet quality of the child varied by age, whereas all the mother's diet quality was reported to be poor or in need of improvement (McIntyre et al., 2002). The younger children had higher quality diets than the older children and mothers (McIntyre et al., 2002). Considering the role of the mother, other studies would be expected to show similar findings.

Food security and obesity/overweight among women. Among women in the United States, obesity is a growing health problem (Bove & Olson, 2006). Overweight

and obese women are at higher risks for adverse health outcomes including mortality, coronary heart disease, diabetes, and hypertension (McTigue et al., 2006). In recent years, the rates of obesity among women have increased drastically: 35.8% of women aged 20-74 years were obese in 2009-2010, 34% of women aged 20-74 years were obese in 1999-2000, 25.9% in 1988-1994, and only 17% of women aged 20-74 were reported as obese in 1976-1980 (Flegal, Carroll, Kit, & Ogden, 2012). In 2009-2010, 63.7% of females were either overweight or obese, with 8.1% of women categorized as having extreme obesity, a $\text{BMI} \geq 40 \text{ kg/m}^2$ (Flegal et al., 2012). Studies suggest that due to the lack of money, food insecure individuals may gain weight because they do not have the money to purchase healthy foods, tending to lead to the consumption of energy-dense but less expensive foods (Darmon & Drewnowski, 2006; Drewnowski & Specter, 2004).

Overweight and obesity have been found to be more prevalent among women who are food insecure when compared to food-secure women in several cross-sectional studies in national, state, and county populations (Adams et al., 2003; Basiotis & Lino, 2003; Olson, 1999; Townsend et al., 2001). It may seem counterintuitive that a person with less available food would be at higher risk of becoming overweight or obese when compared to someone who is food secure; this has been referred to as the “hunger-obesity paradox” (Dietz, 1995). The literature suggests that when food is restricted, cognitive and emotional changes can occur, resulting in a tendency to overeat when food is available—also referred to as the feast or famine pattern of eating (Polivy, 1996).

Another study conducted in rural Appalachian Ohio (Holben & Pheley, 2006) found that participants from food-insecure households, especially among women, had a

higher BMI when compared to their food-secure counterparts. Obesity was also more prevalent among study participants from food-insecure households (48.1%) when compared to participants from food-secure households (35.1%).

Food security and pregnancy. The Academy of Nutrition and Dietetics (AND), formerly known as the American Dietetic Association (ADA), holds the position that systematic and sustained action is needed to achieve food and nutrition security for all in the United States, and to eliminate food insecurity, interventions are needed (Holben, 2010). The AND also holds the position that women of childbearing age must maintain good nutritional health through their lifestyle choices (Kaiser & Allen, 2008). These lifestyle choices should improve maternal health and decrease the risk of birth defects, less than optimal fetal growth and development, and chronic health problems in their children (Kaiser & Allen, 2008). The main components of living a healthy lifestyle during pregnancy include appropriate weight gain and physical activity, eating a variety of foods, supplementing with necessary vitamins and minerals, avoiding harmful substances (including alcohol and tobacco), and following safe food handling practices (Kaiser & Allen, 2008).

Maternal nutrition during pregnancy is a key factor influencing not only the mother's, but also the child's health (Stotland, Hopkins, & Caughey, 2004; Thorsdottir, Torfadottir, Birgisdottir, & Geirsson, 2002). The risk of complications during pregnancy can be reduced if the mother has gained the appropriate amount of weight throughout the pregnancy (Stotland et al., 2004; Thorsdottir et al., 2002). A long-term follow-up study, looking back to World War II, examined the Dutch famine and found that if the mother

was undernourished during pregnancy, her children were at increased risk for developing chronic diseases later in life (Rosebloom, de Rooij, & Painter, 2006). Certain health effects can be traced back to the specific time during gestation when the mother experienced famine (Fagerberg, Bondjers, & Nilsson, 2004). A low birth weight child, who gains rapidly after birth in a catch-up growth effort, has been shown to be at risk for different metabolic syndromes later in adulthood (Fagerberg et al., 2004).

Many U.S. women of childbearing age do not maintain optimal nutrition status during pregnancy, or during the time before and/or after pregnancy (Kaiser & Allen, 2008). On average, women of childbearing age who are not currently pregnant have lower dietary intakes of vitamin E, magnesium, potassium, fiber, and calcium when compared to the Dietary References Intakes (Kaiser & Allen, 2008).

In a recent AND research editorial, Olson (2010) cited a study by Laraia, Siega-Riz, and Gundersen (2010). As anticipated, the study found positive associations among food insecurity, severe obesity, and weight gain during pregnancy (Olson, 2010). However, there was no statistically significant association between food security status and any gestational weight gain pattern (Olson, 2010). Although these variables were not found to have significant relationships, it was found that marginal food insecurity was associated with a mother developing gestational diabetes mellitus [GDM], and that GDM was actually 2.76 times more likely to occur in marginally food-insecure women than in food-secure women (Olson, 2010). Future research is needed to test the relationship between food insecurity and GDM.

It cannot be disputed that the mother's health is important before, during, and after pregnancy. The nutritional status of a female may be affected by having food insecurity. It is the position of the AND and the American Society for Nutrition that all overweight and obese women of reproductive age should receive counseling to understand the importance of being healthy prior to pregnancy, during pregnancy, and during the conception period (Siega-Riz & King, 2009). The effect of maternal nutritional status prior to pregnancy and its effects on pregnancy outcomes are of great public health importance (Siega-Riz & King, 2009).

Food security and depression among women. In 1997, the relationship between food insufficiency and physical and mental health was analyzed in a random sample study (Siefert, Heflin, Corcoran, & Williams, 2001). The study participants included women who were receiving welfare, in an urban county (Siefert et al., 2001). The study found that food insufficiency was significantly associated with poor or fair self-rated health, physical limitations, and also depression (Siefert et al., 2001). A more recent study was conducted with the participation of women from 316 rural low-income families with children (Olson, Anderson, Kiss, Lawrence, & Seiling, 2004). An association was found between food insecurity and depressive symptoms, measured by the Center of Epidemiological Studies Depression Scale (Olson et al., 2004). In this sample, 60% of the women scored above the level on the scale that indicates clinical depression (Olson et al., 2004).

Being isolated due to living in a rural location was found to be a contributing factor to a woman being in a negative emotional state (Bove & Olson, 2006). These

negative feelings could lead some women to emotional eating patterns (Bove & Olson, 2006). For many women in the United States, food insecurity is found to stem from poverty (Olson, 2005). These women often live in both physical and social environments that do not support optimal health, including the access to quality healthcare (Olson, 2005).

In a study using participants from rural Appalachian Ohio, food security and perceptions of health status were measured. Pheley et al. (2002) found that food-insecure individuals reported poorer functional health status in comparison to the food-secure group; no health status differences were found between the different food-insecure groups.

Food security and diabetes among women. It has been hypothesized that food-insecure adults often reduce food intake, have inadequate nutrient intake, and often replace healthier foods with less expensive, energy-dense carbohydrates (Seligman, Bindman, Vittinghoff, Kanaya, & Kushel, 2007). These behaviors are also thought to be associated with food-insecure adults developing diabetes and having impaired diabetes self-management (Seligman et al., 2007). Food insecurity has been shown to be associated with consumption of a less healthy diet and overall lower nutrient intakes (Kirkpatrick & Tarasuk, 2008). In both prevention and treatment of diabetes, it is important to follow a healthy diet (Gucciardi, Vogt, Demelo, & Stewart, 2009).

A study published in the *Journal of Health Care for the Poor and Underserved* found that food-insecure participants reported poorer adherence to blood glucose monitoring than food-secure individuals (Seligman et al., 2007). It was concluded from

this study that food insecurity is a barrier to proper diabetes self-management (Seligman et al., 2007).

Similarly, Holben and Pheley (2006) found that people with diabetes living in Appalachian Ohio were more likely to reside in food-insecure households than in food-secure households. A study conducted in Canada explored the relationship between household food insecurity and diabetes and concluded that high food insecurity is significantly greater among Canadians with diabetes (9.3%) when compared to others without diabetes (6.8%), and is associated with other unhealthy behaviors, psychological problems, and poorer physical health (Gucciardi et al., 2009). When comparing Canadian males and females with diabetes, Gucciardi et al. (2009) found that the rate of females residing in food-insecure households was 12% compared to only 7% of males.

Holben and Pheley (2006) did not find a significant difference between food-secure and food-insecure individuals when comparing diastolic blood pressure, total cholesterol, random blood glucose, HbA1c, and hemoglobin ($p > .05$). However, when comparing the female participants, BMI and HbA1c were significantly greater among women from food-insecure households than among those from food-secure households. Holben and Pheley also found that individuals with an HbA1c level higher than 7% were more likely to come from food-insecure households. Additionally, participants who self-reported having diabetes were significantly more likely to live in food-insecure households (37.9%) than in the food-secure households (25.8%) (Holben & Pheley, 2006).

Food security and dietary intake among women. Individuals residing in food-insecure households have lower intakes of fruits, vegetables, and milk products, overall lower energy and nutrient intakes, and have a less varied diet when compared to those who are food secure (Kaiser et al., 2002; Kendall et al., 1996; Matheson, Varady, Varady, & Killen, 2002). It has been observed that fruits and vegetables are the first food group to be decreased in food-insecure women, resulting in significantly lower intakes of vitamin C and A (Olson, 2005). Also, food-insecure adult women were more likely to have low intakes of vitamins E and B₆, magnesium, thiamin, and niacin (Olson, 2005).

In a sample of low-income Canadian women, Tarasuk, McIntyre, and Li (2007) examined changes in dietary intake over a 30-day period in women who received a main portion of their income in one monthly check. Over the monthly period, the energy, nutrient, and food intakes of the women were examined in relation to the number of days since their checks were received (Tarasuk et al., 2007). It was found that, as the number of days increased from receiving the last check, resources were decreased (Tarasuk et al., 2007). Females classified as having moderate or severe food insecurity showed a decrease in overall consumed energy, carbohydrates, vitamin B₆, and fruit and vegetable intakes; however, no similar patterns were shown in food secure females (Tarasuk et al., 2007). This study suggests that food insecure females live in need of their monthly checks to buy food and that anything threatening those funds to purchase food stands as a barrier to their nutritional health (Tarasuk et al., 2007).

A similar study conducted in Canada found that women receiving emergency food assistance and living in a food-insecure household, reported lower caloric intakes

and lower intakes of several other nutrients including; vitamin A, folate, iron, and magnesium (Tarasuk & Beaton, 1999), suggesting that they were at risk for nutrient deficiencies (Tarasuk & Beaton, 1999).

Studies have shown that, over time, the health effects of consuming inadequate intakes of certain nutrients can increase a women's risk of developing chronic diseases, including cancer and heart disease (Olson, 2005). Food insecurity was found to be a contributing factor to disordered eating patterns that affect food intake (Bove & Olson, 2006).

Food security and produce intake. Fruits and vegetables contain unending amounts of several key nutrients that are needed to fight the onset of developing chronic diseases (Olson, 2005). Numerous studies have shown evidence that a greater consumption of fruits and vegetables can decrease the risk of developing a chronic disease such as diabetes and cancer (Genkinger, Platz, Hoffman, Comstock, & Helzlsouer, 2004; He, Nowson, & MacGregor, 2006; Ziegler et al., 1986). To measure produce intake, individuals' attitudes, beliefs, and feelings associated with fruit and vegetable intake must be considered. In 2003, Townsend, Kaiser, Allen, Joy, and Murphy developed a 13-item Tool to Assess Psychosocial Indicators of Fruit and Vegetable Intake. This survey measures produce intake behaviors including perceived benefit, perceived control, self-efficacy, perceived diet quality, readiness to eat more vegetables, readiness to eat more fruit, enabling domain, predisposing domain, change in intention domain, and change in all domains.

This 13-item tool is important to use when considering individuals' thoughts about consuming fruits and/or vegetables and can allow researchers to gain a deeper understanding of barriers to produce intake. This is an important tool to measure produce intake in females with PCOS because it considers why individuals may or may not be meeting the recommended daily fruit, vegetable, and total produce intakes. Scores for each item will range from 0 (low) to 1 (high). Each construct or domain may include more than 1 item. These constructs and domains of the 13-item tool are defined in Table 3.

Table 3

Definitions of Psychosocial Constructs Related to Produce Intake Behaviors

Construct or domain	Definition (Townsend and Kaiser, 2005)	Number of items
Perceived benefit	What a person believes will happen as a result of performing a behavior defined as, outcome expectations provide motivation for eating fruit and vegetables	2
Perceived control	These items ask who is in charge of the food shopping and food preparation and refer to the perception of having control over these behaviors	2
Self-efficacy	Items used to assess the confidence an individual feels in performing specific fruit and vegetable behaviors in a variety of circumstances	6
Readiness to eat more fruit and vegetables	This item refers to the individual's readiness to increase the current intakes of fruit and vegetables compared to the amount eaten in the past	2
Perceived diet quality	Asks about the individual's perception of their own diet quality	1
Enabling domain	Self-efficacy construct score	
Change in intention domain	Readiness to eat more fruit construct score + readiness to eat More vegetables construct score + perceived diet quality construct score	
Change in all domains	Change in predisposing domain + change in enabling + change in intention	

Polycystic Ovary Syndrome

PCOS is a common reproductive endocrine disorder affecting approximately 10% of women worldwide (ASRM, 2012; Stein, 2006). It is believed by some experts that PCOS affects as many as 6 million women and girls of reproductive age in the United

States (Christopher, 2004). Because the exact definition of PCOS is still being debated, the exact number of women affected is unknown (Trivax & Azziz, 2007).

PCOS was first identified nearly 70 years ago, although the exact cause is still unknown. In 1935, Stein and Leventhal described PCOS as a frequent cause of irregular ovulation and fertility problems (Deepika, Ranjith, Maruthi, & Jahan, 2011). Presently, there is disagreement when it comes to the specific diagnostic criteria for females having PCOS. Original diagnostic criteria were established in 1990 by the NIH and were revised by the ESHRE/ASRM in 2003. Originally, the NIH defined PCOS as having hyperandrogenism and/or hyperandrogenemia, oligoovulation, and exclusion of known disorders (Azziz, 2005). In 2003, the “Rotterdam criteria” (Rotterdam, ESHRE/ASRM, 2004) were set although there is still controversy as to whether or not this should be used to define PCOS. The Rotterdam criteria excluded the related disorders criteria from the original NIH definition (Chhabra & Venkatraman, 2010). Using the Rotterdam criteria, the ASRM defined PCOS as a woman having two of the following three characteristics: (a) oligo- or anovulation; (b) clinical and/or biochemical signs of hyperandrogenism; and (c) polycystic ovaries (Rotterdam ESHRE/ASRM, 2004).

These criteria are shown in Table 4. Although these criteria must be met to have PCOS, many other symptoms may occur. Not all females with PCOS will show the classic symptoms, and not all women who have the symptoms will have this syndrome (Stein, 2006). PCOS is difficult to diagnose and presently is not completely understood. Common symptoms of PCOS are summarized in Table 5.

Table 4

Rotterdam Criteria

Oligo-ovulation (irregular ovulation) or anovulation (no ovulation)

Hyperandrogenism (clinical and/or biochemical signs)

Polycystic ovaries (having one or more cysts in ovaries)

Note. Adapted from “Revised 2003 Consensus on Diagnostic Criteria and Long-term Health Risks Related to Polycystic Ovary Syndrome,” by the Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group, 2004. *Fertility and Sterility*, 81(1), p. 20. doi: <http://dx.doi.org/10.1016/j.fertnstert.2003.10.004>

Table 5

*Symptoms of PCOS***Infertility**

Oligo- or anovulation: irregular and/or absent menstrual periods

Hirsutism: increased unwanted body hair growth (e.g., face, chest, stomach)

Ovarian cysts

Acne and/or oily skin

Overweight or obesity (usually android obesity)

Balding or thinning hair on the head

Acanthosis nigricans: patches of thick skin that are dark brown or black

Excess skin around the armpit and/or neck areas

Pain in the pelvic area

Anxiety and/or depression

Sleep apnea

Note. Adapted from “Polycystic Ovary Syndrome (PCOS) Fact Sheet,” by U.S. Department of Health and Human Services, Office on Women’s Health. Retrieved October 8, 2014, from <http://www.womenshealth.gov/publications/our-publications/fact-sheet/polycystic-ovary-syndrome.html?from=AtoZ>

According to the USDHHS, PCOS affects a woman’s menstrual cycle, hormones, heart, blood vessels, appearance, and ability to have children (USDHHS, 2008). PCOS is the primary cause of female infertility in the United States (Balen, Dresner, Scott, & Drife, 2006). Females with this syndrome have a greater chance to show acne, excessive body and facial hair growth (hirsutism), and weight gain (USDHHS, 2008).

There are also other health risks females with PCOS may face including hypertension (high blood pressure), abnormal bleeding from the uterus, high cholesterol, cardiovascular diseases, endometrial cancer, obesity, insulin resistance, and type 2 diabetes (ASRM, 2012). Obesity increases the presentation of PCOS and weight management is proposed as a first step in a treatment strategy (Moran, Hutchison, Norman, & Teede, 2011). It is estimated that about 50% of women with PCOS are overweight or obese (Deepika et al., 2011). Women with PCOS have a potentially increased risk of developing cardiovascular disease and related mortality later in life (Schmidt, Landin-Wilhelmsen, Brannstrom, & Dahlgren, 2011).

According to the American Heart Association, an individual is at health risk if any of the following occur: (a) total cholesterol of 200 mg/dL or greater, with total cholesterol of less than 180 mg/dL being optimal; (b) LDL cholesterol more than or equal to 100 mg/dL; (c) HDL under 50 mg/dL; (d) triglycerides equal to or over 150 mg/dL; and/or (e) fasting blood glucose greater than or equal to 100 mg/dL (American Heart Association, 2014). Having a HbA1c in the range of 5.7% to 6.4% puts an individual at risk for developing diabetes, and diabetes is diagnosed with a HbA1c of 6.5% or higher (American Heart Association, 2014).

Regardless of the known connection among PCOS, heart disease, and mortality, more studies are needed (Schmidt et al., 2011). Along with health risks, females with PCOS are also more likely to become depressed (Keegan, Liao, & Boyle, 2003; Mansson et al., 2008; McCook, Reame, & Thatcher, 2005; Rasgon et al., 2003).

PCOS and depression. Nearly 14.8 million American adults are affected each year by major depressive disorder (MDD) (National Institute of Mental Health, 2006). MDD is more common in women than men (National Institute of Mental Health, 2006). In women aged 18-44 years, the prevalence of MDD ranged from 12 to 14% (Hasin, Goodwin, Stinson, & Grant, 2005). Studies have shown that females with PCOS are at higher risk of developing depressive symptoms than healthy women without PCOS (Keegan et al., 2003; Mansson et al., 2008; McCook et al., 2005; Rasgon et al., 2003). Along with depression, anxiety has been found to be more common in females with PCOS when compared to healthy females without PCOS (Cinar et al., 2011). In PCOS, depression and anxiety could be associated with metabolic abnormalities, insulin resistance, and weight gain (Cinar et al., 2011).

Treatments for PCOS. Common treatments for PCOS include lifestyle changes, medications, and cosmetic methods for removing excess hair (USDHHS, 2008). Lifestyle changes include weight loss, exercise, and diet. Obesity is common in women with PCOS (Legro, 2007). For weight loss, and an improved hormone levels, the ASRM (2012) suggests exercising for at least 30 minutes three to four times each week. Diet and exercise that result in weight loss improves the frequency of ovulation, improves fertility, lowers the risk of diabetes, and lowers androgen levels in many women with PCOS and is therefore an important component of therapy (ASRM, 2012). Medications used to treat PCOS are targeted at menstrual cycle control, improvement of insulin resistance, and reduction in progression of hair growth. Hormonal medications, such as progesterone and oral contraceptives, are used for cycle regulation and reduction in

endometrial carcinoma risk. Metformin is used to treat diabetes and can lower insulin levels, but is also prescribed to females with PCOS and insulin resistance problems. Some women treated with metformin have also experienced weight loss and lowering of high blood pressure (Legro, 2007). Antiandrogens counter the effects of excess androgens in a female's body. Cosmetic procedures to remove excess facial and body hair includes plucking, shaving, waxing, and laser hair removal. The cost of treatment for PCOS could potentially impact food insecurity.

PCOS and diabetes. Insulin resistance is seen when cells in the body do not properly use the insulin that is being made. Having insulin resistance results in a need for higher levels of insulin to allow for adequate transport of glucose into the cells to be utilized for energy (USDHHS, 2008). Insulin resistance causes a hormonal imbalance in the body and can lead to diabetes. Impaired glucose tolerance is more often found in individuals with PCOS, compared to women without PCOS (Hudecova et al., 2011), putting these women at a higher risk of developing type 2 diabetes mellitus and cardiovascular diseases over healthy females (Tomlinson, Millward, Stenhouse, & Pinkney, 2010). Risk factors for type 2 diabetes mellitus are reduced by weight loss and the use of metformin (Tomlinson et al., 2010). The incidence of diabetes is 5-10 times higher in women with PCOS than among women in the general population (Ehrmann, Barnes, Rosenfield, Cavaghan, & Imperial, 1999). Approximately 50-70% of women with PCOS have some level of insulin resistance and impaired glucose tolerance (Diamanti-Kandarakis, 2006; Lorenz & Wild, 2007). Type 2 diabetes is present in about 40% of women with this syndrome (Diamanti-Kandarakis, 2006; Lorenz & Wild, 2007).

Studies suggest that all women with PCOS should be frequently screened for diabetes (Talbott et al., 2007). It is important to identify diabetes in young females with PCOS and start lifestyle interventions as early as possible (Talbott et al., 2007).

PCOS and risk factors. Although PCOS affects approximately 6 million women and girls of reproductive age in the United States, it still does not have an exact definition and is hard to identify (Christopher, 2004; Trivax & Azziz, 2007). There is a gap in research when it comes to studying PCOS and the exact causes. The symptoms and possible treatments of this syndrome have been widely studied, but the exact cause is still unknown. PCOS has been identified as the number one cause of female infertility (Balen et al., 2006). Researchers believe this condition could be related to family history, diet and exercise (USDHHS, 2008).

One possible cause of a female developing PCOS is not eating a healthy diet. Females who are food insecure are less likely to get the required nutrients. Food insecurity could be a possible precursor to PCOS. There are a small amount of studies that look to socioeconomic status and its relationship to PCOS; however, both studies showed a positive correlation between having a low socioeconomic status and women having PCOS (Chhabra, 2010; Merkin, 2011).

No studies have examined food insecurity and the development and care of PCOS. A study in the *Journal of Women's Health* examined the association of PCOS and its components with socioeconomic status among women. The study explored the role of environment on the development of PCOS. Their results indicated that women who experienced low childhood socioeconomic status were at an increased risk of

developing PCOS (Merkin et al., 2011). Another study was conducted to show the incidence of PCOS in rural young females with menstrual irregularities in India. A complete medical evaluation was conducted on the 200 participants before it was revealed that PCOS was common in low socioeconomic, rural young women from India participating in this study (Chhabra et al., 2010). Of the 200 study participants, half were found to have PCOS, and many of the women had mothers with a history of hypertension, diabetes, and menstrual irregularities (Chhabra et al., 2010). This incidence found of PCOS in rural young females may also show a similar trend in the United States.

Summary

As shown in the literature, food insecurity is a major health issue in the United States. The literature demonstrates health complications that can arise from an individual being food insecure, including overweight/obesity, pregnancy complications, depression, diabetes, and inadequate dietary intake. The literature also demonstrates similar health problems for females with PCOS. However, as previously noted the relationship of food insecurity and PCOS has not been explored; therefore, further research is needed.

Chapter 3: Methodology

Using a sample of females with PCOS, the purpose of this study was to assess the relationship of food security to PCOS-related health parameters, including BMI, biochemical indicators of glucose metabolism, and other health and dietary parameters in adult females using a clinic for management of PCOS. The Institutional Review Board (IRB) at Ohio University approved this study prior to the collection of any data (see Appendix C).

Participants

In this pilot study, approximately 275 eligible participants who were receiving healthcare at the University Medical Associates (UMA) Diabetes Endocrine Center (DEC) and River Rose Obstetrics and Gynecology were recruited through a mailed invitation and survey. Females receiving care from the free clinic in Athens, Ohio were not included in this study. All female clinic attendees age 18 and older diagnosed with PCOS were eligible to participate in the study. Pregnancy was not an exclusion criteria for this study. A list of patients who met the above criteria from their medical record databases was generated ($n = 269$). Potential participants were informed of the specifics of the research study, assured confidentiality of their responses and were asked to partake in the study by completing a survey.

Packets were sent to prospective participants ($n = 269$). The packet introduced the study and invited their participation. The packet also included a consent form, participant survey, self-addressed return envelope, and \$2 cash incentive. A second mailing was sent to nonresponders.

The consent form that accompanied the survey asked permission to review the participant's medical record to determine demographic and information about laboratory testing and medical history (see Appendix D). Letters from the DEC and River Rose are included (see Appendices E and F).

After signing the consent form, all participants then had the opportunity to fill out our survey with items that have been previously validated. The questionnaire included - Psychosocial Indicators of Fruit and Vegetable Intake in Low Income Communities questionnaire and Food Behavior Checklist for a Limited Resource Audience (Townsend et al., 2003; Townsend & Kaiser, 2005), U.S. household food security survey module (Bickel et al., 2000), and the Center for Epidemiologic Studies Depression Scale (Eaton, Smith, Ybarra, Muntaner, & Tien, 2004). There were also questions related to participant characteristics, including diagnosis of PCOS, gender, age, diabetes mellitus status, and presence of infertility.

Those who returned the survey were considered to be participants (see Appendix G). If a signed consent form (see Appendix D) was provided, we used the patient's medical record. Medical record data included height, weight, hemoglobin A1c, fasting blood glucose, total, HDL, and LDL cholesterol, diagnosis of PCOS, presence of infertility, and any medical record of depression. Any missing data were noted. Only parameters ordered by the physician and deemed clinically necessary during the clinic visit were obtained.

Participants were asked to answer questions about their readiness to garden vegetables and/or fruit. The participants in the maintenance and action stages of change

were considered “gardens vegetables” and/or “gardens fruit” if participants answered that they were already growing the vegetable and/or fruit, or if they were currently trying to grow vegetables and/or fruit for their household. Participants that were planning, were thinking about, or were not thinking about gardening vegetables and/or fruit for their household were considered “does not garden vegetables” and/or “does not garden fruit”.

Participants in the high food security category (food secure) were also referred to as fully food secure, whereas participants that have marginal (food secure), low (food insecure), or very low (food insecure) food security were included as not fully food secure.

BMI^s (kg/m^2) were calculated from participants’ height and weight and were used to categorize participants into different ranges. Participants with a BMI between 25 and 29.9 were considered overweight and participants with a BMI of 30 or higher were considered obese. Participants’ county of residence was categorized as distressed or not distressed based upon the criteria set by the Appalachian Regional Commission (ARC). Distressed counties of the Appalachian Ohio region included: Adams, Athens, Meigs, Morgan, Nobel, Pike, and Vinton (ARC, 2014).

Research Question and Statistical Analysis

Quantitative data was tabulated and analyzed using SPSS version 18 (SPSS: An IBM Company, Chicago, IL) software. During tabulation, subject numbers were assigned to all participants. Surveys were tabulated and scored using standardized procedures for each instrument used within the survey. Demographics were computed to describe the sample. To assess the relationship of food insecurity to health parameters in adult

women with PCOS, Kendall's Tau-*b* and Pearson's *r* correlations were used (two-sided). Participants were also stratified as to food security status (food secure vs. food insecure); *p* < .05 was utilized to identify significance. The specific research question and statistical analysis used for this study are listed in Table 6.

Table 6

Research Question and Statistical Analysis

Research question	Statistical analysis
What is the relationship of food insecurity to health parameters in adult women with PCOS?	Kendall's Tau- <i>b</i> correlation Pearson's <i>r</i>

Chapter 4: Results

Characteristics of Participants

Surveys were sent to 269 individuals diagnosed with PCOS. Fifty-four (20.1%) individuals responded to the survey. Participants ($n = 54$) were 32 ± 9 years and primarily White/Non-Hispanic ($n = 49$, 90.7%). Demographic characteristics and diagnoses of the study participants are summarized (see Table 7).

Table 7

Demographic Characteristics and Additional Diagnoses of Adult Females with PCOS Living in Rural Appalachian Ohio

Characteristic	Frequency (<i>n</i>)	Percentage (%)
Race (<i>n</i> = 54)		
American Indian or Native Alaskan Asian	1	1.9
Native Black or African American	1	1.9
Multiracial	3	5.6
White	49	90.7
Education (<i>n</i> = 54)		
Less than high school	1	1.9
High school graduate	10	18.5
Some college or higher	43	79.6
Health insurance (<i>n</i> = 53)		
No health insurance coverage self-pay	4	7.4
Medicaid or Medicare only	5	9.3
Private insurance only	44	81.5

Table 7 (continued)

Characteristic	Frequency (<i>n</i>)	Percentage (%)
Marital status (<i>n</i> = 54)		
Married	32	59.3
Single/never married	15	27.8
Divorced	5	9.3
Separated	2	3.7
Employment (<i>n</i> = 54)		
Working full time	26	48.1
Working part time	8	14.8
Unemployed	6	11.1
Student (full/part-time)	7	13.0
Social security disability	1	1.9
Annual income (<i>n</i> = 54)		
\$0 - \$10,000	9	16.7
\$10,001 - \$20,000	6	11.1
\$20,001 - \$30,000	9	16.7
\$30,001 - \$40,000	6	11.1
Over \$40,000	21	38.9
County (<i>n</i> = 40)		
Distressed	32	80.0
Non-distressed	8	20.0
Smoking (<i>n</i> = 54)		
Does not smoke cigarettes/tobacco	46	85.2
Smokes cigarettes/tobacco	8	14.8

Table 7 (continued)

Characteristic	Frequency (<i>n</i>)	Percentage (%)
Gardening practices (<i>n</i> = 54)		
Gardens vegetables	21	38.9
Does not garden vegetables	33	61.1
Gardens fruit	15	27.8
Does not garden fruit	39	72.2
Self-reported diabetes status (<i>n</i> = 54)		
Type 1	7	13.0
Type 2	3	5.6
Does not have diabetes	44	81.4
Self-reported fertility status (<i>n</i> = 54)		
Infertile	22	40.7
Fertile	32	59.3

Household Adult Food Security Status

Of the 54 study participants, 42 (77.8%) women were living in food secure households, and 12 (22.2%) were living in food insecure households. The household adult food security status of the women who participated in the study is summarized below (see Table 8). Overall, 35 (64.8%) were fully food secure, while 19 (35.2%) were not fully food secure and had experienced some degree of food insecurity during the previous 12 months.

Table 8

Household Adult Food Security Status of Adult Females with PCOS Living in Rural Appalachian Ohio (n = 54)

USDA household food security category	Frequency (n)	Percentage (%)
High food security ^a	35	64.8
Marginal food security ^b	7	13.0
Low food security ^b	9	16.6
Very low food security ^b	3	5.6

^aFully food secure.

^bNot fully food secure.

Anthropometrics

Of those assenting to review of their medical record ($n = 47$), 39 had complete anthropometric data. Considering those ($n = 39$), BMI ranged from $20.5\text{kg}/\text{m}^2$ to $58.1\text{kg}/\text{m}^2$ and was $34.5 \pm 8.8\text{kg}/\text{m}^2$, overall. Of the 39 participants with BMI data, 7 (17.9%) were overweight, and 26 (66.7%) were obese.

Biochemical Indicators for Blood Glucose and Lipid Panel

Additional laboratory tests were not obtained for the purpose of this study. Of those providing access to their medical records ($n = 47$), 20 had glucose and/or lipid tests available. Glucose and lipid panel values of study participants are summarized (see Table 9).

Table 9

Biochemical Indicators for Blood Glucose and Lipid Panel of Adult Females with PCOS Living in Rural Appalachian Ohio

Lab value	n	Mean	SD
Cholesterol			
Total (mg/dL)	11	199.2	37.3
LDL (mg/dL)	10	114.5	38.4
HDL (mg/dL)	11	51.9	10.2
TG (mg/dL)	10	160.6	60.5
Fasting BG (mg/dL)	20	98.0	25.5
HbA1c (%)	11	6.6	1.9

Depression Scale Score

The depression status of participants, based on responses to depression scale portion of the survey are given (see Table 10). Of the 54 participants, 27 (50.0%) had some degree of depression.

Table 10

Adult Females with PCOS Living in Rural Appalachian Ohio Depression Category

Category	n	Percentage (%)
No depression	27	50.0
Degree of depression	27	50.0
Mild to moderate depression	9	16.7
Major depression	18	33.3

Produce Intake

Produce intake of the study participants is summarized (see Table 11).

Table 11

Produce Intake of Adult Females with PCOS Living in Rural Appalachian Ohio

Indicator	n	Mean	SD
Daily vegetable servings	52	2.64	1.82
Daily fruit servings	52	1.86	0.86
<u>Daily total fruit and vegetable servings</u>	<u>52</u>	<u>4.4</u>	<u>2.26</u>

Produce Intake Related Behaviors

The psychosocial indicators (ranging from 0.0 [low] to 1.0 [high]) related to fruit and vegetable intake by study participants are shown (see Table 12).

Table 12

Produce Intake and Related Behaviors of Adult Females with PCOS Living in Rural Appalachian Ohio

Construct/domain	<i>n</i>	Mean	<i>SD</i>
Perceived benefit score	54	0.9	0.2
Perceived control score	54	0.8	0.3
Self-efficacy score ^a	54	0.9	0.1
Perceived diet quality score	54	0.5	0.2
Readiness to eat more vegetables score	54	0.7	0.3
Readiness to eat more fruit score	54	0.7	0.2
Enabling domain score ^a	54	0.9	0.1
Predisposing domain score	54	1.6	0.4
Change in intention domain score	54	1.9	0.6
Change in all domains score	54	4.5	0.8
7-item fruit and vegetable scale score	54	15.7	4.1

^aScoring of self-efficacy score = scoring of enabling domain score.

Relationship of Household Adult Food Security Status to Health Parameters

Household adult food security status was significantly ($p < .05$) related to smoking, daily vegetable intake, total daily produce intake, depression score, perceived benefit, predisposing domain, change in all domains, and 7-item fruit and vegetable scale score. The relationship of food security status to health parameters of participants is summarized (see Table 13).

Table 13

Relationship of Food Security Status to Health Parameters

Health parameter	Correlation coefficient ^{a,b}	<i>p</i> -value
Smokes cigarettes/tobacco	0.285 ^a	.026
Perceived general health	-0.130 ^a	.284
Vegetable servings/day	-0.337 ^b	.015
Fruit servings/day	-0.114 ^b	.420
Total produce/day	-0.315 ^b	.023
Depression	0.466 ^b	<.001
Perceived benefit	-0.293 ^b	.032
Perceived control	-0.181 ^b	.191
Predisposing domain	-0.278 ^b	.042
Self-efficacy	-0.013 ^b	.926
Enabling domain	-0.013 ^b	.926
Readiness to eat more fruit	-0.139 ^b	.315
Readiness to eat more vegetables	-.0187 ^b	.175
Perceived diet quality	-0.214 ^b	.120
Change in intention domain	-0.221 ^b	.108
Change in all domains	-0.280 ^b	.041
7-item fruit and vegetable scale score	-0.297 ^b	.029
BMI (kg/m ²)	-0.053 ^b	.748

Table 13 (continued)

Health parameter	Correlation coefficient ^{a,b}	<i>p</i> -value
Cholesterol		
Total (mg/dL)	0.007 ^b	.985
HDL (mg/dL)	0.303 ^b	.365
LDL (mg/dL)	-0.126 ^b	.729
TG (mg/dL)	0.186 ^b	.608
HbA1c (%)	0.334 ^b	.316
Fasting blood glucose (mg/dL)	0.264 ^b	.261

^aKendall's Tau-*b*.^bPearson's *r*.

Participants Meeting Daily Produce Intake Recommendations

For all participants with produce intake data ($n = 52$), 34 (65.4%), 37 (71.2%), and 36 (69.2%) met vegetable, fruit, and, total produce intake recommendations, respectively. Individuals who were fully food secure were more likely to meet vegetable and total produce intake recommendations. Participants' data on meeting daily recommendations for vegetable, fruit, and total produce intake by food security status is summarized (see Table 14).

Table 14

Adult Females with PCOS Living in Rural Appalachian Ohio Meeting the Recommended Daily Produce Intake (n = 52)

Indicator	Recommended daily intake n (%)		<i>p</i> -value ^d
	Met	Did not meet	
Daily vegetable intake ^a			
Fully food secure (n = 34)	27 (79.4)	7 (20.6)	.003
Not fully food secure (n = 18)	7 (38.9)	11 (61.1)	
Daily fruit intake ^b			
Fully food secure (n = 34)	26 (76.5)	8 (23.5)	.245
Not fully food secure (n = 18)	11 (61.1)	7 (38.9)	
Daily total produce intake ^c			
Fully food secure (n = 34)	27 (79.4)	7 (20.6)	.029
Not fully food secure (n = 18)	9 (50.0)	9 (50.0)	

^a≥ 2 servings (ChooseMyPlate.gov).

^b≥ 1.5 servings (ChooseMyPlate.gov).

^c≥ 3.5 servings (ChooseMyPlate.gov).

^dPearson's chi-squared.

Chapter 5: Discussion, Conclusions, and Recommendations

Overall, this study demonstrated that in the Appalachian region, food insecure females with PCOS had a greater degree of depression and poorer produce intakes and related behaviors when compared to their food secure counterparts with PCOS.

Characteristics of Participants

Demographic characteristics. Participants were 32 ± 9 years old and primarily White/Non-Hispanic with an education level of some college or higher, living in the Appalachian region. The majority of study participant had private insurance, were married, working full time, were nonsmokers, were living in a distressed county, and had an annual income over \$40,000. When asked about their gardening practices many women responded that they do not currently garden fruit and vegetables.

When relating our study to Ohio data we can compare the Appalachian regions to non-Appalachian regions, many of the Appalachian regions had a higher overall White/Non-Hispanic population, an overall lower percentage of individuals with a college degree or higher, and lower total household incomes (Pollard & Jacobsen, 2014). Also, Appalachian regions of Ohio have a lower percentage of people covered by health insurance (Pollard & Jacobsen, 2014). Data from the 2008-2012 American Community Survey (Pollard & Jacobsen, 2014) showed that in the Appalachian region of Ohio 91.8% of the total population was White/Non-Hispanic, in comparison to the non-Appalachian regions of Ohio the White/Non-Hispanic population was lower at 78.8%, similar results were found in our study. Pollard and Jacobsen (2014) also reported that in the Appalachian Ohio region 11.7% of the population had less than a high school

diploma and 17.4% had earned a bachelor's degree or higher. Higher levels of education were seen overall in the non-Appalachian regions of Ohio with only 8.7% of the population having less than a high school diploma and 28.9% having earned a bachelor's degree or higher. Additionally, the mean household income for Appalachian Ohio was \$54,528 compared to the non-Appalachian mean income in Ohio of \$65,996 (Pollard & Jacobsen, 2014). It was also noted in the same report that from 2008-2012, 18% of Appalachian's working-age population did not have health insurance. When compared to the national average, this percentage of health insurance coverage is lower, however it should be noted that this percentage does vary within Appalachian regions. In our study it was found that only 4% of the women had no health insurance. If participants were recruited from the free clinic this percentage would be expected to rise.

Diabetes and infertility. Approximately 50-70% of women with PCOS have some level of insulin resistance and impaired glucose tolerance (Diamanti-Kandarakis, 2006; Lorenz & Wild, 2007) and although, type 2 diabetes is present in about 40% of women with this syndrome, the majority of our study participants did not self-report having diabetes (Diamanti-Kandarakis, 2006; Lorenz & Wild, 2007). Using a larger sample size, or having more blood glucose values available might raise this percentage. Many of the study participants could possibly be in the pre-diabetes range, and this was not measured in the present study.

Approximately 40% of the women from our study reported being diagnosed with infertility. Also, the women recruited for this project from the OB/GYN practice, where commonly the presenting complaint is infertility and PCOS is then diagnosed. The UMA

Diabetes Center is also a referral-based practice and a previous diagnosis of infertility was likely made. These results were expected, as many females with PCOS have fertility problems. PCOS is the primary cause of female infertility in the United States (Balen et al., 2006).

Household Adult Food Security Status

According to the USDA ERS, 85.7% of American households were food secure (high and marginal food security), and 14.3% of households were food insecure (low and very low food security) at least some time during the year 2013. Coleman-Jensen and colleagues (2014) found that of the 14.3% of households that were food insecure, 5.6% had very low food security. USDA ERS also found that when looking at the prevalence of food insecurity by state from 2010-2012, Ohio is seen to have food insecurity rates of 16.1%, which is above the average of the United States.

Research in the Appalachian region by Holben and Pheley (2006) found that 72.8% of their participants were living in food secure households, and 27.2% resided in households that were food insecure. Our study of women with PCOS in the Appalachian region found that 64.8% had high household food security (fully food secure), and 35.2% had marginal, low, or very low household food security (not fully food secure). Our study sample had 22.2% household food insecurity (low and very low food security), which is greater than both national and state averages, at the time of the study (Coleman-Jensen et al., 2014). A rural health study from Appalachian Ohio showed similar results. Pheley et al. (2002) found that 23% of respondents were food insecure. In both our current study and Pheley et al. (2002), the percentage of food insecurity in our region is

almost double the national average. This higher percent of food insecurity could be due to the fact that all participants of our study were women.

These higher rates of food insecurity found in the Appalachian region are especially evident among women who live in food insecure households when compared to men. It has been shown that women who live in low-income households and rural areas (e.g., Appalachian Ohio) may have a higher tendency to fall into some degree of food insecurity (Gorimani & Holben, 1999). It has been found that women will compromise their own needs to provide for other family members, especially their children. A study by Nord et al. (2009) showed that single mothers experience some of the highest rates of food insecurity in the United States. An earlier study by Radimer et al. (1992) found that mothers in Appalachian counties restricted their personal food intake if the available household food was low in order to ensure that her child or children would have enough.

In our study of food security in females with PCOS living in the Appalachian region, we did not ask specific questions about mothers and their children concerning the child's food intake. We used only 10 of the 18 questions from the original survey model concerning adult household food security. Our study was examining women's health and food security status and questions including child food security were omitted.

Food insecurity and PCOS. To the best of our knowledge, no prior studies have examined food insecurity and the development and care of PCOS in the Appalachian region. A similar study examined the association of PCOS with the socioeconomic status among women. The study explored the role of environment on the development of

PCOS and the results indicated that women who experienced low childhood socioeconomic status were at an increased risk of developing PCOS (Merkin et al., 2011). Another study examined the incidence of PCOS in rural young females with menstrual irregularities in India, and this revealed that PCOS was common in low socioeconomic, rural young women (Chhabra et al., 2010).

Although several studies have examined food security and women's health in the Appalachian region, our study was the first in this region to address food security and PCOS. The majority of the women in our study reported high food security while 35% were not fully food secure. Our study was made up of a smaller sample size. If a larger sample size was used a higher percentage of not fully food secure women may have been found.

Food insecurity and diabetes. Studies, including one in the Appalachian region of Ohio (Holben & Pheley 2006), have found that people with diabetes are more likely to reside in food-insecure households than in food-secure households. Lyles and colleagues conducted a study in 2013, participants included those that were low-income and had diabetes. In this study it was observed that the low-income participants had lower self-efficacy and fruit and vegetable intakes when compared to the non-low-income participants (Lyles et al., 2013). In our study household adult food security status was not significantly related to diabetes, HbA1c, or fasting blood glucose. Different results, possibly showing significance, could be expected if more participants of our study had available lab values, or if a larger sample size was used.

Anthropometrics and Biochemical Indicators for Blood Glucose and Lipid Panel

Several researchers have found that overweight and obese women have higher risks for adverse health outcomes including mortality, coronary heart disease, diabetes, and hypertension (Flegal et al., 2012; McTigue et al., 2006). Among women in the United States, several studies have proven obesity to be a fast-growing health problem (Bove & Olson, 2006). This is concerning due to the fact that in recent years the rates of obesity among women have increased drastically, and over 35% of women aged 20-74 years are obese (Flegal et al., 2012).

It is estimated that about 50% of women with PCOS are overweight or obese (Deepika et al., 2011). According to several studies, women with PCOS are at an increased risk for many health problems, including insulin resistance and weight gain. (Knowler et al., 2002; Lorenz & Wild, 2007). Of our 39 participants with BMI data, 85% were either classified as overweight or obese. High rates of obesity were seen in these women, with two-thirds falling into the obese category.

Holben (2010), in the AND position paper, reported that food insecurity is associated with overweight, obesity, and diabetes. A study conducted by Holben and Pheley (2006) in rural Appalachian Ohio, found that participants from food-insecure households, especially among women, had a greater BMI when compared to their food-secure counterparts and that obesity was also greater among study participants from food-insecure households (48.1%) when compared to participants from food-secure households (35.1%). Studies suggest that in relation to a lack of money, food insecure individuals may gain weight due to not having the funds to purchase healthy foods (e.g.,

fruits and vegetables), tending to lead to the consumption of greater energy-dense but less expensive foods (e.g., soda), a result of fewer nutrients in the diet (Darmon & Drewnowski, 2006; Drewnowski & Specter, 2004). Several other studies have found that overweight and obesity were more prevalent among women who were food-insecure when compared to the food-secure women at the national, state, and county levels (Adams et al., 2003; Basiotis & Lino, 2003; Olson, 1999; Townsend et al., 2001).

A study published in the *Journal of Health Care for the Poor and Underserved*, found that food-insecure participants reported poorer adherence to blood glucose monitoring than food-secure individuals (Seligman et al., 2007). It was concluded from this study that food insecurity is a barrier to proper diabetes self-management (Seligman et al., 2007).

Although close to the cut-off numbers, the mean total and HDL cholesterol and fasting blood glucose levels were in the desirable ranges according to the American Heart Association. The mean LDL cholesterol, triglyceride level, and HbA1c were higher than recommended and fell in the range that would put an individual at risk for heart disease and/or diabetes (American Heart Association, 2014). Of the 11 women with available HbA1c values the mean was 6.6%. This is above the range of 5.7% to 6.4% and puts an individual at risk for developing diabetes (American Heart Association, 2014). Diabetes is diagnosed with a HbA1c of 6.5% or higher (American Heart Association, 2014).

Depression Scale Score

Responses from participants to the depression scale portion of our survey revealed that half of the women had some degree of depression. It is common to see depression in

females with PCOS as will be further discussed in the subsequent sections. This depression could be due to the health complications that are associated with this syndrome, including weight gain, insulin resistance, and infertility.

Household adult food security status and depression. Hasin et al. (2005) examined depression in women aged 18-44 years and found 12 to 14% of them had major depression. Several studies have shown that females with PCOS are at higher risk of developing depressive symptoms than healthy women without PCOS. Based on participant responses to the depression portion of our survey, half of the women were seen to have some degree of depression, with 33% having major depression. Our findings indicated a strong relationship of food security status to depression among participants. To our knowledge, no studies have examined females with PCOS in the Appalachian region and depression. However, a similar study showed that people from food-insecure households also have significantly higher rates of major depression and anxiety (Bickel et al., 1998). Comparable to our present study, other studies have examined the association of household food insecurity and adult health status, finding that food insecurity was associated with both poorer self-rated health status and lower scores on physical and mental health tests (Stuff et al., 2004).

In the Appalachian region of Ohio, this inverse relationship between food insecurity and health status has been shown in several studies (Holben et al., 2004; Holben & Pheley, 2006; Pheley et al., 2002; Walker et al., 2007). Pheley et al. (2002) found this inverse relationship when they examined specifically the relationship of food insecurity and mental health.

In a study using participants from rural Appalachian Ohio, food security and perceptions of health status were measured. Pheley et al. (2002) found that food-insecure individuals reported poorer functional health status in comparison to the food-secure group. Another study conducted by Olson et al. (2004) with the participation of women from rural low-income families with children found an association between food insecurity and depressive symptoms. In this sample, 60% of the women were found to have clinical depression (Olson et al., 2004). This is slightly higher than the 50% in our current study. In a larger sample size, or in a sample size including only the not-fully food secure women, similar, if not higher results could be expected in not-fully food secure females with PCOS. Our study has built a base for future research to build upon researching the connection between PCOS, food security, and depression.

Produce Intake and Related Behaviors

Of the study participants that provided produce intake data, 65% of them met the recommendations for daily vegetable intake of 2-2.5 cups/day, while 71% of the women met the recommendations for daily fruit intake of 1.5-2 cups/day, and 69% of the women met the recommendations for daily total produce intake (ChooseMyPlate.gov).

The majority of women that participated in our study shared that they were in the action or maintenance stages of change for readiness to eat more vegetables and readiness to eat more fruit. According to the stages of change model, participants at the action stage are currently trying to make the particular change, and participants at the maintenance stage have been sustaining the change for a longer period of time.

In our sample the majority of women obtained high perceived benefit, perceived control, and self-efficacy scores, although the mean score for perceived diet quality was lower. Overall, participants shared they believe they could improve their produce intake behaviors, shown by the high mean scores for predisposing domain and enabling domain. However, when answering questions about intentions of changing a specific behavior, change in intention domain scores were low. This change in intention domain scores included participants' scores for perceived diet quality, which as previously noted were low.

The women in our study showed overall positive beliefs and self-confidence when answering questions related to their produce intake behaviors. This attitude about produce intake is essential in order to reach the desirable health effects that are seen with consuming more fruit and vegetables. These positive attitudes and beliefs of the women may also help increase the entire family's fruit and vegetable intake. Findings from a study conducted in Appalachian Ohio (Denham, 2004) suggest that women are the gatekeepers of health information in the family and interventions that target women can be beneficial to the overall health of the family.

Relationship of Household Adult Food Security Status to Health Parameters

Overall, food insecurity was significantly related to smoking, daily vegetable intake, total daily produce intake, depression score, perceived benefit, predisposing domain, change in all domains, and 7-item fruit and vegetable scale score. In fact, participants who were not fully food secure were less likely to meet recommended

vegetable and total produce intake. Our results on produce intake and related behaviors are similar to other studies examining food security in the Appalachian region.

Researchers have found food security is associated with greater fruit and vegetable intake. In a study conducted by Kirkpatrick and Tarasuk (2008) it was revealed that food insecurity is associated with consumption of a less healthy diet and overall lower nutrient intakes. Studies from the Appalachian region have found that food insecure women have poorer produce intake and that food insecurity is associated with poorer perceived diet quality (Kropf et al., 2007). In a similar study, Vardell (2010) found that household food insecurity among low-income households was related to poorer produce intake related behaviors when compared to their food secure counterparts.

Several studies, including one from Pheley et al. (2002), reported an inverse relationship between food insecurity and an individual's health status. Holben (2010) reported that negative outcomes have been associated with food insecurity, including inadequate intake of key nutrients, poor health, an increased risk of developing various chronic diseases, poor disease management, and poor psychological and cognitive functioning and that food insecurity is also associated with overweight, obesity, and diabetes.

Participants Meeting Daily Produce Intake Recommendations

When looking at women meeting the recommended daily produce intake by food security status we found that fully food secure women were more likely to meet the recommended intakes. Significant difference were found when comparing the fully food secure participants to their not fully food secure counterparts for daily vegetable intake

and daily total produce intake. Similar studies have shown that food insecure individuals have an association with other unhealthy dietary behaviors and that food secure participants are seen to have a greater fruit, vegetable, and total produce intake (Kendall et al., 1996; Kirkpatrick & Tarasuk, 2008). Hazen et al. (2008) found that food insecurity is inversely associated with perceived diet quality and vegetable intake among impoverished women from rural Appalachian, Ohio. This could be due to individuals residing in a food insecure household having an overall lower income when compared to non-Appalachian regions, resulting in less money for groceries such as fresh produce. Many food insecure households might buy more affordable energy-dense, less nutritious food sources.

Limitations, Conclusions, and Recommendations

Overall, this study showed that in females with PCOS, the food insecure participants when compared to the food secure participants had greater depression and poorer produce intakes and related behaviors.

Despite several limitations of this study, it is the first on PCOS and food security and provides an important foundation for further research. The main limitation of our pilot study was that we had a small convenience sample. Although a total of 54 women returned their surveys, not all included the signed consent to access their medical records, potentially influencing our study results. Another limitation was that several women did not have available recent lab values to add to our biochemical data analysis. Also, we did not include pregnancy as an exclusion criteria, and this could have skewed the BMI data.

If we included participants from the free clinic we would have also seen different

results, and higher rates of food insecurity possibly would have been revealed. Our convenience sample did not match the demographic of rural Appalachia, and the level of education seen in our participants was higher than expected. Being a mailed paper survey, our study would have also excluded any participants who were unable to read.

Being the first to examine food security and PCOS in the Appalachian region, no other studies were available for comparison. If time and money had not been a concern, the recruiting process might have attracted more participants from the Appalachian area. Using the survey through the mail gave us a total response rate of 20%. If the survey was e-mailed, more participants might have returned responses. Also, if it had been possible to meet with participants during their clinic visits—without disrupting the clinics' normal functions—we would have conducted the surveys on site at the Diabetes and Endocrine Center or River Rose Obstetrics and Gynecology, i.e., we could have met with participants individually to go through the survey. Some surveys were incomplete or did not have the signed consent form. We received enough funding to give participants \$2. The response rate might have been higher if the incentive had been greater, and if the participants had received the money after completing and returning the survey. If additional clinics in the Appalachian region had been used, a greater response rate probably would have been seen and might have yielded different results. Despite these limitations, this study is important because it provides a foundation for future research on PCOS and food insecurity.

Our study included self-reported data. The survey we used has been found to accurately portray food security status, but food security status might have been reported

inaccurately for reasons we could not control. In response to our survey questions, the women in our study might have given biased answers, might not have known the answers, or might have given incorrect answers for various personal reasons.

Although medical records were examined for some of our participants, others did not provide consent for us to access their medical records. No differences were seen by food security status when comparing BMI, blood glucose, and lipid panels. However, a greater sample size might have yielded different results. Our study showed that depression in women with PCOS was significantly related to food security status; similar results could be seen in a larger sample size. To gain more meaningful information, future studies should further examine food insecure females with PCOS and the specific causes of their depression using open-ended questions to gather more detail. The findings from our study could be useful for health professionals when diagnosing or talking with patients that have PCOS knowing that depression could be present or develop later.

The fully food secure women in our study were more likely to meet the recommended vegetable and total produce intake. It would be interesting in future studies to explore what type of produce these women are consuming, whether it is fresh, frozen, or canned. Also, the women might have under- or over reported their fruit and vegetable intakes. It would be ideal if the females were instructed on what a serving size would be to gain the most accurate results.

In the near future, there must be more research on PCOS, related health factors, and food security. Ideally, an education program or medical cohort, offering support and

information for females with PCOS, could be created. PCOS by itself is hard to diagnose and many females with this syndrome might not understand the related health complications such as high blood glucose, infertility, and weight gain that could possibly be causing depression. This program could be a support group with an education component that could help the women answer any uncertainties they might have about the syndrome or accompanying results. Also, this group should be led by a nutrition expert to share how increased produce intake and a healthy diet can prevent the onset of many chronic diseases.

The class should also bring in experts to talk about other issues such as depression that could be possibly occurring, and how this can affect women in their daily activities. Another component to this class could be learning how to garden. If space were available, it would be beneficial for both mental and physical health to share a community garden with the group. To benefit study participants and further examine PCOS and food security status in the Appalachian region, a similar education component could be added to future research.

Future research on PCOS is needed to explore and gain a greater insight into the syndrome and the relationship it has to food security status, produce intake, depression, and other variables.

References

- Adams, E. J., Grummer-Strawn, L., & Chavez G., Food insecurity is associated with increased risk of obesity in California women. *Journal of Nutrition*, 133, 1070-1074.
- American Heart Association (2014). *Numbers that count for a healthy heart*. Retrieved October 11, 2014, from
http://www.heart.org/HEARTORG/Conditions/More/ToolsForYourHeartHealth/Numbers-That-Count-for-a-Healthy-Heart_UCM_305427_Article.jsp
- American Society for Reproductive Medicine (ASRM). (2012). *Hirsutism and polycystic ovary syndrome (PCOS): A guide for patients*. Retrieved from the American Society for Reproductive Medicine website:
http://www.asrm.org/uploadedFiles/ASRM_Content/Resources/Patient_Resource_Fact_Sheets_and_Info_Booklets/hirsutismPCOS.pdf
- Anderson, S. A. (1990). Core indicators of nutritional state for difficult-to-sample populations. *Journal of Nutrition*, 120(Suppl 11), 1559-1600.
- Appalachian Regional Commission (n.d.). *County economic status and number of distressed areas in Appalachian Ohio, fiscal year 2015*. Retrieved from
http://www.arc.gov/images/appregion/economic_statusFY2015/CountyEconomic_StatusandDistressAreasFY2015Ohio.pdf
- Azziz, R. (2005). Diagnosis of polycystic ovarian syndrome: The Rotterdam criteria are premature. *Journal of Clinical Endocrinology & Metabolism*, 91, 781-785.
doi:10.1210/jc.2005-2153

- Balen, A. H., Dresner, M., Scott, E. M., & Drife, J. O. (2006). Should obese women with polycystic ovary syndrome receive treatment for infertility?. *British Medical Journal*, 332, 434-435.
- Basiotis, P. P., & Lino, M. (2003). Food insufficiency and prevalence of overweight among adult women. *Family Economics & Nutrition Review*, 15(2), 55-57.
- Behringer, B., & Friedell, G. H. (2006). Appalachia: Where place matters in health. *Preventing Chronic Disease*, 3(4). Retrieved October 11, 2014, from the Centers for Disease Control and Prevention website:
http://www.cdc.gov/pcd/issues/2006/oct/06_0067.htm
- Bickel, G., Carlson, S., & Nord, M. (1998). *Household food security in the United States: 1995-1998* (Advance Report). Washington, DC: U.S. Department of Agriculture, Food and Nutrition Service.
- Bickel, G., Nord, M., Price, C., Hamilton, W., & Cook, J. (2000). *Guide to measuring household food security*. Washington DC: U.S. Department of Agriculture, Food and Nutrition Service.
- Biros, M. H., Hoffman, P. L., & Resch, K. (2005). The prevalence and perceived health consequences of hunger in emergency department patient populations. *Academic Emergency Medicine*, 12(4), 310-317.
- Bove, C., & Olson, C. (2006). Obesity in low-income rural women: Qualitative insights about physical activity and eating patterns. *Women & Health*, 44(1), 57-78.

- Briefel, R. R., & Woteki, C. E. (1992). Development of the food sufficiency questions for the Third National Health and Nutrition Examination Survey. *Journal of Nutrition Education*, 24(Suppl 1), 24S-28S.
- Chhabra, S., & Venkatraman, S. (2010). Menstrual dysfunction in rural young women and the presence of polycystic ovarian syndrome. *Journal of Obstetrics and Gynecology*, 30(1), 41-5. doi:10.3109/01443610903294154
- ChooseMyPlate.gov (n.d.). Available from <http://choosemyplate.gov>
- Christopher, A. (2004). Polycystic ovary syndrome: Common but unrecognized threat. *DOC News*, 1(2), 13-14.
- Cinar, N., Kizilarslanoglu, M. C., Harmanci, A., Aksoy, D. Y., Bozdag, G., Demir, B., & Yildiz, B., O. (2011). Depression, anxiety and cardio metabolic risk in polycystic ovary syndrome. *Human Reproduction* (Oxford, England), 26(12), 3339. doi:10.1093/humrep/der338
- Coleman-Jensen, A., Gregory, C., & Singh, A. (2014, September). *Household food security in the United States in 2013* (Economic Research Report No. 173). Retrieved from the U.S. Department of Agriculture, Economic Research Service website: <http://www.ers.usda.gov/media/1565415/err173.pdf>
- Coleman-Jensen, A., Nord, M., Andrews, M., & Carlson, S. (2012, September). *Household food security in the United States in 2011* (Economic Research Report No. 141). Retrieved from the U.S. Department of Agriculture, Economic Research Service website: <http://www.ers.usda.gov/media/884525/err141.pdf>

- Cristofar, S., & Basiotis, P. (1992). Dietary intakes and selected characteristics of women ages 19-50 years and their children ages 1-5 years by perception of food insufficiency. *Journal of Nutrition Education*, 24, 53-58.
- Darmon, A. E., & Drewnowski, A. (2006). Low-cost diets: More energy, fewer nutrients. *European Journal of Clinical Nutrition*, 60, 434-436.
- Deepika, L. M., Ranjith, K. K., Maruthi, G. G., & Jahan, P. P. (2011). Polycystic ovary syndrome: A package of complex diseases. *IUP Journal of Genetics & Evolution*, 4(1), 54-59.
- DeNavas-Walt, C., Proctor, B. D., & Smith, J. C. (2009). Income, poverty and health insurance coverage in the United States: 2008. In *Current population reports* (pp. 60-235). Washington, DC: U.S. Census Bureau.
- Denham, S. (2004). Providing health education to Appalachia populations. *Holistic Nursing Practice*, 18(6), 293-301.
- Diamanti-Kandarakis, E. (2006). Insulin resistance in PCOS. *Endocrine*, 30(1), 13-17.
- Dietz, W. (1995). Does hunger cause obesity? *Pediatrics*, 95(5), 766-767.
- Drewnowski, A., & Specter, S. E. (2004). Poverty and obesity: The role of energy density and energy costs. *American Journal of Clinical Nutrition*, 79(1), 6-16.
- Eaton, W. W., Smith, C., Ybarra, M., Muntaner, C., & Tien, A. (2004). Center for Epidemiologic Studies Depression Scale: Review and revision. In M. E. Maruish (Ed.). *The use of psychological testing for treatment planning and outcomes assessment* (Vol. 3, 3rd ed., pp. 363-377). Mahwah, NJ: Lawrence Erlbaum.

- Ehrmann, D. A., Barnes, R. B., Rosenfield, R. L., Cavaghan, M. K., & Imperial, J. (1999). Prevalence of impaired glucose tolerance and diabetes in women with polycystic ovary syndrome. *Diabetes Care*, 22, 141-146.
- Fagerberg, B., Bondjers, L., & Nilsson, P. (2004). Low birth weight in combination with catch-up growth predicts the occurrence of the metabolic syndrome in men at late middle age: The atherosclerosis and insulin resistance study. *Journal of Internal Medicine*, 256(3), 254-259.
- Fenton, C., Hatfield, J., & McIntyre, L. (2012). A qualitative pilot study of food insecurity among Maasai women in Tanzania. *Pan African Medical Journal*, 12(81), 1-7.
- Fitchen, J. (1998). Hunger, malnutrition, and poverty in the contemporary United States: Some observations on their social and cultural context. *Food Foodways*, 2, 309-333.
- Flegal, K. M., Carroll, M. D., Kit, B. K., & Ogden, C. L. (2012). Prevalence of obesity and trends in the distribution of body mass index among U.S. adults, 1999-2010. *JAMA: Journal of the American Medical Association*, 307(5), 491-497.
- Genkinger, J. M., Platz, E. A., Hoffman, S. C., Comstock, G. W., & Helzlsouer, K. J. (2004). Fruit, vegetable, and antioxidant intake and all-cause cancer, and cardiovascular disease mortality in a community-dwelling population in Washington County, MD: *American Journal of Epidemiology*, 160(12), 1223-1233. doi:10.1093/aje/kwh339

- Gorimani, E. T., & Holben, D. H. (1999). WIC program participants in rural Appalachia may be prone to food insecurity: A pilot study [Abstract]. *Journal of the American Dietetic Association, 99*(9), A25.
- Gucciardi, E., Vogt, J., DeMelo, M., & Stewart, D. (2009). Exploration of the relationship between household food insecurity and diabetes in Canada. *Diabetes Care, 32*(12), 2218-2224. doi:10.2337/dc09-0823
- Harrison, G., DiSogra, C., & Brown, E. (2004). Household food insecurity predicts poor disease management in adults with chronic disease [Abstract]. *Federation of American Societies for Experimental Biology Journal, 18*, A489.
- Hasin, D. S., Goodwin, R. D., Stinson, F. S., & Grant, B. F. (2005). Epidemiology of major depressive disorder: Results from the National Epidemiologic Survey on Alcoholism and Related Conditions. *Archives of General Psychiatry, 62*, 1097-1106.
- Hazen, C., Holben, D., Holcomb, J., & Struble, C. (2008). Food insecurity is inversely associated with perceived diet quality and vegetable intake among impoverished women from rural Appalachian Ohio [Abstract]. *Federation of American Societies for Experimental Biology Journal, 22*(5), A5090.
- He, F. J., Nowson, C. A., & MacGregor, G. A. (2006). Fruit and vegetable consumption and stroke: Meta-analysis of cohort studies. *Lancet, 367*(9507), 320-326.
- Holben, D. H. (2010). Position of the American Dietetic Association: Food insecurity in the United States. *Journal of the American Dietetic Association, 110*(9), 1368-1377.

- Holben, D. H., McClincy, M. C., Holcomb, J. P., Jr., Dean, K. L., & Walker, C. E. (2004). Food security status of households in Appalachian Ohio with children in head start. *Journal of the American Dietetic Association, 104*(2), 238-241.
- Holben, D. H., & Pheley, A. (2006). Diabetes risk and obesity in food-insecure households in rural Appalachian Ohio [Abstract]. *Preventing Chronic Disease, 3*(3), A82.
- Hudecova, M., Holte, J., Olovsson, M., Larsson, A., Berne, C., & Poromaa, I. (2011). Diabetes and impaired glucose tolerance in patients with polycystic ovary syndrome—A long term follow-up. *Human reproduction* (Oxford, England), 26(6), 1462-1468. doi:10.1093/humrep/der065
- Kaiser, L. L., & Allen, L. H. (2008). Position of the American Dietetic Association: Nutrition and lifestyle for a healthy pregnancy outcome. *Journal of the American Dietetic Association, 108*, 553-561.
- 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*(7), 924-929.
- Keegan, A., Liao, L. M., & Boyle, M. (2003). Hirsutism: A psychological analysis. *Journal of Health Psychology, 8*, 327-345.
- Kendall, 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), 1019-1026.

- Kevesdy, A., Holben, D., & Holcomb, J. (2008). Food insecurity and poor produce intake are associated with food bank use in British Columbia, Canada [Abstract]. *Federation of American Societies for Experimental Biology Journal*, 22(5), A5233.
- Kirkpatrick, S. I., & Tarasuk, V. (2008). Food insecurity is associated with nutrient inadequacies among Canadian adults and adolescents. *Journal of Nutrition*, 138(3), 604-612.
- Knowler, W. C., Barrett-Connor, E., Fowler, S. E., Hamman, R. F., Lachin, J. M., Walker, E. A., & Nathan, D. M. (2002). Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *New England Journal of Medicine*, 346, 343-403.
- Kropf, M. L., Holben, D. H., Holcomb, J. P., Jr., & Anderson, H. (2007). Food security status and produce intake and behaviors of special supplemental nutrition program for women, infants, and children and farmers' market nutrition program participants. *Journal of the American Dietetic Association*, 107(11), 1903-1908.
- Laraia, B., Siega-Riz, A., & Gungerson, C. (2010). Household food insecurity is associated with self-reported pregravid weight status, gestational weight gain and pregnancy complications. *Journal of the American Dietetic Association*, 110(5), 692-701. doi:10.1016/j.jada.2010.02.014
- Legro, R. (2007). Pregnancy considerations in women with polycystic ovary syndrome. *Clinical Obstetrics and Gynecology*, 50(1), 295-304.

- Lorenz, L., & Wild, R. A. (2007). Polycystic ovarian syndrome: An evidence-based approach to evaluation and management of diabetes and cardiovascular risks for today's clinician. *Clinical Obstetrics and Gynecology*, 50(1), 226-243.
- Lyles, C. R., Wolf, M. S., Schillinger, D., Davis, T. C., DeWalt, D., Dahlke, A. R., & Seligman, H. K. (2013). Food insecurity in relation to changes in hemoglobin A1c, self-efficacy, and fruit/vegetable intake during a diabetes educational intervention. *Diabetes Care*, 36(6), 1448-1453. doi:10.2337/dc12-1961
- Mansson, M., Holte, J., Landin-Wilhelmsen, K., Dahlgren, E., Johansson, A., & Landen, M. (2008). Women with polycystic ovary syndrome are often depressed or anxious: A case control study. *Psychoneuroendocrinology*, 33, 1132-1138.
- Margen, S., & Neuhauser, L.A. (1987). *Hunger surveys in the United States* [Report of a Workshop]. Berkeley, CA: University of California Berkeley, School of Public Health.
- 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.
- McCook, J. G., Reame, N. E., & Thatcher, S. S. (2005). Health-related quality of life issues in women with polycystic ovary syndrome. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*, 34, 12-20.
- McIntyre, L., Glanville, N. T., Officer, S., Anderson, B., Raine, K. D., & Dayle, J. B. (2002). Food insecurity of low-income lone mothers and their children in Atlantic Canada. *Canadian Journal of Public Health*, 93, 411-415.

- McIntyre, L., & Matheson, J. (2013). Women respondents report higher household food insecurity than do men in similar Canadian households. *Public Health Nutrition, 17*(1), 40-48.
- McTigue, K., Larson, J. C., Valoski, A., Burke, G., Kotchen, J., Lewis, C. E., . . . Kuller, L. (2006). Mortality and cardiac and vascular outcomes in extremely obese women. *JAMA: Journal of the American Medical Association, 296*(1), 79-86. doi:10.1001/jama.296.1.79
- Merkin, S., Azziz, R., Seeman, T., Calderon-Margalit, R., Daviglus, M., Kiefe, C., & Siscovick, D. (2011). Socioeconomic status and polycystic ovary syndrome. *Journal of Women's Health, 20*(3), 413-419. doi:10.1089/jwh.2010.2303
- Moran, L., Hutchison, S., Norman, R., & Teede, H. (2011). Lifestyle changes in women with polycystic ovary syndrome. *Cochrane Database System Review, No. 7*. doi:10.1002/14651858.CD007506.pub3
- National Institute of Mental Health. (2013, October 1). *The numbers count: Mental disorders in America*. Retrieved October 11, 2014, from the National Institute of Mental Health website: <http://www.lb7.uscourts.gov/documents/12-cv-1072url2.pdf>
- Nord, M., Andrews, M., & Carlson, S. (2008, November). *Household food security in the United States, 2007* (Economic Research Report No. 66). Retrieved from the U.S. Department of Agriculture, Economic Research Service website: <http://www.ers.usda.gov/media/189485/err66.pdf>

- Nord, M., & Coleman-Jensen, A. (2009). *Food security in the United States: History of the food security measurement project*. Retrieved from the U.S. Department of Agriculture, Economic Research Service website:
<http://www.ers.usda.gov/Briefing/FoodSecurity/history.htm#early>
- Olson, C. M. (1999). Nutrition and health outcomes associated with food insecurity and hunger. *Journal of Nutrition, 129*(2S Suppl), 521S-524S.
- Olson, C. M. (2005). Food insecurity in women: A recipe for unhealthy trade-offs. *Topics in Clinical Nutrition, 20*(4), 321-328.
- Olson, C. M. (2010). Food insecurity and maternal health during pregnancy. *Journal of the American Dietetic Association, 110*(5), 690-691.
doi:10.1016/j.jada.2010.02.001
- Olson, C. M., Anderson, K., Kiss, E., Lawrence, F. C., & Seiling, S. B. (2004). Factors protecting against and contributing to food insecurity among rural families. *Family Economics and Nutrition review, 16*(1), 12-20.
- Pheley, A. M., Holben, D. H., Graham, A. S., & Simpson, C. (2002). Food security and perceptions of health status: A preliminary study in rural Appalachia. *Journal of Rural Health, 18*(3), 447-454.
- Pollard, K., & Jacobsen, L. (2014). *The Appalachian region: A data overview from the 2008-1012 American Community Survey Chartbook*. Retrieved from the Appalachian Regional Commission website:
http://www.arc.gov/assets/research_reports/DataOverviewfrom2008-2012ACS.pdf

- Polivy, J. (1996). Psychological consequences of food restriction. *Journal of the American Dietetic Association, 96*(6), 589-592.
- Radimer, K. (2002). Measurement of household food security in the USA and other industrialized countries. *Public Health Nutrition, 5*(6A), 859-864.
doi:10.1079/PHN2002385
- Radimer, K. L., Olson, C. M., & Campbell, C. C. (1990). Development of indicators to assess hunger. *Journal of Nutrition, 120*(Suppl 11), 1544-1548.
- Radimer, K. L., Olson, C. M., Green J. C., Campbell, C. C., & Habicht, J. P. (1992). Understanding hunger and developing indicators to assess it in women and children. *Journal of Nutrition Education, 24*, 36S-44S.
- Rasgon, N. L., Rao, R. C., Hwang, S., Altshuler, L. L., Elman, S., Zuckerbrow-Miller, J., & Korenman, S. G. (2003). Depression in women with polycystic ovary syndrome: Clinical and biochemical correlates. *Journal of Affective Disorders, 74*, 299-304.
- Rose, D., & Oliveira, V. (1997). Nutrient intakes of individuals from food-insufficient households in the United States. *American Journal of Public Health, 87*(12), 1956-1961.
- Rosebloom, T., de Rooij, S., & Painter, R. (2006). The Dutch famine and its long-term consequences for adult health. *Early Human Development, 82*(8), 485-491.

- Rotterdam European Society of Human Reproduction and Embryology/American Society for Reproductive Medicine (ESHRE/ASRM) Sponsored PCOS Consensus Workshop Group. (2004). Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome. *Fertility and Sterility*, 81(1), 19-25. doi: 10.1016/j.fertnstert.2003.10.004
- Schmidt, J., Landin-Wilhelmsen, K., Brannstrom, M., & Dahlgren, E. (2011). Cardiovascular disease and risk factors in PCOS women of postmenopausal age: A 21-year controlled follow-up study. *Journal of Clinical Endocrinology and Metabolism*, 96(12), 3794-803. doi:10.1210/jc.2011-1677
- Seligman, H. K., Bindman, A. B., Vittinghoff, E., Kanaya, A. M., & Kushel, M. B. (2007). Food insecurity is associated with diabetes mellitus: Results from the National Health Examination and Nutrition Examination Survey (NHANES) 1999-2002. *Journal of General Internal Medicine*, 22(7), 1018-1023.
- Seligman, H. K., Davis, T., Schillinger, D., & Wolf, M. (2010). Food insecurity is associated with hypoglycemia and poor diabetes self-management in a low-income sample with diabetes. *Journal of Health Care for the Poor and Underserved*, 21(4), 1227-1233. doi:10.1353/hpu.2010.0921
- 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(1), 159-177.

- Siega-Riz, A., & King, J. (2009). Position of the American Dietetic Association and American Society for Nutrition: Obesity, reproduction, and pregnancy outcomes. *Journal of the American Dietetic Association, 109*(5), 918-927.
- Stein, K. (2006). Polycystic ovarian syndrome: What it is and why registered dietitians need to know. *Journal of the American Dietetic Association, 106*(11), 1738-1741.
doi:10.1016/j.jada.2006.09.004
- Stotland, N. E., Hopkins, L. M., & Caughey, A. B. (2004). Gestational weight gain, macrosomia, and risk of cesarean birth in nondiabetic nulliparas. *Obstetrics & Gynecology, 104*(4), 671-677.
- Stuff, J. E., Casey, P. H., Szeto, K. L., Gossett, J. M., Robbins, J. M., Simpson, P. M., . . . Bogle, M. L. (2004). Household food insecurity is associated with adult health status. *Journal of Nutrition, 134*(9), 2330-2335.
- Talbott, E., Zborowski, J., Rager, J., Kip, K., Xu, X., & Orchard, T. (2007). Polycystic ovarian syndrome (PCOS): A significant contributor to the overall burden of type 2 diabetes in women. *Journal of Women's Health, 16*(2), 191-197.
doi:10.1089/jwh.2006.0098
- Tarasuk, V. S., & Beaton, G. H. (1999). Women's dietary intakes in the context of household food insecurity. *Journal of Nutrition, 129*(3), 672-679.
- Tarasuk, V. S., McIntyre, L., & Li, J. (2007). Low-income women's dietary intakes are sensitive to the depletion of household resources in one month. *Journal of Nutrition, 137*(8), 1980-1987.

- Thorsdottir, I., Torfadottir, J. E., Birgisdottir, B. E., & Geirsson, R. T. (2002). Weight gain in women of normal weight before pregnancy: Complications in pregnancy or delivery and birth outcome. *Obstetrics & Gynecology*, 99(5), 799-806.
- Tomlinson, J., Millward, A., Stenhouse, E., & Pinkney, J. (2010). Type 2 diabetes and cardiovascular disease in polycystic ovary syndrome: What are the risks and can they be reduced? *Diabetic Medicine*, 27(5), 498-515. doi:10.1111/j.1464-5491.2010.02994.x
- Townsend, M. S., & Kaiser, L. L. (2005). Development of a tool to assess psychosocial indicators of fruit and vegetable intake for 2 federal programs. *Journal of Nutrition Education and Behavior*, 37(4), 170-184.
- Townsend, M. S., Kaiser, L. L., Allen, L. H., Joy, A. B., & Murphy, S. P. (2003). Selecting items for a food behavior checklist for a limited-resource audience. *Journal of Nutrition Education and Behavior*, 35(2), 69-77.
- Townsend, M. S., Peerson, J., Love, B., Achterberg, C., & Murphy, S. P. (2001). Food insecurity is positively related to overweight in women. *Journal of Nutrition*, 131, 1738-1745.
- Trivax, B., & Azziz, R. (2007). Diagnosis of polycystic ovary syndrome. *Clinical Obstetrics and Gynecology*, 50(1), 168-177.

- U.S. Department of Agriculture, Economic Research Service. (2014, September 3). *Definitions of food security*. Retrieved from the U.S. Department of Agriculture, Economic Research Service website: <http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/definitions-of-food-security.aspx#.VDTKoEv-Jg0>
- U.S. Department of Health and Human Services, National Institutes of Health, Eunice Kennedy Shriver National Institute of Child Health and Human Development. (2008). *Beyond infertility: Polycystic ovary syndrome (PCOS)*. Retrieved from http://permanent.access.gpo.gov/LPS113791/LPS113791/www.nichd.nih.gov/publications/pubs/upload/PCOS_booklet.pdf
- U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. (2014). *Nutrition and weight status*. Retrieved from the Healthy People website: <http://www.healthypeople.gov/2020/topics-objectives/topic/nutrition-and-weight-status/objectives>
- U.S. Department of Health and Human Services, Office on Women's Health. (2012). *Polycystic Ovary Syndrome (PCOS) fact sheet*. Retrieved from the Office on Women's Health website: <http://www.womenshealth.gov/publications/our-publications/fact-sheet/polycystic-ovary-syndrome.html?from=AtoZ>
- Vardell, M. J. (2010). *Improving access to fresh produce by low-income households in Appalachian Ohio that obtain food from a rural food pantry* (Master's thesis). Retrieved from <https://etd.ohiolink.edu>

Walker, J. L., Holben, D. H., Kropf, M. L., Holcomb, J. P., Jr., & Anderson, H. (2007).

Household food insecurity is inversely associated with social capital and health in females from special supplemental nutrition program for women, infants, and children households in Appalachian Ohio. *Journal of the American Dietetic Association*, 107(11), 1989-1993.

Ziegler, R. G., Mason, T. J., Stemhagen, A., Hoover, R., Schoenberg, J. B., Gridley, G., & Fraumeni, J. F. (1986). Carotenoid intake, vegetables, and the risk of lung cancer among white men in New Jersey. *American Journal of Epidemiology*, 123(6), 1080-1093.

Appendix A: Six-Item Food Security Module

U.S. Household Food Security Survey Module: Six-Item Short Form Economic Research Service, USDA September 2012

Six-Item Food Security Module

FILL INSTRUCTIONS: Select the appropriate fill from parenthetical choices depending on the number of persons and number of adults in the household.

HH3. I'm going to read you several statements that people have made about their food situation. For these statements, please tell me whether the statement was often true, sometimes true, or never true for (you/your household) in the last 12 months—that is, since last (name of current month).

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

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

HH4. "(I/we) couldn't afford to eat balanced meals." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

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

AD1. In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?

- Yes
- No (Skip AD1a)
- DK (Skip AD1a)

AD1a. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

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

AD2. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?

- Yes
- No
- DK

AD3. In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?

- Yes
- No
- DK

Appendix B: 18-Item Survey

**U.S. HOUSEHOLD FOOD SECURITY SURVEY MODULE:
THREE-STAGE DESIGN, WITH SCREENERS**

Economic Research Service, USDA

September 2012

18-Item Survey

Transition into Module (administered to all households):

These next questions are about the food eaten in your household in the last 12 months, since (current month) of last year and whether you were able to afford the food you need.

Optional USDA Food Sufficiency Question/Screener: Question HH1 (This question is optional. It is not used to calculate any of the food security scales. It may be used in conjunction with income as a preliminary screener to reduce respondent burden for high income households).

HH1. [IF ONE PERSON IN HOUSEHOLD, USE "I" IN PARENTHEICALS, OTHERWISE, USE "WE."]

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

- [1] Enough of the kinds of food we want to eat
- [2] Enough but not always the kinds of food we want
- [3] Sometimes not enough to eat
- [4] Often not enough to eat
- [] DK or Refused

Household Stage 1: Questions HH2-HH4 (asked of all households; begin scale items).

[IF SINGLE ADULT IN HOUSEHOLD, USE "I," "MY," AND "YOU" IN PARENTHEICALS; OTHERWISE, USE "WE," "OUR," AND "YOUR HOUSEHOLD."]

HH2. Now I'm going to read you several statements that people have made about their food situation. For these statements, please tell me whether the statement was often true, sometimes true, or never true for (you/your household) in the last 12 months—that is, since last (name of current month).

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

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

HH3. “The food that (I/we) bought just didn’t last, and (I/we) didn’t have money to get more.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

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

HH4. “(I/we) couldn’t afford to eat balanced meals.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

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

Screener for Stage 2 Adult-Referenced Questions: If affirmative response (i.e., "often true" or "sometimes true") to one or more of Questions HH2-HH4, OR, response [3] or [4] to question HH1 (if administered), then continue to **Adult Stage 2**; otherwise, if children under age 18 are present in the household, skip to **Child Stage 1**, otherwise skip to **End of Food Security Module**.

NOTE: In a sample similar to that of the general U.S. population, about 20 percent of households (45 percent of households with incomes less than 185 percent of poverty line) will pass this screen and continue to Adult Stage 2.

Adult Stage 2: Questions AD1-AD4 (asked of households passing the screener for Stage 2 adult-referenced questions).

AD1. In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?

- Yes
- No (Skip AD1a)
- DK (Skip AD1a)

AD1a. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

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

AD2. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?

- Yes
- No
- DK

AD3. In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?

- Yes
- No
- DK

AD4. In the last 12 months, did you lose weight because there wasn't enough money for food?

- Yes
- No
- DK

Screener for Stage 3 Adult-Referenced Questions: If affirmative response to one or more of questions AD1 through AD4, then continue to *Adult Stage 3*; otherwise, if children under age 18 are present in the household, skip to *Child Stage 1*, otherwise skip to *End of Food Security Module*.

NOTE: In a sample similar to that of the general U.S. population, about 8 percent of households (20 percent of households with incomes less than 185 percent of poverty line) will pass this screen and continue to Adult Stage 3.

Adult Stage 3: Questions AD5-AD5a (asked of households passing screener for Stage 3 adult-referenced questions).

AD5. In the last 12 months, did (you/you or other adults in your household) ever not eat for a whole day because there wasn't enough money for food?

- Yes
- No (Skip AD5a)
- DK (Skip AD5a)

AD5a. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

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

Child Stage 1: Questions CH1-CH3 (Transitions and questions CH1 and CH2 are administered to all households with children under age 18) Households with no child under age 18, skip to *End of Food Security Module*.

SELECT APPROPRIATE FILLS DEPENDING ON NUMBER OF ADULTS AND NUMBER OF CHILDREN IN THE HOUSEHOLD.

Transition into Child-Referenced Questions:

Now I'm going to read you several statements that people have made about the food situation of their children. For these statements, please tell me whether the statement was OFTEN true, SOMETIMES true, or NEVER true in the last 12 months for (your child/children living in the household who are under 18 years old).

CH1. “(I/we) relied on only a few kinds of low-cost food to feed (my/our) child/the children) because (I was/we were) running out of money to buy food.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

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

CH2. “(I/We) couldn’t feed (my/our) child/the children) a balanced meal, because (I/we) couldn’t afford that.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

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

CH3. "(My/Our child was/The children were) not eating enough because (I/we) just couldn't afford enough food." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

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

Screener for Stage 2 Child Referenced Questions: If affirmative response (i.e., "often true" or "sometimes true") to one or more of questions CH1-CH3, then continue to **Child Stage 2**; otherwise skip to **End of Food Security Module**.

NOTE: In a sample similar to that of the general U.S. population, about 16 percent of households with children (35 percent of households with children with incomes less than 185 percent of poverty line) will pass this screen and continue to Child Stage 2.

Child Stage 2: Questions CH4-CH7 (asked of households passing the screener for stage 2 child-referenced questions).

NOTE: In Current Population Survey Food Security Supplements, question CH6 precedes question CH5.

CH4. In the last 12 months, since (current month) of last year, did you ever cut the size of (your child's/any of the children's) meals because there wasn't enough money for food?

- Yes
- No
- DK

CH5. In the last 12 months, did (CHILD'S NAME/any of the children) ever skip meals because there wasn't enough money for food?

- Yes
- No (Skip CH5a)
- DK (Skip CH5a)

CH5a. [IF YES ABOVE ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

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

CH6. In the last 12 months, (was your child/were the children) ever hungry but you just couldn't afford more food?

- Yes
- No
- DK

CH7. In the last 12 months, did (your child/any of the children) ever not eat for a whole day because there wasn't enough money for food?

- Yes
- No
- DK

Appendix C: IRB Approval



OHIO
UNIVERSITY
Office of the Vice President for
Research

13X029

Office of Research Compliance
RTEC 117
Athens, OH 45701-2979

T: 740.593.0664
F: 740.593.9838
www.research.ohio.edu

The following research study has been approved by the Institutional Review Board at Ohio University for the period listed below. This review was conducted through an expedited review procedure as defined in the federal regulations as Category(ies):

5 7 0

Project Title: The Relationship of Food Insecurity to Health Parameters in Adult Women with Polycystic Ovary Syndrome (PCOS)

PI: Primary Investigator: Angela M. Hamilton

Co-Investigator(s): David Holben

Jay Shubrook
Jody Gerome

Faculty Advisor:

(if applicable)

Department: School of Applied Health Sciences and Wellness

Robin Stack

Robin Stack, CIP, Human Subjects Research Coordinator
Office of Research Compliance

March 27, 2013

Approval Date

March 26, 2014

Expiration Date

This approval is valid until expiration date listed above. If you wish to continue beyond expiration date, you must submit a periodic review application and obtain approval prior to continuation.

Adverse events must be reported to the IRB promptly, within 5 working days of the occurrence.

The approval remains in effect provided the study is conducted exactly as described in your application for review. Any additions or modifications to the project must be approved by the IRB (as an amendment) prior to implementation.

B

Appendix D: Consent Form

Ohio University Women's Health and Nutrition Survey Consent Form

Dear Diabetes and Endocrine Center, University Medical Associates, or River Rose Clinic Patient:

We are conducting a women's health and nutrition study in women with Polycystic Ovary Syndrome (PCOS). You are being invited to participate in this research. This study is being conducted to gain a better understanding of women's health and food access in our area. For you to be able to decide whether you want to participate in this project, you should understand what the project is about, as well as the possible risks and benefits in order to make an informed decision. This process is known as informed consent. This consent form describes the purpose, procedures, possible benefits, and risks of the study. It also explains how your personal information will be used and protected. Once you have read this form and your questions about the study are answered, you will be asked to sign it. This will allow your participation in this study. You should also keep one copy for your records. Regardless of your decision to participate or not, the medical care that you receive at your clinic will not be affected.

Explanation of Study

Currently, the relationship of food access to PCOS and other health measures is unknown. Therefore, this study is being done to look at these factors that can affect women's health and nutrition.

You may participate in this study only if you are 18 years of age or older, and you are willing to participate. If you agree to participate, you will be asked to complete a 15-minute survey. The survey will first ask for some basic information about you, such as your age. The survey will also ask questions about your health information and about the foods you eat.

If you agree to participate, you are giving us permission to look at your medical records and information gathered at the clinic, including PCOS diagnosis, diagnosis of depression, presence of infertility, health insurance information, height, weight, diabetes related parameters, and lab values (Hemoglobin A1C, fasting blood glucose, total, HDL, and LDL cholesterol). The investigators will only use information that is in your medical record. No extra tests will be ordered as part of this research.

If you agree to participate, we also may call you in the future to invite you to participate in a related study, and you may say no (see "Information About You" section of survey).

Risks and Discomforts

There are no anticipated risks of participating in this study, other than protecting your private medical information. Every effort will be made to protect your private medical information in the following ways: (1) the data will only be examined at your

medical clinic or a private office at Ohio University, (2) only members of the investigating team will be reviewing your information, and (3) your information will be kept in a locked cabinet and a password protected computer, and will be destroyed 24 months after the study ends.

Benefits

As compensation for your time/effort, you have received \$2 cash for your participation in this survey. If you decide not to participate, you may keep the \$2 anyways. This study is important to science/society because it will help us to better understand food access and PCOS. This study will help us get more information about women's health related to behaviors and nutrition, but you might not benefit personally.

Confidentiality and Records

Every effort will be made to keep your study-related records confidential. Your survey will not have your name on it, only a unique number. These surveys will be kept in a locked filing cabinet in one of the researchers offices. This consent form will originally be stapled to the survey. Once the survey and consent form are returned, the researcher will detach the consent form from the survey packet.

A master list that contains each participant's name, date of birth, and unique number will be kept in a separate locked filing cabinet in one of the researchers' offices, along with this consent form. Your information will be coded with a subject number, which will be kept in a locked cabinet in the researchers office.

Additionally, while every effort will be made to keep your study-related information confidential, there may be circumstances where this information must be shared with:

- * Federal agencies, for example the Office of Human Research Protections, whose responsibility is to protect human subjects in research;
- * Representatives of Ohio University (OU), including the Institutional Review Board, a committee that oversees the research at OU.

Contact Information

If you have any questions regarding this study, please contact Dr. David Holben (Nutrition program at Ohio University) at (740) 593-2875 or holben@ohio.edu, Dr. Jay Shubrook (University Medical Associates Diabetes Endocrine Center) at (740) 593-2137 or shubrook@ohio.edu , Dr. Jody Gerome (River Rose) at (740) 593-2227 or geromez@ohio.edu, or Angela Hamilton at (740) 593-2875 or ah241605@ohio.edu.

If you have any questions regarding your rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University, (740) 593-0664.

By signing below, you are agreeing that:

- you have read this consent form (or it has been read to you) and have been given the opportunity to ask questions and have them answered
- you have been informed of potential risks and they have been explained to

your satisfaction.

- you understand Ohio University has no funds set aside for any injuries you might receive as a result of participating in this study
- you are 18 years of age or older
- your participation in this research is completely voluntary
- you may leave the study at any time. If you decide to stop participating in the study, there will be no penalty to you and you will not lose any benefits to which you are otherwise entitled.

By signing below, you are agreeing that you give full consent for access to your medical records.

Signature _____ Date _____

Printed Name _____ Version Date: [03/20/13]

Appendix E: DEC Letter of Support



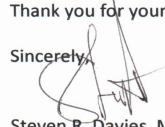
January 28, 2013

Dear Ohio University Institutional Research Board Committee,

I am writing this letter to demonstrate University Medical Associates ("UMA") complete support of the grant application titled "The Relationship of Food Insecurity to Health Parameters in Adult Women with Polycystic Ovary Syndrome (PCOS)", to be completed by Angela Hamilton, David Holben, and Jay Shubrook, D.O.. We look forward to partnering with these researchers in our UMA facilities. We are aware that the research team will be providing surveys to patients to eligible patients who are willing to participate in accordance with their established research protocols.

Thank you for your consideration this matter.

Sincerely,


Steven R. Davies, M.S, M.B.A
Chief Executive Officer
sdavies@uma-inc.org

Appendix F: River Rose Letter of Support



Obstetrics and Gynecology

Kathleen Bertuna, D.O., FACOOG
Jane Broecker, M.D., FACOG
J. Jack Chan, D.O., FACOOG
Michael Clark, D.O., FACOOG
Jody Gerome, D.O., FACOOG
Jack Ramey, D.O., FACOOG
Pamela Scholl, CNP

Pediatric/Adolescent Gynecology

Jane Broecker, M.D., FACOG

Neuromusculoskeletal Medicine

Anna Wright, D.O.

March 20, 2013

To whom it may concern:

This letter is written to formally support the project entitled, *The Relationship of Food Insecurity to Health Parameters in Adult Women with Polycystic Ovary Syndrome (PCOS)*. A patient list will be generated for those being seen in the clinic who qualify for the study so that a survey can be mailed to them by the research team. Additional data will also be collected, per the protocol. I will be responsible for oversight of these processes by predetermined protocols summarized in the IRB application.

Please let me know if any further information is needed to make this project a success.

Sincerely,

Jody M. Gerome, DO
River Rose Obstetrics and Gynecology
Assistant Professor, Department of Obstetrics & Gynecology
Ohio University Heritage College of Osteopathic Medicine
Athens, Ohio 45701
Email: geromez@ohio.edu
Phone: (740) 594-8819

Appendix G: Survey

Women's Health and Nutrition Survey

Completion of this survey is completely voluntary and you may stop participating at any time, or you may simply skip questions you do not wish to answer. No one will be able to identify you in any report resulting from this survey.

This survey should be taken by a patient who attends the Diabetes and Endocrine Center, University Medical Associates, or River Rose Obstetrics and Gynecology. This study is being done in order to gain a deeper understanding of food access and women's health in our area. The survey will take about 15 minutes to complete. In no way will your answers affect you or your family's access to the clinic. Thank you very much for your time and assistance.

***If you have questions related to this interview please contact, per your consent form:**

David H. Holben, PhD, RD, LD (researcher) at 740-593-2875

or

Jo EllenSherow (Director of Research Compliance) at 740-593-0664.

Tell Us About You.

How old are you?

What is your race? (Circle all that apply)					
American Indian or Native Alaskan	Asian Native	Black or African American	Hispanic	Hawaiian or Other Pacific Islander	White
Other (Please specify.)					

What is your current marital status? (Circle one answer)

Married	Widowed	Divorced	Separated	Single/Never Married
If not married, do you have a live-in partner? Yes No				

Including you, how many people live in your household?	_____ adults
	_____ children 18 yrs & younger

What is your highest level of education completed?	
(Check one box only)	
Less than High School	
High School Graduate – high school DIPLOMA or the equivalent (GED)	
Some College or Higher	

What is your occupation type?	
(Check one box only)	
Working full-time (35 or more hours per week)	
Working part-time (fewer than 35 hours per week)	
Unemployed	
Student (either full or part-time)	
Social Security Disability	
Applying for Social Security	
Retired	
Other (Please explain)	

What is your current employment status?	
(Circle one answer)	
Unskilled labor/ never employed/ Other	Professional/ skilled labor

Which of the following best describes your current living arrangement?	
(Check one box only)	
I live with immediate family members (parents, brothers, sisters)	
I live with my partner/significant other/spouse	
I live with relatives (cousins, aunt or uncle, etc.)	
I live with a friend (or friends)	
I live alone	

What figure is closest to your current annual income?					
(Circle one answer)					
\$0-\$10,000	\$10,001-\$20,000	\$20,001-\$30,000	\$30,001-\$40,000	Over \$40,000	Prefer not to answer

Do you currently have health insurance?		(Circle one answer)
No coverage/ self-pay	Medicaid or Medicare only	Private insurance only (job/ school/ purchased)

What county do you live in? _____

Do you belong to a church / religion? (Circle one answer)	Yes	No
----------------------------------------------------------------------------	-----	----

Do you smoke cigarettes/ tobacco?	Yes	No
------------------------------------------	-----	----

The age you started smoking / using tobacco	_____ years	
Average cigarettes smoked per day/ average use of tobacco per day	_____ cigarettes/ tobacco	

In general my health is excellent, very good, good, fair, or poor. (Circle one answer)				
Excellent	Very Good	Good	Fair	Poor

Did a doctor ever tell you that you had one of the following conditions? Please select all that apply, (if in doubt select "Don't know").				
	Yes	No	Don't Know	
Polycystic Ovary Syndrome				
Depression				
Diabetes Type 1				
Diabetes Type 2				
Infertility				

May we call you in the future about another study related fruits and vegetables? (Circle only one.)				
Yes	No			

Tell Us About Your Food and Nutrition Habits and Behaviors.

I feel that I am helping my body by eating more fruits and vegetables. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I may develop health problems if I do not eat fruit and vegetables. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I feel that I can eat fruit or vegetables as snacks. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I feel that I can buy more vegetables the next time I shop. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I feel that I can plan meals or snack with more fruit during the next week. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I feel that I can eat two or more servings of vegetables at dinner. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I feel that I can plan meals with more vegetables during the next week. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I feel that I can add extra vegetables to casseroles and stews. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
In your household who is in charge of what foods to buy? (Circle one answer)	I Am	Shared Decision	Other Person
In your household who is in charge of how to prepare the food? (Circle one answer)	I Am	Shared Decision	Other Person

How would you best describe your diet? (Circle one answer)				
Excellent	Very Good	Good	Fair	Poor

Which one statement best fits you?	
(Check one box only.)	
I am not thinking about eating more fruit.	
I am thinking about eating more fruit...planning to start within six months.	
I am definitely planning to eat more fruit in the next month.	
I am trying to eat more fruit now.	
I am already eating 3 or more servings of fruit a day	

Which one statement best fits you?	
(Check one box only.)	
I am not thinking about eating more vegetables.	
I am thinking about eating more vegetables...planning to start within six months.	
I am definitely planning to eat more vegetables in the next month.	
I am trying to eat more vegetables now.	
I am already eating 3 or more servings of vegetables a day.	

Do you eat more than 1 kind of fruit daily? (Circle only one.)			
Never	Sometimes	Often	Always

Do you eat more than 1 kind of vegetable in a day? (Circle only one.)			
Never	Sometimes	Often	Always

During the past week, did you have citrus fruit (such as orange or grapefruit) or citrus juice?		(Circle one.)	Yes	No
--------------------------------------------------------------------------------------------------------	--	----------------------	-----	----

How many servings of vegetables do you eat each day?	Number _____
-------------------------------------------------------------	--------------

Do you eat 2 or more servings of vegetables at your main meal? Sometimes, often, always, or never?

(Circle one.)

Sometimes	Often	Always	Never
-----------	-------	--------	-------

Do you eat fruit or vegetables as snacks?

(Circle one.)

Yes No

How many servings of fruits do you eat each day?

Number _____

Over the past five years, has your daily produce intake changed? (Circle only one.)

No, it is the same as it is now.	Yes, it has decreased.	Yes, it has increased.	Don't know.
----------------------------------	------------------------	------------------------	-------------

If you answered "yes," please answer the following questions about your produce intake over the past five years.

Over the past five years, how many servings of vegetables have you eaten, on average, each day?

Number _____

Over the past five years, how many servings of fruit have you eaten, on average, each day?

Number _____

Which one statement best fits you?

(Check one box only.)

I am not thinking about gardening to grow vegetables for my household.

**I am thinking about gardening to grow vegetables for my household.
...planning to start within six months**

**I am definitely planning to garden to grow vegetables for my household
in the next month.**

I am trying to garden to grow vegetables for my household.

I am already gardening to grow vegetables for my household.

Which one statement best fits you?	
(Check one box only.)	
I am not thinking about gardening to grow fruits for my household.	
I am thinking about gardening to grow fruits for my household. ...planning to start within six months	
I am definitely planning to garden to grow fruits for my household in the next month.	
I am trying to garden to grow fruits for my household.	
I am already gardening to grow fruits for my household.	
Which of these statements best describes the food eaten in your household in the last 12 months?	
(Check one box only.)	
Enough of the kinds of food I/we want to eat	
Enough but not always the kinds of food I/we want	
Sometimes not enough to eat	
Often not enough	
Don't Know or Refused	

Here are some reasons why people don't always have enough to eat. For each one, please tell me if that is a reason why YOU don't always have enough to eat.	Yes	No	Don't Know
Not enough money for food			
Not enough time for shopping or cooking			
Too hard to get to the store			
On a diet			
No working stove available			

Not able to cook or eat because of health problems			
----------------------------------------------------	--	--	--

Here are some reasons why people don't always have the quality or variety of food they want. For each one, please tell me if that is a reason why YOU don't always have the kinds of food you want to eat.	Yes	No	Don't Know
Not enough money for food			
Kinds of food (I/we) want not available			
Not enough time for shopping or cooking			
Too hard to get to the store			
On a special diet			

In the past 12 months, (I/we) worried whether (my/our) food would run out before (I/we) got money to buy more. (Circle only one.)			
Often true	Sometimes true	Never true	Don't Know or Prefer Not to Answer

In the past 12 months, the food that (I/we) bought just didn't last, and (I/we) didn't have money to get more. (Circle only one.)			
Often true	Sometimes true	Never true	Don't Know or Prefer Not to Answer

In the past 12 months, (I/we) couldn't afford to eat balanced meals. (Circle only one.)			
Often true	Sometimes true	Never true	Don't Know or Prefer Not to Answer

In the past 12 months, did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food? (Check one box only)				
Yes. Almost every month	Yes. Some months but not every month	Yes. Only 1 or 2 months	No.	Don't Know or Prefer Not to Answer

In the past 12 months, did you (personally) ever eat less than you felt you should because there wasn't enough money to buy food? (Check one box only)		
Yes	No	Don't Know or Prefer Not to Answer

In the past 12 months, were you (personally) ever hungry but didn't eat because you couldn't afford enough food? (Check one box only)		
Yes	No	Don't Know or Prefer Not to Answer

In the past 12 months, did you (personally) lose weight because you didn't have enough money for food? (Check one box only)		
Yes	No	Don't Know or Prefer Not to Answer

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

(Check one box only)

Yes. Almost every month	Yes. Some months but not every month	Yes. Only 1 or 2 months	No.	Don't Know or Prefer Not to Answer
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Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week. **(Circle only one for each question.)**

During the past week I was bothered by things that usually don't bother me.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I did not feel like eating; my appetite was poor.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I felt that I could not shake off the blues even with help from my family or friends.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I felt I was just as good as other people.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I had trouble keeping my mind on what I was doing.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I felt depressed.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)

During the past week I felt that everything I did was an effort.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I felt hopeful about the future.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I thought my life had been a failure.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I felt fearful.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week my sleep was restless.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I was happy.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I talked less than usual.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)

During the past week I felt lonely.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week people were unfriendly.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I enjoyed life.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I had crying spells.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I felt sad.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I felt that people dislike me.	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
During the past week I could not get “going.”	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)

Thank you for participating in our survey!

Version: March 20, 2013

Appendix H: 13-Item Tool to Assess Psychosocial Indicators of Produce Intake

Perceived Benefits (1 construct): Outcome expectations within the Social Cognitive Theory defined as what a person believes will happen as a result of performing a behavior (Bandura, 1986; Townsend et al., 2007). "Outcome expectations provide motivation for eating fruits and vegetables (Townsend et al., 2007)."				
Question	Answer Options			Scoring
"I feel that I am helping my body by eating more fruits and vegetables."	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)	Sum of item scores/# of items Agree (Yes) = 1 Agree or Disagree (Maybe) = .5 Disagree (No) = 0
"I may develop health problems if I do not eat fruit and vegetables."	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)	

Perceived Control (1 construct): "The items asked who is in charge of the food shopping and food preparation and refer to the perception of having control over the behaviors (Armitage et al., 1999; Townsend et al., 2007).				
Question	Answer Options			Scoring
"In your household who is in charge of what foods to buy?"	I Am	Shared Decision	Other Person	Sum of item scores I Am = .5 Shared Decision = .25 Other Person = 0
"In your household who is in charge of how to prepare the food?"	I Am	Shared Decision	Other Person	

Predisposing Domain = Perceived Benefit Construct Score + Perceived Control Construct Score

Note. Adapted from "Development of a Tool to Assess Psychosocial Indicators of Fruit and Vegetable Intake for 2 Federal Programs" by M. S. Townsend and L. L. Kaiser, 2005, *Journal of Nutrition Education and Behavior*, 37(4), p.173-175.

<p>Self-Efficacy (1 construct): “Items assessing the confidence a participant feels in performing specific fruit and vegetable behaviors in a variety of circumstances (Townsend et al., 2007).” “Within the Social Cognitive Theory and the Health Belief Model, self-efficacy provides the confidence that barriers can be overcome and has been shown to be an important mediator of behavior change (Bandura, 1986).”</p>			
Question	Answer Options		Scoring
“I feel that I can eat fruit or vegetables as snacks.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
“I feel that I can buy more vegetables the next time I shop.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
“I feel that I can plan meals or snack with more fruit during next week.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
“I feel that I can eat two or more servings of vegetables at dinner.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
“I feel that I can plan meals with more vegetables during the next week.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
“I feel that I can add extra vegetables to casseroles and stews.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)

Sum of item scores/# of items

Agree (Yes) = 1
Agree or Disagree (Maybe) = .5
Disagree (No) = 0

Enabling Domain = Self-efficacy Construct Score

Note. Adapted from “Development of a Tool to Assess Psychosocial Indicators of Fruit and Vegetable Intake for 2 Federal Programs” by M. S. Townsend and L. L. Kaiser, 2005, *Journal of Nutrition Education and Behavior*, 37(4), p.173-175.

Readiness to Eat more Fruit and Vegetables (1 construct): “Eating more fruit and vegetables referred to increasing the current intakes of fruit and vegetables compared to the amount eaten in the past (Townsend et al., 2007).” “Readiness for change, measured by stage of change algorithm, is the temporal dimension of Prochaska’s Transtheoretical Model of Behavior Change (Greene et al., 1999).”

Which statement best fits you?	Scoring
“I am not thinking about eating more fruit.”	Precontemplation = 0
“I am thinking about eating more fruit...planning to start within six months.”	Contemplation = .25
“I am definitely planning to eat more fruit in the next month.”	Preparation/Planning = .50
“I am trying to eat more fruit now.”	Action = .75
“I am already eating 3 or more servings of fruit a day.”	Maintenance = 1
Readiness to Eat more Fruit and Vegetables (1 construct)	
Which statement best fits you?	Scoring
“I am not thinking about eating more vegetables.”	Precontemplation = 0
“I am thinking about eating more vegetables...planning to start within six months.”	Contemplation = .25
“I am definitely planning to eat more vegetables in the next month.”	Preparation/Planning = .50
“I am trying to eat more vegetables now.”	Action = .75
“I am already eating 3 or more servings of vegetables a day.”	Maintenance = 1

Perceived Diet Quality (1 construct): “Considered as a mediator of behavior, perceived diet quality was assessed (Havas, Treiman, et al., 1998).

Question	Answer Options					Scoring
“How would you best describe your diet?”	Excellent	Very Good	Good	Fair	Poor	Excellent = 1 Very Good = .75 Good = .50 Fair = .25 Poor = 0

Note. Adapted from “Development of a Tool to Assess Psychosocial Indicators of Fruit and Vegetable Intake for 2 Federal Programs” by M. S. Townsend and L. L. Kaiser, 2005, *Journal of Nutrition Education and Behavior*, 37(4), p.173-175.

**Change in Intention Domain = Readiness to Eat More Fruit Construct Score +
Readiness to Eat More Vegetables Construct Score + Perceived Diet Quality
Construct Score**

**Change in All Domains = Change in Predisposing Domain + Change in Enabling +
Change in Intention**

Note. Adapted from “Development of a Tool to Assess Psychosocial Indicators of Fruit and Vegetable Intake for 2 Federal Programs” by M. S. Townsend and L. L. Kaiser, 2005, *Journal of Nutrition Education and Behavior*, 37(4), p.173-175.

Appendix I: 7-Item Food Behavior Checklist

Question	Answer Options				Scoring
“Do you eat more than one kind of fruit daily?”	Never	Sometimes	Often	Always	Never = 1 Sometimes = 2 Often = 3 Always = 4
“Do you eat more than 1 kind of vegetable in a day?”	Never	Sometimes	Often	Always	Never = 1 Sometimes = 2 Often = 3 Always = 4
“Do you eat 2 or more servings of vegetables at your main meal?”	Never	Sometimes	Often	Always	Never = 1 Sometimes = 2 Often = 3 Always = 4

Question	Answer Options		Scoring
“During the past week, did you have citrus fruit (such as an orange or grapefruit) or citrus juice?”	Yes	No	Yes = 2 No = 1
“Did you eat fruit or vegetables as snacks?”	Yes	No	

Question	Answer Options	Scoring
“How many servings of vegetables do you eat each day?”	Number _____	Number of vegetables + Number of Fruit
“How many servings of fruit do you eat each day?”	Number _____	

7-Item Fruit and Vegetable Scale Score = Sum of item scores (Townsend et al., 2003)

Note. Adapted from “Selecting Items for a Food Behavior Checklist for a Limited-Resource Audience” by M. S. Townsend, L. L. Kaiser, L. H. Allen, A. B. Joy, and S. P. Murphy, 2003, *Journal of Nutrition Education and Behavior*, 35(2), p.173-175.

Appendix J: Periodic Review – Continued IRB Approval



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13X029

Periodic Review

The following research study has been approved by the Institutional Review Board at Ohio University for the period listed below. This review was conducted through an expedited review procedure as defined in the federal regulations as Category(ies):

5 7 0

Project Title: The Relationship of Food Insecurity to Health Parameters in Adult Women with Polycystic Ovary Syndrome (PCOS)

Primary Investigator: Angela M. Hamilton

Co-Investigator(s): David Holben
Jay Shubrook
Jody Gerome

Faculty Advisor:

(if applicable)

Department: School of Applied Health Sciences and Wellness

Robin Stack

Robin Stack, CIP, Human Subjects Research Coordinator
Office of Research Compliance

Feb. 13, 2014

Approval Date

Feb. 12, 2015

Expiration Date

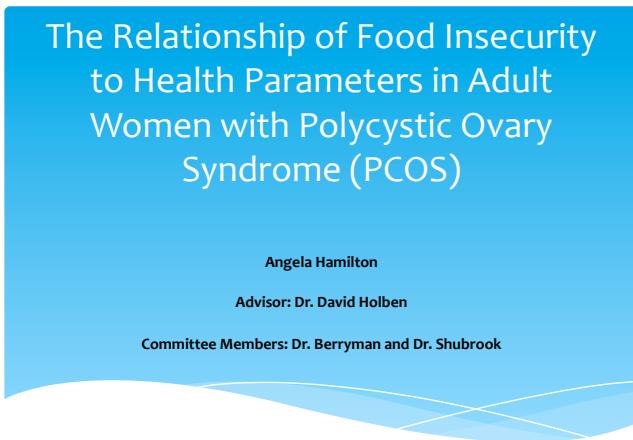
This approval is valid until expiration date listed above. If you wish to continue beyond expiration date, you must submit a periodic review application and obtain approval prior to continuation.

Adverse events must be reported to the IRB promptly, within 5 working days of the occurrence.

The approval remains in effect provided the study is conducted exactly as described in your application for review. Any additions or modifications to the project must be approved by the IRB (as an amendment) prior to implementation.

B

Appendix K: Thesis Defense Presentation



- * Introduction, Review, and Food Security Updates
- * Results and Discussion
- * Conclusions and Recommendations

9/18/14



- * Access by all people at all times to enough food to live an active healthy lifestyle (Anderson, 1990)
- * **Food security**
 - * High food security and marginal food security (USDA ERS, 2014)
- * **Food insecurity**
 - * Low food security and very low food security (USDA ERS, 2014)

9/18/14

Fully Food Secure vs. Not Fully Food Secure

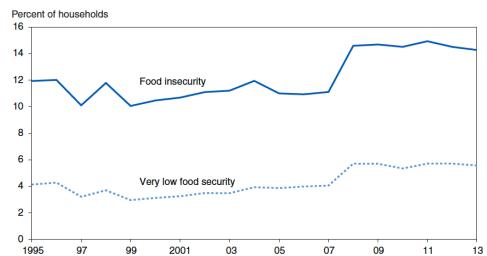
(USDA ERS, 2014)

- * Fully food secure
- * High food security
- * Not fully food secure
- * Marginal food security
- * Low food security
- * Very low food security

9/18/14

Trends in the Prevalence of Food Insecurity and Very Low Food Security in U.S. Households, 1995-2013

(USDA ERS, 2014)

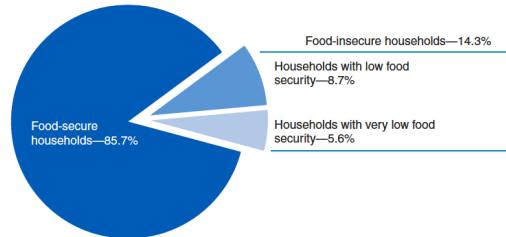


9/18/14

U.S. Households by Food Security Status, 2013

(USDA ERS, 2014)

U.S. households by food security status, 2013



9/18/14

Statement of Problem

- * The links between **food insecurity** and **diabetes**, as well as **PCOS** and **diabetes**, have been studied.
- * The relationship of **food insecurity** and **PCOS** has not been explored prior to this study.
- * Having access to adequate food for a healthy, active life, including fresh produce, is essential to consuming a healthy diet and could possibly have a positive impact on the symptoms seen in females with PCOS.

9/18/14

Purpose

- * To assess the relationship of food security to PCOS-related health parameters, including body mass index (BMI), biochemical indicators of glucose metabolism, and other health and dietary parameters in adult females using a clinic for management of PCOS.

9/18/14

Parameters

- | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> * Food security status * Diabetes related parameters * Hemoglobin A1c * Fasting blood glucose * BMI * Total, HDL, and LDL cholesterol * Triglycerides | <ul style="list-style-type: none"> * Produce intakes and behaviors * Infertility * Depression |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|

9/18/14

Medical Record Data

- Height, weight, BMI, hemoglobin A1c, fasting blood glucose, total, HDL, and LDL cholesterol, triglycerides, clinical diagnosis of PCOS, presence of infertility, and any medical record of depression

9/18/14

Research Question	Research Hypothesis
What is the relationship of food insecurity to health parameters in adult women with PCOS?	Food insecurity will be related to poorer glucose control and management, as well as poorer health-related outcomes.

9/18/14

Results

9/18/14

Characteristics of Participants

- * Surveys were sent to 269 individuals diagnosed with PCOS
- * Fifty-four (20.1%) individuals responded to the survey
- * Participants (n = 54) were 32 ± 9 years and primarily White/Non-Hispanic (n = 49, 90.7%)

9/18/14

Demographic Characteristics and Additional Diagnoses of Adult Females with PCOS Living in Rural Appalachian Ohio

Characteristic	Frequency (n)	Percentage (%)
Race (n = 54)		
American Indian or Native Alaskan Asian	1	1.9
Native Black or African American	1	1.9
Multiracial	3	5.6
White	49	90.7
Education (n = 54)		
Less than high school	1	1.9
High school graduate	10	18.5
Some college or higher	43	79.6
Health insurance (n = 53)		
No health insurance coverage self-pay	4	7.4
Medicaid or Medicare only	5	9.3
Private insurance only	44	81.5

9/18/14

Added Category: Distressed Area

- * The participant's county of residence was categorized as distressed or not distressed based upon the criteria set by the Appalachian Regional Commission.
- * Distressed counties of the Appalachian Ohio region
 - * Adams, Athens, Meigs, Morgan, Noble, Pike, and Vinton (ARC, 2014)
- * Criteria based on three economic indicators
 - * Three-year average unemployment rates, per capita market income, and poverty rates

9/18/14

(Table continued)

Characteristic	Frequency (n)	Percentage (%)
Marital status (n = 54)		
Married	32	59.3
Single/never married	15	27.8
Divorced	5	9.3
Separated	2	3.7
Employment (n = 54)		
Working full-time	26	48.1
Working part-time	8	14.8
Unemployed	6	11.1
Student (full/part-time)	7	13.0
Social security disability	1	1.9
Annual income (n = 54)		
\$0 - \$10,000	9	16.7
\$10,001 - \$20,000	6	11.1
\$20,001 - \$30,000	9	16.7
\$30,001 - \$40,000	6	11.1
Over \$40,000	21	38.9
County (n = 40)		
Distressed	32	80.0
Non-distressed	8	20.0
Employment (n = 54)		
Yes	34	62.9
No	6	11.1
Smoking (n = 54)		
Does not smoke cigarettes/tobacco	46	85.2
Smokes cigarettes/tobacco	8	14.8

9/8/14

Gardening Practices

- * Considered “gardens” if in action or maintenance based on Stages of Change Theory
 - * “I am trying to garden to grow vegetables/fruit for my household”
 - * trying to make the particular change
 - * “I am already gardening to grow vegetables/fruit for my household”
 - * have been sustaining the change for a longer period of time

9/8/14

(Table continued)

Characteristic	Frequency (n)	Percentage (%)
Gardening practices (n = 54)		
Gardens vegetables	21	38.9
Does not garden vegetables	33	61.1
Gardens fruit	15	27.8
Does not garden fruit	39	72.2
Self-reported diabetes status (n = 54)		
Type 1	7	13.0
Type 2	3	5.6
Does not have diabetes	44	81.4
Self-reported fertility status (n = 54)		
Infertile	22	40.7
Fertile	32	59.3

9/8/14

Demographic Characteristics of Participants

(Pollard & Jacobsen 2014)

- * Ohio data – Comparing Appalachian regions to non-Appalachian regions
 - * Many Appalachian regions had a higher overall White/Non-Hispanic population
 - * Overall lower percentage of individuals with a college degree or higher
 - * Lower total household incomes
 - * Also, in the Appalachian regions of Ohio it is seen that a lower percentage of people are covered by health insurance

9/18/14

Insulin Resistance

- * Approximately 50 -70% of women with PCOS have some level of insulin resistance and impaired glucose tolerance (Diamanti-Kandarakis, E., 2006; Lorenz & Wild, 2007)
- * The majority of our study participants did not self-report having diabetes
 - * Using a larger sample size, or having more blood glucose values available might raise this percentage.
- * Many of the study participants could possibly be in the pre-diabetes range, and this was not measured in the present study.

9/18/14

Infertility

- * Approximately 40% of the women from our study reported being diagnosed with infertility.
- * These results were expected, as many females with PCOS have fertility problems (Balen et al., 2006).

9/18/14

Household Adult Food Security Status

- * Of the 54 study participants:
 - * 42 (77.8%) women were living in food secure households
 - * 12 (22.2%) were living in food insecure households - greater than both the national and state averages
 - * 35 (64.8%) were fully food secure
 - * 19 (35.2%) were not fully food secure
 - * Experienced some degree of food insecurity during the previous 12 months

9/8/14

Household Adult Food Security Status of Adult Females with PCOS Living in Rural Appalachian Ohio (n = 54)

USDA household food security category	Frequency (n)	Percentage (%)
High food security ^a	35	64.8
Marginal food security ^b	7	13.0
Low food security ^b	9	16.7
Very low food security ^b	3	5.6

^aFully food secure

^bNot fully food secure

9/8/14

Household Adult Food Security Status

- * According to the USDA ERS
 - * 85.7% of American households were food secure
 - * 14.3% of households were food insecure
- * Prevalence of food insecurity by state from 2010 – 2012, Ohio is seen to have food insecurity rates of 16.1%, which is above the U.S. average

9/8/14

Household Adult Food Security Status

- * Research in the Appalachian region by Holben and Pheley (2006) found that 72.8% of their participants were living in food secure households, and 27.2% did reside in a household that was food insecure.
- * Our study results of women with PCOS in the Appalachian region found
 - * 64.8% had high household food security
 - * 35.2% had marginal, low, or very low household food security (not fully food secure)

9/18/14

Household Adult Food Security Status

- * Higher rates of food insecurity in the Appalachian region are especially evident in women who live in food insecure households.
- * Women who live in low-income households and rural areas such as Appalachia Ohio may have a higher tendency to experience some degree of food insecurity (Gorimani & Holben, 1999).
- * It has been found that women will compromise their own needs to provide for other family members, especially their children Nord and colleagues (2009).

9/18/14

Food Insecurity and PCOS

- * To the best of our knowledge, no prior studies have examined food insecurity and the development and care of PCOS in the Appalachian region

9/18/14

Food Insecurity and PCOS

- * Although several studies have examined food security and women's health in the Appalachian region, our study was the first in this region on food security and PCOS.
- * The majority of the women in our study reported high food security while 35% were not fully food secure. Our study was made up of a smaller sample size.
- * If a larger sample size was used a higher percentage of not fully food secure women could have been found.

9/18/14

Food Insecurity and Diabetes

- * Studies have found that people with diabetes are more likely to reside in food-insecure households than in food-secure households (Holben Pheley, 2006).
- * A study with low-income participants, and also diagnosed with diabetes, observed that these participants had lower self-efficacy and fruit and vegetable intakes than the non-low-income participants (Lyles et al., 2013).
- * In our study household adult food security status was not significantly related to diabetes, HbA1c, or fasting blood glucose.
- * Different results, possibly showing significance, could be expected if more participants of our study had available lab values, or if a larger sample size was used.

9/18/14

Anthropometrics

- * Of those consenting to review of their medical record ($n = 47$), 39 had complete anthropometric data
- * BMI ranged from $20.5\text{kg}/\text{m}^2$ to $58.1\text{kg}/\text{m}^2$
- * Average: $34.5 \pm 8.8\text{kg}/\text{m}^2$
- * 7 (17.9%) were overweight
- * 26 (66.7%) were obese
- * It is estimated that about 50% of women with PCOS are overweight or obese (Deepika et al., 2011)

9/18/14

Anthropometrics

- * Position paper of the Academy of Nutrition and Dietetics found that food insecurity is associated with overweight, obesity, and diabetes
- * Another study in rural Appalachian Ohio, found that participants from food-insecure households, especially among women, had a greater BMI when compared to their food-secure counterparts and that obesity was also greater among study participants from food-insecure households (48.1%) when compared to participants from food-secure households (35.1%) (Holben and Pheley, 2001)

9/18/14

Biochemical Indicators for Blood Glucose and Lipid Panel

- * Of those providing access to their medical records (n = 47), 20 had glucose and/or lipid tests available

9/18/14

Blood Glucose Monitoring

- * A study published in the *Journal of Health Care for the Poor and Underserved*, found that food-insecure participants reported poorer adherence to blood glucose monitoring than food-secure individuals (Seligman et al., 2007). It was concluded from this study that food insecurity is a barrier to proper diabetes self-management (Seligman et al., 2007).

9/18/14

*Biochemical Indicators for Blood Glucose and Lipid Panel of Adult Females with PCOS
Living in Rural Appalachian Ohio*

Lab value	n	Mean	SD
Cholesterol			
Total (mg/dL)	11	199.2	37.3
LDL (mg/dL)	10	114.5	38.4
HDL (mg/dL)	11	51.9	10.2
TG (mg/dL)	10	160.6	60.5
Fasting BG (mg/dL)	20	98.0	25.5
HbA1c (%)	11	6.6	1.9

9/18/14

Blood Glucose Monitoring

- * A study published in the *Journal of Health Care for the Poor and Underserved*, found that food-insecure participants reported poorer adherence to blood glucose monitoring than food-secure individuals (Seligman et al., 2007). It was concluded from this study that food insecurity is a barrier to proper diabetes self-management (Seligman et al., 2007).

9/18/14

Biochemical Indicators for Blood Glucose and Lipid Panel

- * Mean total and HDL cholesterol and fasting blood glucose levels were in the desirable ranges (American Heart Association, 2014)
- * The mean LDL cholesterol, triglyceride level, and HbA1c were higher than recommended and fell in the range that would put an individual at risk for heart disease and/or diabetes (American heart Association, 2014)
- * Of the 11 women with available HbA1c values the mean was 6.6%
 - * Having a HbA1c in the range of 5.7% to 6.4% puts an individual at risk for developing diabetes, and diabetes is diagnosed with a HbA1c of 6.5% or higher (American Heart Association, 2014).

9/18/14

Depression Scale Score

Adult Females with PCOS Living in Rural Appalachian Ohio Depression Category

Category	n	Percentage (%)
No depression	27	50.0
Degree of depression	27	50.0
Mild to moderate depression	9	16.7
Major depression	18	33.3

9/8/14

Depression Scale Score

- * Responses from participants to the depression scale portion of our survey revealed that half of the women had some degree of depression
- * It is common to see depression in females with PCOS
- * This depression could be due to the health complications that are associated with this syndrome, including weight gain, insulin resistance, and infertility.

9/8/14

Produce Intake

Produce Intake of Adult Females with PCOS Living in Rural Appalachian Ohio

Indicator	n	Mean	SD
Daily vegetable servings	52	2.64	1.82
Daily fruit servings	52	1.86	0.86
Daily total fruit and vegetable servings	52	4.4	2.26

9/8/14

Definitions of Psychosocial Constructs Related to Produce Intake Behaviors

9/8/14

Definitions of Psychosocial Constructs Related to Produce Intake Behaviors

Construct or domain	Definition (Townsend and Kaiser, 2005)	Number of items
Perceived benefit	What a person believes will happen as a result of performing a behavior defined as, outcome expectations provide motivation for eating fruit and vegetables	2
Perceived control	These items ask who is in charge of the food shopping and food preparation and refer to the perception of having control over these behaviors	2
Self-efficacy	Items used to assess the confidence an individual feels in performing specific fruit and vegetable behaviors in a variety of circumstances	6
Readiness to eat more fruit and vegetables	This item refers to the individual's readiness to increase the current intakes of fruit and vegetables compared to the amount eaten in the past	2

9/8/14

(Table continued)

Construct or domain	Definition (Townsend and Kaiser, 2005)	Number of items
Perceived diet quality	Asks about the individual's perception of their own diet quality	1
Predisposing domain	Perceived benefit construct score + perceived control construct score	
Enabling domain	Self-efficacy construct score	
Change in intention domain	Readiness to eat more fruit construct score + readiness to eat More vegetables construct score + perceived diet quality construct score	
Change in all domains	Change in predisposing domain + change in enabling + change in intention	

9/8/14

Produce Intake Related Behaviors

Produce Intake and Related Behaviors of Adult Females with PCOS Living in Rural Appalachian Ohio

Construct/domain	n	Mean	SD
Perceived benefit score	54	0.9	0.2
Perceived control score	54	0.8	0.3
Self-efficacy score ^a	54	0.9	0.1
Perceived diet quality score	54	0.5	0.2
Readiness to eat more vegetables score	54	0.7	0.3

9/18/14

(Table continued)

Construct/domain	n	Mean	SD
Readiness to eat more fruit score	54	0.7	0.2
Enabling domain score ^a	54	0.9	0.1
Predisposing domain score	54	1.6	0.4
Change in intention domain score	54	1.9	0.6
Change in all domains score	54	4.5	0.8
7-item fruit and vegetable scale score	54	15.7	4.1

^aScoring of self-efficacy score = scoring of enabling domain score.

9/18/14

Produce Intake and Related Behaviors

- * In our sample the majority of women obtained high perceived benefit, perceived control, and self-efficacy scores, although the mean score for perceived diet quality was lower.
- * Participants shared they believe they could improve their produce intake behaviors, shown by the high mean scores for predisposing domain and enabling domain.
- * However, when answering questions about intentions of changing a specific behavior, change in intention domain scores were low.

9/18/14

Produce Intake and Related Behaviors

- * The women in our study showed overall positive beliefs and self-confidence when answering questions related to their produce intake behaviors.
- * This attitude about produce intake is essential in order to reach the desirable health effects that are seen with consuming more fruit and vegetables.

9/18/14

Statistical Analysis

- * Kendall's Tau-b
 - * Non-parametric, categorical data
 - * Example: Smokes or does not smoke cigarettes/tobacco
- * Pearson's r
 - * Continuous variables
 - * Example: Servings of vegetables per day, readiness to eat more vegetables score, and fasting blood glucose
- * Pearson's chi-squared
 - * Example: Daily vegetable intake by food security status and if met or did not meet recommendations
- * p < .05 was utilized to identify significance

9/18/14

Household adult food security status was significantly ($p < .05$) related to:

- * Food insecurity was significantly related to:
 - * Smoking, daily vegetable intake, total daily produce intake, depression score, perceived benefit, predisposing domain, change in all domains, and 7-item fruit and vegetable scale score
- * Participants who were not fully food secure were less likely to meet recommended vegetable and total produce intake.
- * Our results on produce intake and related behaviors are similar to other studies examining food security in the Appalachian region.

9/18/14

<i>Relationship of Food Security Status to Health Parameters</i>		
Health parameter	Correlation coefficient ^{a,b}	p-value
Smokers cigarettes/tobacco	0.285 ^c	.026
Perceived general health	-0.130 ^c	.284
Vegetable servings/day	-0.337 ^b	.015
Fruit servings/day	-0.114 ^c	.420
Total produce/day	-0.315 ^b	.023
Depression	0.466 ^b	<.001
Perceived benefit	-0.293 ^b	.032
Perceived control	-0.181 ^b	.191
Predisposing domain	-0.278 ^b	.042
Self-efficacy	-0.013 ^b	.926
Enabling domain	-0.013 ^b	.926
Readiness to eat more fruit	-0.139 ^b	.315
Readiness to eat more vegetables	-.0187 ^b	.175
Perceived diet quality	-0.214 ^b	.120
Change in intention domain	-0.221 ^b	.108
Change in all domains	-0.280 ^b	.041
7-item fruit and vegetable scale score	-0.297 ^b	.029
BMI (kg/m ²)	-0.053 ^b	.748

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Relationship of Household Adult Food Security Status to Health Parameters

- * Researchers have found food security is associated with greater fruit and vegetable intake
- * Food insecurity is associated with consumption of a less healthy diet and overall lower nutrient intakes (Kirkpatrick and Tarasuk, 2008)
- * Studies from the Appalachian region have found that food insecure women have poorer produce intake and that food insecurity is associated with poorer perceived diet quality (Kropf et al. 2007)
- * Household food insecurity among low-income households was related to poorer produce intake related behaviors when compared to their food secure counterparts (Vardell, 2010)

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Household Adult Food Security Status and Depression

- * Hasin and others (2005) examined depression in women aged 18 - 44 years and found 12 to 14% of them had major depression.
- * Pheley and others (2002) found an inverse relationship when they examined specifically the relationship of food insecurity and mental health.

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<i>Relationship of Food Security Status to Health Parameters (continued)</i>		
Health parameter	Correlation coefficient ^{a,b}	p-value
Cholesterol		
Total (mg/dL)	0.007 ^b	.985
HDL (mg/dL)	0.303 ^b	.365
LDL (mg/dL)	-0.126 ^b	.729
TG (mg/dL)	0.186 ^b	.608
HbA1c (%)	0.334 ^b	.316
Fasting blood glucose (mg/dL)	0.264 ^b	.261

^aKendall's tau-b.
^bPearson's r.

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Participants Meeting Daily Produce Intake Recommendations

- * Participants with produce intake data (n = 52)
- * Met Recommendations:
 - * 34 (65.4%) vegetable
 - * 37 (71.2%) fruit
 - * 36 (69.2%) total produce intake
- * Individuals who were fully food secure were more likely to meet vegetable and total produce intake recommendations.

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<i>Adult Females with PCOS Living in Rural Appalachian Ohio Meeting the Recommended Daily Produce Intake (n = 52)</i>			
Indicator	Recommended daily intake n (%)		
	Met	Did not meet	p-value ^d
Daily vegetable intake^a			
Fully food secure (n = 34)	27 (79.4)	7 (20.6)	.003
Not fully food secure (n = 18)	7 (38.9)	11 (61.1)	
Daily fruit intake^b			
Fully food secure (n = 34)	26 (76.5)	8 (23.5)	.245
Not fully food secure (n = 18)	11 (61.1)	7 (38.9)	
Daily total produce intake^c			
Fully food secure (n = 34)	27 (79.4)	7 (20.6)	.029
Not fully food secure (n = 18)	9 (50.0)	9 (50.0)	

^a≥ 2 servings (ChooseMyPlate.gov).
^b≥ 1.5 servings (ChooseMyPlate.gov).
^c≥ 3.5 servings (ChooseMyPlate.gov).
^dPearson chi-squared.

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Participants Meeting Daily Produce Intake Recommendations

- * Fully food secure women were more likely to meet the recommended intakes
 - * Significant difference were found when comparing the fully food secure participants to their not fully food secure counterparts for daily vegetable intake and daily total produce intake.
 - * This could be due to individuals residing in a food insecure household having an overall lower income when compared to non-Appalachian regions, resulting in less money for groceries such as fresh produce.
 - * Many food insecure households might buy more affordable energy-dense, less nutritious food sources.

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Conclusions and Recommendations

- * Overall, this study demonstrated that in the Appalachian region food insecure females with PCOS had a greater degree of depression and poorer produce intakes when compared to their food secure counterparts.

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Limitations of Study

- * Vague definition on PCOS, not uniformly agreed upon
- * Clinical diagnosis of PCOS, some women not diagnosed
- * Convenience sample
 - * Those responding might not be representative of the population as a whole
- * Not all participants included the signed consent to access their medical records
- * Several women did not have available recent lab values to add to our biochemical data analysis
- * Lack of previous research on food insecurity and PCOS

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Limitations Continued

- * Time and money for recruiting
 - * Greater incentive
 - * Meet with each participant to go through the survey
 - * Incomplete or did not return consent form
- * Using the survey through the mail gave us a total response rate of 20%, try email

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Limitations Continued

- * Reliability of self-reported data, bias or not known answer
- * The survey used has been found to accurately portray food security status although food security status may have been inaccurately reported due to the responses of the women.
- * No differences were seen by food security status when comparing BMI, blood glucose, and lipid panels.
- * With a greater sample size, different results could have been yielded.

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Recommendations

- * Our study showed that depression in women with PCOS is significantly related to food security status, similar results could be seen in a larger sample size.
- * To gain more meaningful information, future studies should examine food insecure females with PCOS and the specific causes of their depression.

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Recommendations

- * The findings from our study could be useful for health professionals when diagnosing or talking with patients that have PCOS.
- * It would be interesting in future studies to explore what type of produce these women were consuming, whether it is fresh, frozen, or canned.
- * Also, the women might have under- or over-reported their fruit and vegetable intakes. It would be ideal if the females were instructed on what a serving size would be to gain the most accurate results.

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Recommendations

- * Ideally, a program for females with PCOS could be created.
 - * Support group with an education component that could help the women answer any uncertainties they might have about the syndrome
- * The class should also bring in experts to talk about other issues such as depression that could be possibly occurring, and how this can affect the women in their daily activities.
- * Another component to this class could be learning how to garden.

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Conclusion

- * Future research on PCOS would be beneficial to explore and gain a greater insight into the syndrome and the relationship it has to food security status, produce intake, depression, and other variables.

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References

- * Anderson, S. (1990). Core indicators of nutritional state for difficult-to-sample populations. *The Journal of Nutrition*, 120(Suppl 11) 1559-1604.
- * Coleman-Jensen, A., Gregory, C., and Singh, A. Household Food Security in the United States in 2013, ERR-173, U.S. Department of Agriculture, Economic Research Service, September 2014.
- * Pollard, K., & Jacobsen, L. (2014). The Appalachian Region: A Data Overview From the 2008-2012 American Community Survey Chartbook. Retrieved August 30, 2014, from http://www.arc.gov/assets/research_reports/DataOverviewfrom2008-2012ACS.pdf
- * Diamanti-Kandarakis, E. (2006). Insulin resistance in PCOS. *Endocrine*, 30(1), 13-17.
- * Lorenz, L., & Wild, R.A. (2007). Polycystic ovarian syndrome: An evidence-based approach to evaluation and management of diabetes and cardiovascular risks for today's clinician. *Clinical Obstetrics and Gynecology*, 50(1), 226-243.
- * Balen, A. H., Dresner, M., Scott, E. M., Drife, J. O. (2006). Should obese women with polycystic ovary syndrome receive treatment for infertility? *BMJ*, 332, 434-435.

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References

- * Holben, D. (2010). Position of the American Dietetic Association: food insecurity in the United States. *Journal of the American Dietetic Association*, 110(9), 1368-77.
- * Holben, D., & Phelley, A. (2006). Diabetes risk and obesity in food-insecure households in rural Appalachian Ohio. *Prev Chronic Dis*, 3(3), A82.
- * Gorimani, E. T., & Holben, D. H. (1999). WIC program participants in rural Appalachia may be prone to food insecurity: A pilot study. *Journal of the American Dietetic Association*, 99(9), A25.
- * Nord, M., Coleman-Jensen, A., ERS, USDA. Food Security in the United States: History of the Food Security Measurement Project. 2009. <http://www.ers.usda.gov/Briefing/FoodSecurity/history.htm#early>
- * ChooseMyPlate.gov Available from <http://choosemyplate.gov/>
- * Lyles, C. R., Wolf, M. S., Schillinger, D., Davis, T. C., DeWalt, D., Dahake, A. R., Seligman, H. K. (2013). Food Insecurity in relation to changes in hemoglobin A_{1c}, self-efficacy, and fruit/vegetable intake during a Diabetes Educational Intervention. *Diabetes Care*, 36(6), 1448-1453. doi:10.2337/dc12-1961

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References

- * Deepika, L. M., Ranjith, K. K., Maruthi, G. G., & Jahan, P. P. (2011). Polycystic Ovary Syndrome: A Package of Complex Diseases. *IUP Journal Of Genetics & Evolution*, 4(1), 54-59.
- * Seligman, H. K., Bindman, A. B., Vittinghoff, E., Kanaya, A. M., & Kushel, M. B. (2007). Food insecurity is associated with diabetes mellitus: Results from the national health examination and nutrition examination survey (NHANES) 1999-2002. *Journal of General Internal Medicine*, 22(7), 1018-1023.
- * American Heart Association. "Numbers That Count for a Healthy Heart." N.p., n.d. Web. http://www.heart.org/HEARTORG/Conditions/MoreToolsForYourHealth/NumbersThatCountforaHealthyHeart_UCM_305432_Article.jsp
- * Kirkpatrick & Tarasuk, (2008). Food insecurity is associated with nutrient inadequacies among Canadian adults and adolescents. *J Nutr*, 2008 Mar;138(3):604-12.
- * Kropp, M. L., Holben, D. H., Holcomb, J. P. Jr., & Anderson, H. (2007). Food security status and produce intake and behaviors of special supplemental nutrition program for women, infants, and children and farmers' market nutrition program participants. *Journal of the American Dietetic Association*, 107(1), 1903-1908.
- * Vardell, M. J. (2010). Improving access to fresh produce by low-income households in Appalachian Ohio that obtain food from a rural food pantry (Master's thesis).
- * Hasin, D.S., Goodevin, R.D., Stinson, F.S., Grant, B.F. Epidemiology of major depressive disorder: results from the National Epidemiologic Survey on Alcoholism and Related Conditions. *Arch Gen Psychiatry* 2005;62:1097-1106.
- * Walker, J. L., Holben, D. H., Kropp, M. L., Holcomb, J. P. Jr., & Anderson, H. (2007). Household food insecurity is inversely associated with social capital and health in females from special supplemental nutrition program for women, infants, and children households in Appalachian Ohio. *Journal of the American Dietetic Association*, 107(11), 1989-1993.

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