# Knowledge and Perceptions of a Plant-Based Diet Among Individuals with Type 2 Diabetes and High Food Security Living in Rural Appalachian Ohio

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## Abstract

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Knowledge and Perceptions of a Plant-Based Diet Among Individuals with Type 2 Diabetes and High Food Security Living in Rural Appalachian Ohio

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Food insecurity is associated with an increase in prevalence rates of type 2 diabetes. Food insecurity is also associated with decreased levels of fruit and vegetable consumption. Similarly, type 2 diabetes is independently associated with lower intake levels of micronutrients in the diet. Plant–based diets are able to help increase food security through a reduction in average grocery costs, potentially increase micronutrient intake, as well as aid in the management and control of type 2 diabetes. This study was designed to explore the knowledge, perceptions, and barriers surrounding plant-based diets among participants with type 2 diabetes and varying levels of food security.

Men and women aged between 30-70 years, diagnosed with type 2 diabetes for at least 2 years, with an HbA1c below 14.0% and living in Appalachian Ohio were recruited for this study. The Household Food Security Survey Module was used to measure food security among participants; validated surveys measuring produce intake and behavior and diabetes-related emotional distress and depression were also used for descriptive purposes. Ten adults with type 2 diabetes (age = 54 ± 10 years, hemoglobin $A_{1c}$ = 7.1 ± 0.7%, diabetes duration = 8.6 ± 6.1 years, BMI = 32.8 ± 3.7, 50% female, 90% White, 60% married, 10% retired, 100% food secure) participated in in-depth face-to-face interviews lasting between 30-70 min. Circumstances prevented a sample with varying

levels of food security. The following results are for a highly food secure sample. Diabetes-related emotional distress and depression were low. Average self-reported fruit intake was 1.7 ± 0.9 servings daily. Average self-reported vegetable intake was 2.4 ± 1.3 servings daily. Overall, a lack of knowledge about plant-based diets existed among the majority of participants. Self-efficacy and social support surrounding the incorporation of a plant-based diet into one's lifestyle remained low due to several identified barriers. These barriers included time, spoilage of produce, access to fresh fruits and vegetables and convenience, cost, difficulty of giving up certain foods, and lack of support from family members and friends. In order to move this population towards the incorporation of more fruits and vegetables and plant-based meals, education connecting type 2 diabetes, nutrition, and plant-based diets needs to be provided to type 2 diabetes patients. Before this type of educational intervention can occur, more qualitative and quantitative research will need to occur to achieve data saturation and address the limitations of the current study.

## Dedication

*I would like to dedicate my work to my family, friends, and loving partner, who all provided me with the encouragement, support, and patience I especially needed during the time spent on this project.*

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# Chapter 1: Introduction

## Overview of Food Insecurity and Chronic Disease

Food insecurity, defined as inadequate access to enough food for an active healthy life due to lack of funds or other resources (Anderson, 1990), is a major problem in America today. In 2014, 14.0% of American households, or approximately 17.4 million families, experienced food insecurity at some point during the year (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2015). Additionally, the Appalachian region of southeastern Ohio has a food insecurity rate that is much higher on average. Holben and Pheley found that while the United States had an average rate of 10.1% food insecure households in 1999, the average rate in southeastern Ohio was 27.2%, with 20.1% being food insecure with hunger (Holben & Pheley, 2006). Food insecurity clearly needs to be addressed in the Appalachian Ohio region.

Reduced fruit and vegetable intake is found to be associated with food insecurity (Brown, Holben, Shubrook, & Schwartz, 2012; Drewnowski, 2010; Drewnowski & Darmon, 2005; Holben, 2012; Yeh et al., 2008). Research shows that women, young adults, and older adults who are food insecure have insufficient nutrient intake when compared to their food secure counterparts, likely from reduced fruit and vegetable intake (Dixon, Winkleby, & Radimer, 2001; Kendall, Olson, & Frongillo, 1996). One reason reduced fruit and vegetable intake occurs is due to lack of sufficient funds, resulting in purchasing foods that have a lower cost and are less likely to strain the budget (Drewnowski & Darmon, 2005; Yeh et al., 2008). These foods are often energy-dense but low in nutritional value (Drewnowski, 2010; Drewnowski & Darmon, 2005). In

addition, because fruits and vegetables have a higher actual cost, shoppers tend to forego buying them all together when funds are running low (Blisard & Stewart, 2006; Kirkpatrick & Tarasuk, 2008; Olson, 2005). For example, Canadians using food banks in British Columbia have a produce intake that is lower than the recommended levels, and the amount consumed decreases as food insecurity levels worsen (Holben, 2012). Food insecurity is also found to be associated with lower levels of produce intake in the rural Appalachian area of Ohio among those who have diabetes (Brown et al., 2012). Because adequate fruit and vegetable intake is important for good health, the lack thereof is a cause of concern.

Contributing to the lack of produce is the transition from periods of plenty of food to scarcity of food that households under the stress of food insecurity typically experience (Dinour, Bergen, & Yeh, 2007). The lack of proper and adequate nutrition, in addition to the "binge" eating created by the cycle of funds and amounts of food throughout each month, may be another contributor to the poor health outcomes associated with food insecurity, such as obesity and diabetes (Brown et al., 2012; Drewnowski, 2010; Drewnowski & Darmon, 2005; Dinour et al., 2007; Holben, 2012; Yeh et al., 2008).

The health issues that are associated with food insecurity include, but are not limited to, significantly higher rates of chronic diseases such as obesity, type 2 diabetes, and cardiovascular disease (Drewnowski & Darmon, 2005; Gooding, Walls, & Richmond, 2011; Holben & Pheley, 2006; Metallinos-Katsaras, Must, & Gorman, 2012; Ray, Holben, & Holcomb, 2012; Sarlio-Lahteenkorva & Lahelma, 2001; Seligman, Bindman, Vittinghoff, Kanaya, & Kushel, 2007; Seligman, Laraia, & Kushel, 2010;

Tarasuk, Mitchell, McLaren, & McIntyre, 2013; Tayie & Zizza, 2009; Townsend, Peerson, Love, Achterberg, & Murphy, 2001). For example, people who are experiencing very low food security have a higher risk and prevalence of diabetes than those who are food secure (Seligman et al., 2007). Rates of diabetes among the food secure are 11.7%, as compared to 16.1% among those experiencing very low food security (Seligman et al., 2007). Among those instances of diabetes, obesity accounts for only 20%. Although diabetes is found to be associated independently in most cases, obesity is still a concern among those who are food insecure. For example, Gooding et al. (2011) found that women experiencing food insecurity have an increased body mass index (BMI), on average 0.9 $kg/m^2$ higher than those who are food secure. Additionally, participants in Appalachia have higher rates of obesity (48.1%) when food insecure compared to those who are food secure (35.1%), as well has higher rates of self-reported diabetes (37.9% compared to 25.8%) (Holben & Pheley, 2006). Thus, food insecurity is a relevant factor in the health status among this population. Interestingly, it has been found that having a chronic disease contributes to food insecurity and that having increased numbers of chronic illnesses results in even higher levels of food insecurity, creating an almost cyclic relationship between the two (Tarasuk et al., 2013).

**Diabetes and Related Dietary Outcomes**

Type 2 diabetes is the most common form of diabetes seen in America today (American Diabetes Association, 2014), and is significantly associated with food insecurity. This form of diabetes occurs when the body can no longer use insulin properly (American Diabetes Association, 2014). Specifically, the pancreatic beta cells

are no longer able to produce insulin properly in response to glucose in the blood. Insulin is important for the body because it regulates blood glucose, preventing both hypoglycemia and hyperglycemia (American Diabetes Association, 2014). In the case of type 2 diabetes, hyperglycemia is more common than hypoglycemia (American Diabetes Association, 2014). Complications that can occur include but are not limited to retinopathy, neuropathy and nephropathy, and cardiovascular damage (American Diabetes Association, 2014). Typically type 2 diabetes will be treated with suggestions for healthy eating, physical activity, and possibly oral medications to counteract the associated insulin resistance (American Diabetes Association, 2014). However, type 2 diabetes is a progressive disease. In later stages of the disease, the ability of the pancreatic beta cells to produce insulin decreases, and treatment may include insulin injection.

While food insecurity is associated with higher rates of type 2 diabetes and poor nutrient intake, diabetes is also independently related to inadequate nutrient intakes in adults (Kobayashi et al., 2013; Pitt, May, Colman, & Wraight, 2007). For example, one study found that Japanese patients with diabetes report consuming less than the estimated average requirement for vitamins A, $B_1$, C, calcium, magnesium, and zinc (Kobayashi et al., 2013). Other studies show similar results (Pitt et al., 2007). Based on these results, it is clear that those who have diabetes often do not consume an adequate level of micronutrients, which may result in poorer health and exacerbation of the disease. While inadequate levels of micronutrients may not be attributed entirely to a lack of fruits and vegetables in one's diet, many of the micronutrients lacking in diets for those with

diabetes are those that can be found in produce. Thus, it is likely that this population could benefit from a dietary intervention that promotes the increased consumption of fruits and vegetables.

**Plant-Based Diets, Dietary Quality, and Health**

Type of diet has also been studied in regard to proper, adequate nutrition and disease. Research shows that: (a) an increase in fruits and vegetables greatly decreases the risk of coronary heart disease (Joshipura et al., 2001; Tucker et al., 2005); (b) a diet high in plant-based foods is associated with a lower risk in overweight and obesity (Murtaugh et al., 2007); (c) plant foods decrease blood pressure, while red and processed meats increase it (Steffen et al., 2005); and (d) vegetarian diets high in plant foods are associated with reduced rates of diabetes (Fraser, 1999; Leitzmann, 2005). In addition, work by Flynn, Reinert, and Schiff (2013) finds that weekly food cost decreases on a plant-based diet, or a diet that encourages whole, plant-based foods and discourages meats, dairy products, and eggs as well as all refined and processed foods (Tuso, Ismail, Ha, & Bartolotto, 2013). Combined, these studies show that plant-based foods provide benefits to those who consume them.

While much research has been conducted to try to increase fruit and vegetable intake among those who are food insecure (Anderson et al., 2001; Herman, Harrison, & Jenks, 2006; Johnson, Beaudoin, Smith, Beresford, & LoGerfo, 2004; Miewald, Holben, & Hall, 2012), only one study has looked into the health and cost benefits associated with switching to a few plant-based meals a week (Flynn et al., 2013). A 6-week plant-based cooking program was provided by the Rhode Island Community Food Bank to all

participants who were then followed for a total of 6 months to determine if any associated benefits were present. Results show that participants increased both vegetable and fruit consumption weekly. In addition, weekly costs of groceries decreased, food insecurity decreased, and body mass index (BMI) significantly decreased. Thus, this study shows that not only increasing the number of plant-based foods, such as fruits and vegetables, but also incorporating several plant-based meals weekly provides tremendous benefits for participants under the stress of food insecurity.

**Theoretical Foundations**

The success of the aforementioned intervention in the study conducted by Flynn et al. (2013) is grounded in its conceptual framework. The Social Cognitive Theory (SCT) suggests that in order for a change in behavior to occur, in this case health behavior, one must have self-agency, or self-efficacy (Bandura, 1986, 1997). Without self-efficacy, which is the belief in one's own abilities, no change would be able to occur or be maintained. Not only is self-agency required, but social support is as well (Bandura, 2004). Social support can be defined as emotional, informational, instrumental or appraisal support provided by others within the person's environment. The informational and instrumental supports are key components in the above study–or rather, the observational learning that is provided. Many people, at any level of food security, may not know what a plant-based diet consists of or how to prepare meals that are plant-based. Without being shown the basics of a plant-based diet and its preparation, those who prepare meals may not be able to do so effectively. In the study by Flynn et al. (2013), participants were provided the necessary support and tools via the instructional

and informational 6-week cooking class. However, self-agency and motivation were needed as well for successful completion of and positive results from the intervention.

SCT is relevant not only in the study conducted by Flynn et al. (2013) but also for guiding future research related to food insecurity and plant-based diets. Because plant-based diets are not as common, social support and observational learning will be useful in providing the tools needed to grow the knowledge and use of plant-based diets in the hope of enhancing healthful behaviors in populations that can benefit from dietary intervention. As shown in Figure 1, the conceptual framework provided by SCT is very useful in showing the relationship between food insecurity, diabetes, and a plant-based diet and what is needed for long-term success with dietary intervention. Thus, when exploring these concepts, gaining deeper insight into factors related to SCT is vital. The current study will explore the environmental and behavioral factors seen below.

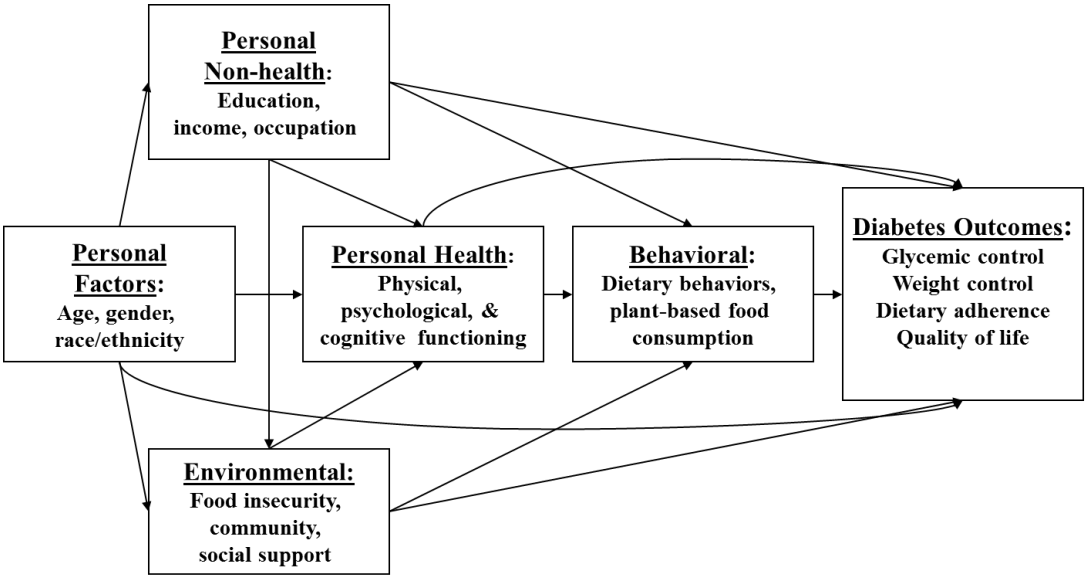


*Figure 1.* Conceptual framework showing relationship among food insecurity, plant-based diet, and diabetes outcomes.

**Statement of Problem and Significance**

Because an increase in plant-based foods can prevent or reduce the risk of some chronic diseases in a cost-effective manner, it is important to further investigate the potential ability of a plant-based diet in reducing the risk of these diseases, particularly in the food insecure population–a population that is at a higher risk of these diseases and one that may benefit from a reduction in food costs. However, based on SCT, it is also important to investigate the knowledge and perceptions, and especially the perceived benefits and barriers, which are present with regard to a plant-based diet in order to create future interventions that will be effective.

**Research Questions**

The current study aimed to investigate the knowledge and perceptions of plant-based diets and its associated benefits and barriers among adults with type 2 diabetes, who may be experiencing food insecurity. The specific research questions for the study follow.

1. How does knowledge of plant-based diets among type 2 diabetes patients vary by food security level?
2. How does perception of plant-based diets among type 2 diabetes patients vary by food security level?
3. What are the barriers to plant-based food consumption among type 2 diabetes patients, and do they vary by food security level?

**Limitations and Delimitations**

Study limitations include the small, homogenous sample from one region in the Midwestern United States, as participants were recruited from various health care centers located in and around Athens, Ohio. Additionally, the inclusion of Ohio University faculty and staff resulting from recruitment issues leads to further homogeneity and may have limited generalizability to the larger population. The recruitment issues also did not allow for varying levels of food security within the participant sample. Next, cultural and social variations regarding fruit and vegetable access among adults with type 2 diabetes were not addressed and warrant further study. Further, social desirability may have influenced participants' reporting of barriers to fruit and vegetable consumption behaviors as well as fruit and vegetable security among adults with type 2 diabetes. Questions asked in the interview guide may have been too specific; this may have taken away from potential data regarding other forms of fruits and vegetables. Only one question was asked regarding knowledge, which may have resulted in less information than could have been elicited. Finally, qualitative research is exploratory and the findings should be considered hypotheses. Quantitative research with a larger, more representative sample will be needed to examine these hypotheses.

Study delimitations included the decision to use individual semistructured interviews instead of focus groups so as to avoid influence of participants on answers and enable a longer period of time for responses to the questions. Additionally, due to decisions regarding the recruitment issues, the small sample size did not allow for data saturation.

**Definition of Terms**

**Audit trail.** An audit trail is a transparent description of the research steps taken from the start of a research project to the development and reporting of findings (Morse & Field, 1995).

**Body mass index (BMI).** Measurement of body fat based on height and weight (CDC, 2011a).

**Cardiovascular disease.** In general, set of conditions that involve narrowed or blocked blood vessels leading to a stroke, heart attack, or chest pain (American Heart Federation, 2011).

**Chronic disease.** A condition that is long lasting and cannot be cured, but controlled (CDC, 2011b).

**Confirmability.** Confirmability refers to the objectivity or the degree to which the findings can be confirmed or corroborated by others. Confirmability can be established with the use of the inquiry audit (researchers' peer review the study and reflexive journal (journal to record your thoughts throughout the study) (Morse & Field, 1995).

**Content analysis.** Content analysis is a qualitative technique for systematic text analysis. More specifically, content analysis is analysis by topic, and each interview is segmented by topics into categories. Codes identify the content in the interview, and category labels are descriptive names for each group of data (Morse & Field, 1995).

**Credibility.** Credibility (comparable to internal validity) refers to the accuracy of the information obtained in a study. Credibility of the data can be maintained via

triangulation of data sources, methods, and investigators; or when multiple data sources provided the same interpretation (Morse & Field, 1995).

**Dependability.** Dependability refers to the consistency of the data (Lincoln & Guba, 1985).

**Field notes.** Notes recorded by researchers during or after their interview or observation of a specific phenomenon they are studying (Morse & Field, 1995).

**Food insecurity.** Inadequate access to enough food for an active healthy life due to lack of funds or other resources (Anderson, 1990).

**Food security.** Access by all people at all times to enough food for an active, healthy life (Anderson, 1990).

**High food security.** Range of food security; no problems or limitations with food access (USDA, 2006).

**Low food security.** Range of food insecurity; reduced quality, variability, or desirability but not of quantity in regard to food (USDA, 2006).

**Marginal food security.** Range of food security; one or two problems, typically with anxiety due to shortage of food but with no change in quality or quantity of diet (USDA, 2006).

**Obesity.** A BMI of 30 or higher (CDC, 2012).

**Plant-based.** A diet that encourages whole, plant-based foods and discourages meats, dairy products, and eggs as well as all refined and processed foods (Tuso et al., 2013).

**Purposive sampling.** A form of nonprobability sampling in which participants are selected for a study based on specific criteria, which may include special knowledge of the research issue (Seidman, 2013).

**Social Cognitive Theory (SCT).** Theory with conceptual framework identifying self-efficacy and social-support as key in sustained behavior change (Bandura 1986, 1997, 2004).

**Theme.** A theme represents an abstract concept, linking substantial portions of the interviews together (Seidman, 2013).

**Transferability.** Transferability (comparable to external validity) is the extent to which study findings are transferable, or generalizable, to other contexts. Transferability can be supported via thick descriptions of the research context and assumptions and verbatim quotations included in the data (Lincoln & Guba, 1985).

**Triangulation.** In qualitative research, triangulation involves using two or more different methods to check the findings in order to increase the validity of a study (Morse & Field, 1995).

**Type 2 diabetes.** Condition in which the pancreatic beta cells of the body no longer produce insulin properly resulting in hyperglycemia (ADA, 2014).

**Vegan.** A diet excluding all animal products including meat, eggs, and dairy in addition to animal byproducts (Miriam-Webster, 2014a).

**Vegetarian.** A diet excluding only certain animal products, but always meat. Can exclude either dairy or eggs, but not necessary (Miriam-Webster, 2014b).

**Very low food security.** Range of food insecurity; multiple indications of reduced quality and quantity of diet (USDA, 2006).

# Chapter 2: Literature Review

## Overview of Chapter

The current study aimed to investigate the knowledge and perceptions of plant-based diets and the associated benefits and barriers among adults with type 2 diabetes who may be experiencing food insecurity. This chapter will review the relevant research in regard to food insecurity, health disparities, and plant-based diets and how these factors interact with each other. The Social Cognitive Theory (SCT) in relation to the current project will be discussed further.

## Food Insecurity

**Overview of food insecurity.** Food insecurity, or inadequate access to enough food for an active healthy life due to lack of funds or other resources, is not a problem that is new in our world today (Maxwell & Smith, 1992). While food insecurity has been around for quite some time, the definitions and measurement tools used to identify the different levels of food insecurity are relatively new. In fact, the first definition for food insecurity was created at the World Food Conference in 1974 with a definition that focused on food supply and stability of costs (United Nations, 1975). Since then the term has grown to include multiple ideas sourced from different events and organizations, such as food access and availability. The most current definitions as provided by the U.S. Department of Agriculture in 2006 are displayed in Table 1.

Table 1

*Definition of Food Security and Insecurity with Associated Levels*

| Term | Definition |
|---|---|
| High food security | No reported indications of food-access problems or limitations. |
| Marginal food security | One or two reported indications--typically of anxiety over food sufficiency or shortage of food in the house. Little or no indication of changes in diets or food intake. |
| Low food security | Reports of reduced quality, variety, or desirability of diet. Little or no indication of reduced food intake. |
| Very low food security | Reports of multiple indications of disrupted eating patterns and reduced food intake. |

*Note.* Adapted from "Definitions of Food Security," 2006. Retrieved November 7, 2015, from the 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

Food insecurity can start or be exacerbated through a variety of different situations. These situations can include limited funds or resources as in poverty, limited accessibility to food, increases in food cost, natural disasters, or having a chronic disease (Tarasuk et al., 2013). The status of food insecurity for a person or within a family is continually changing based on these and other factors. The levels of food insecurity refer to any point over the course of a year and are measured by specific food insecurity measurement tools. These tools are discussed in the following section.

**Food insecurity measurement tools.** The definitions in Table 1 help to explain the different levels of food insecurity that are present, particularly in the United States. These different levels of food insecurity show to what extent someone may be struggling to access enough food. In addition, many studies use these levels of food insecurity when studying the effects of food insecurity on items such as human health outcomes. The current measurement tool used in the United States for food insecurity is the Food Security Supplement (FSS), attached as a supplement to the Current Population Survey (CPS) (Wunderlich & Norwood, 2006). While the FSS is not used to determine eligibility, programs are available to aid with food insecurity. The Supplemental Nutrition Assistance Program, or SNAP, formerly known as the food stamp program, is one of these programs. Eligibility is based on household resources, income, and deductions.

The formulation of the FSS began in 1990, when a Ten-Year Comprehensive Plan was started with the goal to create a standard tool with which to measure food insecurity (U.S. Department of Agriculture, 2014). A study was conducted to create a definition for hunger and to examine the validity and reliability of items designed to measure the agreed-upon definition (Radimer, Olson, & Campbell, 1990). In 1992, research of previous literature on the topic began that provided information on the conceptual basis as well as the problems or issues that existed with creating a survey tool for food security in the United States (U.S. Department of Agriculture, 2014). Based on these studies and on a meeting held in 1994, the FSS was created and then tested in April 1995 (U.S. Department of Agriculture, 2014). After several administrations of the survey, the

measurement scale was established and validated (U.S. Department of Agriculture, 2014). After its initial use in 1995, the FSS has continued to be used every year (U.S. Department of Agriculture, 2014). Since 2001, the survey has been provided regularly in December to control for time of year (U.S. Department of Agriculture, 2014).

The FSS uses over 70 questions that relate to household food use and experiences. It asks for recollection over the past year in addition to the month in which a household is being surveyed and covers five areas of food security. These five sections include expenditures, the minimum amount needing to be spent, participation in food assistance programs, food sufficiency and security, and ways of coping when the amount of food in a household is not sufficient. The section that is used specifically to measure and calculate levels of food security or insecurity is the Household Food Security Survey Module (HFSSM) and contains 18 questions.

The 18 questions used to measure food insecurity cover anxiety over lack of resources for food, insufficiency in quality, and reduced quantity of food intake or hunger. Each of the questions also measures the range of severity of the household's experience. The specific questions and scoring information used are in Appendix A.

**Food insecurity in the United States.** In 2014, 14.0% of American households, or approximately 17.4 million families, experienced food insecurity at some point during the year (Coleman-Jensen et al., 2015). In southeastern Ohio, an Appalachian region, food insecurity rates tend to be much higher. Holben and Pheley (2006) found that while the United States had an average rate of 10.1% food insecure households in 1999, the

average rate in southeastern Ohio was 27.2%, with 20.1% being food insecure with hunger.

**Food Insecurity and Health Outcomes**

One of the greatest concerns of food insecurity is the correlation it has to higher risks and rates of chronic disease (Seligman et al., 2010). Food insecurity is associated with overweight and obesity in relation to BMI, diabetes, nutritional inadequacies, and overall poorer health in those who are food insecure, although there are mixed results (Drewnowski & Darmon, 2005; Gooding et al., 2011; Holben & Pheley, 2006; Kirkpatrick & Tarasuk, 2008; Metallinos-Katsaras et al., 2012; Ray et al., 2012; Sarlio-Lahteenkorva & Lahelma, 2001; Seligman et al., 2007, 2010; Tarasuk et al., 2013; Tayie & Zizza, 2009; Townsend et al., 2001; Vozoris & Tarasuk, 2003). It is important to examine these disparities in order to find ways in which to prevent further exacerbation of these chronic diseases and create interventions within this population.

**Overweight, obesity, and BMI.** Many studies have focused on overweight and obesity. According to a study that investigated a representative sample of the population of Finland, people who were obese or very thin were more likely to report being food insecure when compared to those who were of normal weight status (Sarlio-Lahteenkorva & Lahelma, 2001). This study showed that food insecurity could affect weight. Several studies indicated that food insecurity is mainly associated with a higher risk of overweight and obesity in women but not men (Gooding et al., 2011; Holben & Pheley, 2006; Tayie & Zizza, 2009; Townsend et al., 2001). Using the Add Health database and taking into account such factors as race, income, education level, smoking and drinking

habits, activity level, and use of food assistance programs, the relationship of increased BMI due to food insecurity existed only among young women (Gooding et al., 2011). Another study measured levels of food insecurity and related levels of high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), total cholesterol (TC), triglyceride levels (TG), and LDL/HDL-C, TC/HDL-C, and TG/HDL-C ratios (Tayie & Zizza, 2009). Women, but not men, with food insecurity at varying levels had higher rates of abnormal levels of the cholesterol and triglyceride measurements and higher risk of overweight or obesity (Tayie & Zizza, 2009). Townsend et al. (2001) reported similar results within a nationally representative sample of the United States. In this study, food insecurity and BMI were evaluated, and while there was a relationship between the two only among women, the level of food insecurity interestingly increased as BMI increased as well (Townsend et al., 2001). Holben and Pheley (2006) also found BMI and obesity to be associated with those living in food-insecure households, again especially among women. The stronger relationship found between obesity and food insecurity among women may be due to cycles of food deprivation and overeating more likely occurring among women due to their desire to protect their children from hunger (Dammann & Smith, 2009; Edin et al., 2013).

The studies above focused on adults, but the relationship between food insecurity and obesity exists in young children as well (Metallinos-Katsaras et al., 2012). Persistent food insecurity without hunger was associated with increased weight status of children in preschool (Metallinos-Katsaras et al., 2012). An additional factor playing a role on the weight of these children was the pre-pregnancy weight of the mother; both underweight

and overweight food insecure mothers tended to have children who had a higher weight status by preschool (Metallinos-Katsaras et al., 2012). Therefore, not only did the food insecurity of the child determine their weight, but the level of food insecurity and weight of the mother did as well.

Drenowski and Darmon (2005) suggested possible reasons behind the poverty and obesity relationship. One reason was that people in a financial bind typically purchased items that were less costly, and these lower-cost items were usually energy dense but nutrient poor. This idea of a higher consumption of low cost, energy dense, low nutrient dense foods by those who are food insecure was verified in a study conducted by Kirkpatrick & Tarasuk (2008). The study identified that food insecure adults and adolescents had lower nutrient intakes when compared to those in food secure households. Specifically for adults, an increase in the energy density of foods consumed was associated with those who were food insecure, in addition to a lower intake of meat, fruits, and vegetables. A summary of this information is located in Table 2.

Table 2

*Food Insecurity and Overweight, Obesity, and BMI Summary*

| Study subjects | Study result | Reference |
|---|---|---|
| Representative nationwide sample of Finnish men and women, 25-64 years old | Obese or very thin participants more likely to have food insecurity compared to those with normal weight | Sarlio-Lahteenkorva & Lahelma, 2001 |
| Adolescents in grades 7-12, again measured at ages 24-32 | Food insecurity related to increased BMI in young women, but not men | Gooding et al., 2011 |
| Low income preschool aged children in Massachusetts WIC and their mothers | Persistent food insecurity without hunger associated with increased weight status of children in preschool; underweight/ overweight food insecure mothers have children with higher weight | Metallinos-Katsaras et al., 2012 |
| Men and women in the National Health and Nutrition Examination Survey 1999-2002, 18-50 years old | HDL-C, LDL-C, TC, TG, and associated ratios higher in food insecure women, but not men; food insecure women have higher risk of overweight or obesity | Tayie & Zizza, 2009 |
| Nationally representative U.S. population sample, 20+ years old | Food insecurity and BMI relationship only among women; as level of food insecurity increases BMI increases as well | Townsend et al., 2001 |

**Diabetes.** Due to this project focusing on those who have type 2 diabetes, the nature of this chronic illness is explained in detail. As mentioned in chapter 1, type 2 diabetes is currently the most common form of diabetes in America (American Diabetes Association, 2014). Ninety to 95% of diagnosed cases in adults are type 2 diabetes (Centers for Disease Control and Prevention, 2014). This form of diabetes occurs when

the body can no longer use insulin properly, known as insulin resistance (American Diabetes Association, 2014). Insulin, a hormone, is extremely important in the regulation of glucose in the blood and body. Without it, glucose uptake into muscle and adipose, or fat, tissue in the body cannot occur properly, if at all (Ross, Gulve, & Wang, 2004). This results in hyperglycemia, or too much glucose in the blood. Because insulin is so important, the body will try to compensate for insulin resistance by producing higher insulin levels in an attempt to promote glucose uptake by the cells (Ross et al., 2004). Eventually, the pancreatic beta cells that produce insulin become worn out and are no longer able to continue producing insulin (Ross et al., 2004). Thus, most people who have type 2 diabetes will eventually need to insulin injections to compensate for that fact (Ross et al., 2004). The cause of type 2 diabetes is complex, likely resulting from several different factors. These factors include genetics, type of diet, level of physical activity, and the age of the person (Ross et al., 2004). Many times, obesity is a predisposing factor for acquiring type 2 diabetes (Kodama et al., 2014).

Many studies have shown that food insecurity is related to an increase in type 2 diabetes prevalence (Bawadi et al., 2012; Berkowitz, Baggett, Wexler, Huskey, & Wee, 2013; Berkowitz, Gao & Tucker, 2014; Galesloot, McIntyre, Fenton, & Tyminski, 2012; Gucciardi, Vogt, DeMelo, & Stewart, 2009; Holben & Pheley, 2006; Lyles et al., 2013; Ray et al., 2012; Seligman et al., 2007; Seligman, Jacobs, Lopez, Tschann, & Fernandez, 2012). More specifically, self-reported diabetes was higher among those who identified as food insecure in rural Appalachian Ohio (Holben & Pheley, 2006). Additionally, food insecurity rates among Navajo women with children on an Arizona reservation were

relatively high compared to other populations. As the levels of food insecurity increased within this population, the risk of diabetes increased as well (Ray et al., 2012). The same increase in the risk or prevalence of diabetes as food insecurity worsened existed among Puerto Rican adults (Berkowitz et al., 2014). A decrease in perceived diet quality, lower consumption of fruits and vegetables, and poorer glycemic control was seen among the food insecure as well (Berkowitz et al., 2014). Evidence from the National Health and Nutrition Examination Survey (NHANES) study showed that food insecurity was related to diabetes, independent of obesity, among a nationally representative sample of participants with low income (Seligman et al., 2007).

Another study using NHANES found that food insecurity was significantly associated with poor glycemic control among adults with diabetes (Berkowitz et al., 2013). Poor glycemic control, lower diabetes self-efficacy, and higher emotional diabetes distress were found again to be associated among adults with type 2 diabetes at higher levels of food insecurity (Seligman et al., 2012). Other studies also have shown the relationship between food insecurity and poor glycemic control (Bawadi et al., 2012; Seligman, Davis, Schillinger, & Wolf, 2010). A summary of this information is located in Table 3.

Table 3

*Food Insecurity and Diabetes Summary*

| Study subjects | Study result | Reference |
|---|---|---|
| Adults aged 18+ in rural Appalachian Ohio | Self-reported diabetes higher among food insecure in sample from Appalachian Ohio | Holben & Pheley, 2006 |
| Adults aged 20+ with income levels less than 300% of federal poverty level | Food insecurity related to diabetes, independent of obesity, among nationally representative sample of participants with low income from NHANES study | Seligman et al., 2007 |
| Adult females aged 18+ living on Navajo reservation | Food insecurity rates among Navajo women with children on Arizona reservation relatively high compared to other populations; as levels of food insecurity increase, risk of diabetes increases as well | Ray, et al., 2012 |
| Adults with type 2 diabetes aged 22-84; adults with diabetes in NHANES aged 20+; adults 18+ years with type 2 diabetes; adults 18+ with diabetes | Food insecurity found to be related to poor glycemic control in diabetic adults | Bawadi et al., 2012; Berkowitz et al., 2013; Seligman et al., 2010, 2012 |
| Puerto Rican adults with diabetes aged 45-75 years of age | Food insecurity found to be associated with diabetes in Puerto Rican adults; as food insecurity worsens there is higher prevalence of diabetes | Berkowitz et al., 2014 |
| Adults 18+ with diabetes from Canada | Diabetes found to be associated with food insecure Canadian adults | Galesloot et al., 2012; Gucciardi et al., 2009 |

***Diabetes in Appalachia.*** Regardless of food insecurity level, those living in distressed counties (worst 10% compared to all counties based on economic development including 3-year unemployment rate, per capita income, and poverty rate as compared to national rates) in Appalachia had a 33% higher odd of reporting diabetes than those living in nonAppalachian counties (Barker et al., 2010). Self-report of diabetes was higher in distressed Appalachian counties when compared to nondistressed Appalachian counties (Barker et al., 2010). Higher self-report of diabetes in rural Appalachian Ohio was found when compared to other counties in Ohio and national data as well (Schwartz et al., 2009). Additionally, those living in distressed counties in Appalachia reported diagnosis of type 2 diabetes at a younger age, on average (Barker, Gerzoff, Crespo, & Shrewsberry, 2011). Compared to nonAppalachian counties with an average age at diagnosis of 51.3, those in distressed Appalachian counties reported at average age at diagnosis of 50.0 (Barker et al., 2011).

**Cardiovascular disease.** Risk factors of cardiovascular disease include but are not limited to hypertension, obesity, high cholesterol, diabetes, and unhealthy diets (World Heart Federation, 2014). The previous studies already addressed the effects of each of these factors in relation to food insecurity with the exception of hypertension. Seligman et al. (2010) found a relationship between food insecurity and an increase in high blood pressure, both in self-reports and examination data, among participants in the NHANES study. However, studies have also shown high blood pressure and blood pressure control to be unassociated with food insecurity (Berkowitz et al., 2013; Holben & Pheley, 2006). A summary of this information is located in Table 4.

Table 4

*Food Insecurity and High Blood Pressure Summary*

| Study subjects | Study result | Reference |
|---|---|---|
| Adults aged 18-65 in NHANES below 200% federal poverty level | Among NHANES participants, food insecurity related to increase in high blood pressure for both the examination and self-reported data | Seligman et al., 2010 |
| Adults with diabetes in NHANES aged 20+ | High blood pressure not related to food insecurity | Berkowitz et al., 2013 |
| Adults aged 18+ in rural Appalachian Ohio | High blood pressure not related to food insecurity | Holben & Pheley, 2006 |

**Lower nutrient and produce intakes.** Several studies indicated that those who were food insecure tended to have overall lower nutrient intakes, which will be further exemplified by the following studies (Brown et al., 2012; Dixon et al., 2001; Drewnowski, 2010; Drewnowski & Darmon, 2005; Holben, 2012). Women who were food insecure tended to consume less fruits and vegetables, resulting in less potassium, fiber, and vitamin C intake than women who were food secure (Kendall et al., 1996). Similarly, food insecure young adults had inadequate levels of calcium and vitamin E, while older adults experienced insufficient amounts of iron and zinc; both groups had lower vitamin A levels than their food secure counterparts (Dixon et al., 2001). Inadequate nutrient intakes can cause many health problems as vitamins and minerals are essential for good health. A summary of this information is located in Table 5.

Table 5

*Food Insecurity and Nutrient and Produce Intake Summary*

| Study subjects | Study result | Reference |
|---|---|---|
| Women aged 15-40 years of age with children | Food insecure women consume less fruits and vegetables; less potassium, fiber, and vitamin C intake than women who are food secure | Kendall et al., 1996 |
| Nationally representative sample of adults aged 20-59 years and older adults aged 60+ | Food insecure young adults have inadequate levels of calcium and vitamin E; older adults have insufficient amounts of iron and zinc; both groups have lower vitamin A levels than their food secure counterparts | Dixon et al., 2001 |
| Canadian adults aged 18+ using food banks | Produce intake lower than recommended levels in Canadians using food banks in British Columbia; amount consumed decreases as food insecurity levels worsen | Holben, 2012 |
| | Those who are food insecure tend to consume energy dense but nutrient poor foods | Drewnowski, 2010; Drewnowski & Darmon, 2005 |
| Adults aged 37-69 years with diabetes and food insecurity in Appalachian Ohio | Food insecurity associated with lower levels of produce intake in rural Appalachian area of Ohio among those who have diabetes | Brown et al., 2012 |

**Bidirectional relationship of chronic disease to food insecurity.** While the studies above showed that food insecurity is correlated to increased risks of chronic disease, chronic disease is also able to predict food insecurity. Tarasuk et al. (2013) showed that food insecurity worsened as the intensity or number of chronic diseases

increased or from more than one person in a household with such an illness. The reason behind this bidirectional effect of food insecurity and chronic disease was that increased funds might have been used towards maintaining the chronic disease, therefore taking more money away from food and its associated beneficial nutrients. This in turn, as seen above, has the potential to exacerbate the chronic disease even further.

**Diabetes and Its Associated Dietary Outcomes**

Type 2 diabetes has been found to be independently related to inadequate nutrient intakes in adults (Kobayashi et al., 2013; Pitt et al., 2007). For example, Japanese patients with diabetes consumed less than the estimated average requirement for vitamins A, thiamin, C, calcium, magnesium, and zinc (Kobayashi et al., 2013). A study evaluating the nutrient intake of adults with diabetes who have related foot complications found that calcium, folate, magnesium, riboflavin, vitamin A, and zinc were all below the recommended dietary intakes (Pitt et al., 2007).

As the above research suggests, food insecurity has a great effect on chronic disease (and vice versa), and both food insecurity and diabetes are independently related to inadequate nutrient intake. It is of great importance to find ways to prevent such an effect for food insecure populations in order to increase public health and reduce the health disparities that are present.

**Plant-Based Diets**

**Description.** A plant-based diet is one in which plant foods are the majority of foods consumed; little or no animal products are contained within the diet (McDougall & McDougall, 1997; Tuso et al., 2013). This means that main staples include whole grains,

legumes, fruits, vegetables, nuts, and seeds (McDougall & McDougall, 1997; Tuso et al., 2013). Foods that are often avoided include items such as dairy, eggs, meat, and animal derivatives such as gelatin. Another name for this type of diet is vegan; however, as the current study's goal is to move people toward eating a more plant-based diet and the avoidance of more animal-based foods, the term plant-based is used.

The reasons people choose to eliminate animal foods from their diet are abundant and lie within four main categories. These different categories include personal health benefits, the benefit to the environment, ethics as related to the treatment of animals, and the religion to which one adheres (Haverstock & Forgays, 2012; UK Department of Education, 2007). While the reason someone may eat a plant-based diet can vary, the health benefits associated with this type of diet are clear.

**Health benefits of plant-based foods.** The following section focuses on and describes the health benefits that occur by either changing the diet to one that is plant-based or by incorporating a higher level of fruits and vegetables into the diet. The specific chronic diseases that will be looked at in detail are obesity, diabetes, and cardiovascular disease. While the current study will focus only on those with diabetes for the purpose of this thesis' population sample, it is important to understand the health effects this diet can have on other types of chronic illnesses as well. In addition, many times obesity can lead to acquiring type 2 diabetes (Kodama et al., 2014), and obesity and type 2 diabetes are risk factors for cardiovascular disease (World Heart Federation, 2014).

***Overweight, obesity, and BMI.*** Among both Hispanic and nonHispanic white women, a relationship existed among dietary patterns, macronutrient composition, and the risk of being overweight or obese. A Western diet and the act of dieting were associated with an increased risk while the consumption of a plant-based diet was associated with a lower risk (Murtaugh et al., 2007). The western diet contained more energy dense foods and animal protein while the plant-based diet was more focused on whole foods and had greater consumption of plant protein. These associations did not change when accounting for ethnicity. This is of great interest as the studies investigating the relationship between food insecurity and obesity find that women are more likely to have a positive relationship between the two variables than men (Gooding et al., 2011; Holben & Pheley, 2006; Tayie & Zizza, 2009; Townsend et al., 2001). The current study showed that the weight status of women was affected by overall diet; namely a higher amount of energy dense and animal foods, the same types of foods that are more often eaten by those who are food insecure, lead to higher risk of overweight and obesity.

Other studies researching both male and female middle-aged adults have shown an inverse relationship between produce intake and obesity prevalence and risk, showing that increased fruits and vegetables, plant-based foods, may aid in preventing obesity (He et al., 2004; Kahn et al., 1997; Svendsen, Blomhoff, Holme, & Tonstad, 2007). A summary of this information is provided in Table 6.

Table 6

*Summary of Weight Benefits of Plant-Based Foods*

| Study subjects | Study result | Reference |
|---|---|---|
| Hispanic and nonHispanic women from southwestern United States | Western diet and dieting associated with an increased risk while plant-based diet associated with a lower risk; Western diet contains more energy dense foods and animal protein; plant-based diet more focused on whole foods and has greater consumption of plant protein | Murtaugh et al., 2007 |
| Female nurses aged 38-63 years; adults aged 50-74 | Inverse relationship between fruit and vegetable intake and obesity found for participants in longitudinal studies | He et al., 2004; Kahn et al., 1997 |
| Adults aged 39-57 years old and obese | 3-month behavioral program shows weight reduction in participants who increase their produce intake to 400 g/day of vegetables and 300 g/day of fruit | Svendsen et al., 2007 |

***Diabetes.*** Several studies reported that a plant-based diet or an increase in plant-based foods was able to prevent, aid in the management of, or even begin to reverse type 2 diabetes (Barnard et al., 2006; Barnard, Cohen, Jenkins, Turner-McGrievy, & Ferdowsian, 2007; Natale et al., 2009; Tonstad et al., 2013). However, there are exceptions. For example, one study showed no difference between plant or animal protein and their effects on diabetes (Wheeler, Fineberg, Fineberg, Gibson, & Hackward, 2002). In this study, participants spent 6 weeks consuming each type of diet, either animal or plant-based protein, with participants randomized into which diet they consumed first and a 4-week period of their regular diet separating the two (Wheeler et

al., 2002). The animal proteins in this study were beef, poultry, fish, and milk, while the plant proteins were tofu, textured vegetable protein, soymilk, and legumes (Wheeler et al., 2002). However, more studies show benefits of plant-based diets. One study that supported plant-based diets showed a higher reduction in weight, LDL cholesterol, urine albumin concentration, and $HbA_{1c}$ when comparing randomized participants with diabetes who consumed a low-fat vegan diet and those who consumed a diet as recommended by the American Dietetic Association (ADA) for a period of 22 weeks (Barnard et al., 2006). The vegan diet in the study consisted of approximately 10% energy from fat, 15% from protein, and 75% from carbohydrates (Barnard et al., 2006). Participants in this group consumed vegetables, fruits, grains, and legumes. The ADA diet in the study consisted of 15-20% energy from protein, less than 7% from saturated fat, and 60-70% of energy from carbohydrates and monounsaturated fats, with cholesterol intake less than 200 milligrams a day (Barnard et al., 2006). Those in the vegan cohort were able to reduce their medication by 43% and those in the ADA cohort by 26%. This same study was continued through 74 weeks and showed similar and consistent results (Barnard et al., 2007). This showed that the low-fat vegan diet provided sustained significant benefits to those with type 2 diabetes.

Tonstad et al. (2013) investigated the relationship of diet and diabetes within the Adventist population. The differences between vegetarians, which include vegan, lacto-ovo vegetarian, pesco-vegetarian, and semivegetarian, and nonvegetarians were compared. Results indicated that those consuming vegetarian diets had decreased incidences of diabetes when compared to the nonvegetarians. Those with vegan diets had

the lowest incidence of diabetes among all vegetarian groups, at a rate of 0.54% developing diabetes. The reduction is significant when compared to the 2.12% rate of those who are non-vegetarian. Another study showed that a plant-based diet rich in carbohydrates and fiber, with a low glycemic index and glycemic load, was better able to reduce levels of postprandial lipoproteins, blood glucose, insulin, and LDL cholesterol among patients with type 2 diabetes when compared to a diet that was high in monounsaturated fats and low in carbohydrates (Natale et al., 2009). A summary of this information is provided in Table 7.

Table 7

*Summary of Diabetes Benefits of Plant-Based Foods*

| Study subjects | Study result | Reference |
|---|---|---|
| Adults with type 2 diabetes | Higher reduction in weight, LDL cholesterol, urine albumin concentration, and HbA1c among vegan group when comparing randomized diabetic participants to those who consumed a diet as recommended by the ADA for a period of 22 weeks; medication usage reduced by 43% in vegan group and those in ADA cohort by 26%; same results after 74 weeks | Barnard et al., 2006, 2007 |
| Men and women free of diabetes at beginning of study, eating various diets | Vegetarian diets have decreased incidences of diabetes when compared to nonvegetarians; vegan diets have lowest incidence of diabetes among all vegetarian groups, at a rate of 0.54% developing diabetes (compared to 2.12% of non-vegetarians) | Tonstad et al., 2013 |
| Men and women with type 2 diabetes | Plant-based high carbohydrate, high fiber diet largely based on legumes, vegetables, fruit, and whole cereals reduces postprandial lipoproteins, blood glucose, insulin, and LDL cholesterol levels better than high monounsaturated fat, low carbohydrate diet when both diets are followed for four weeks by two groups in a randomized cross-over study | Natale et al., 2009 |
| Adults aged 35-75 with type 2 diabetes | No difference between plant or animal protein and their effects on diabetes | Wheeler et al., 2002 |

***Cardiovascular disease.*** The following studies were chosen as they cover a diverse group of men and women over an age range of 18-80 years old. Joshipura et al. (2001) assessed the association between fruit and vegetable intake and the risk of

coronary heart disease. Using participants who at baseline had no cardiovascular disease, diabetes, or cancer, diet was studied over 8 years for men and 14 years for women. Results showed that increased fruit and vegetable intake decreased the risk of developing coronary heart disease and hypertension. Increased servings of fruits and vegetables per day also subsequently decreased coronary heart disease to a greater degree. That is, those who were in the highest percentile of fruit and vegetable consumption had a 20% lower risk than those in the lowest. Green leafy vegetables and foods rich in vitamin C had the greatest effect.

Similarly, Steffen et al. (2005) evaluated different food group intakes and the incidence of high blood pressure among black and white adults ranging from 18-30 years at baseline, over the course of 15 years. Results indicated that intakes of red and processed meats increased blood pressure while plant foods decreased blood pressure. Dairy did not seem to have an effect, although milk did appear to decrease blood pressure at some levels. Continued increases in plant food servings also appeared to lead to greater decreases in blood pressure.

The associations between fruit, vegetable, and saturated fat intake with cardiovascular disease and mortality were studied in a cohort of men in the Baltimore Longitudinal Study of Aging. Results indicated that the men consuming both low saturated fat and high fruits and vegetables had a much lower risk of mortality (31% lower) and cardiovascular disease (76% lower) than men who only had low saturated fat or high fruits and vegetables (Tucker et al., 2005). This showed that overall diet was important and not just individual food groups and nutrients, such as only increasing fruits

and vegetables but consuming the same level of saturated fat. Other studies also have found that increased fruits and vegetables or increased vegetarian or plant-based meals decrease the risk of cardiovascular disease (Bhupathiraju et al., 2013; Hu, Huang, Wang, Zhang, & Qu, 2014; Hung et al., 2004; Tanaka et al., 2013). A summary of this information is provided in Table 8.

Table 8

*Summary of Cardiovascular Disease Benefits of Plant-Based Foods*

| Study subjects | Study result | Reference |
|---|---|---|
| Women ages 34-59 and men ages 40-75, all free of cardiovascular disease, cancer, and diabetes at baseline | Increased fruit and vegetable intake decreases the risk of developing coronary heart disease and hypertension; Increasing servings subsequently decreases coronary heart disease at a higher amount | Joshipura et al., 2001 |
| Adults between 18 and 30 years at baseline | Intakes of red and processed meats increase blood pressure while plant foods decrease blood pressure; dairy does not seem to have an effect, although milk does appear to decrease blood pressure at some levels; continued increases in plant food servings also appear to lead to greater decreases in blood pressure | Steffen et al., 2005 |
| Men born before 1929 but 80 years of age or younger | Men consuming low saturated fat and high fruits and vegetables have lower risk of mortality and cardiovascular disease than men who only have low saturated fat or high fruits and vegetables | Tucker et al., 2005 |
| Female nurses ages 30-55 and male health professionals ages 40-75 | Higher fruit and vegetable intake found to be associated with lower coronary heart disease and cardiovascular disease | Bhupathiraju et al., 2013; Hung et al., 2004 |
| Men and women of varying ages | Fruit and vegetable consumption inversely associated with stroke; higher levels of intake result in lower levels of stroke | Hu et al., 2014 |
| Adults aged 40-70 years old with diabetes | Fruit and vegetable consumption inversely associated with stroke but not coronary heart disease in those with diabetes | Tanaka et al., 2013 |

**Food Insecurity and Plant-Based Diets**

After reviewing the research, it is clear that food insecurity is strongly associated with increased rates and risk of chronic disease while plant-based diets may reduce the risk for these diseases. Because of this, it would seem as though there would be an interest to investigate plant-based diets and their ability to aid in reduction and prevention of the diseases associated with food insecurity. However, only one study exists that studies the relationship between these two variables.

Flynn et al. (2013) reported the results of their study, in which they focused on determining the effects of a plant-based diet among people who were food insecure. Participants were from Rhode Island and used food pantries and low-income housing locations; a total of 63 adults, the majority women, participated. The methods were based on Raising the Bar on Nutrition protocol, which was part of a program provided by the Rhode Island Community Food Bank. A 6-week cooking class was taught to participants to show them how to prepare plant-based meals as well as to provide them with groceries during the course of the class and knowledge of the health benefits of these foods. Over a period of 6 months, the effects of consuming several plant-based meals per week were studied. Measurements were taken at baseline, after the cooking class, and after the 6-month follow-up period. Receipts were collected during each time period to determine average grocery costs. The results, which are located in Table 9 below, showed that this type of diet has the potential to reduce food insecurity by lowering grocery food costs and stretching both income and SNAP benefits. The study

also indicated that a plant-based diet has the potential to improve health by reducing body weight.

Table 9

*Summary of Results from Flynn, Reinert, and Schiff Study (2013)*

| Baseline | After 6 months |
|---|---|
| 68% used food pantry in last month | 54% used food pantry in last month |
| 52% food secure | 67% food secure |
| 14% food insecure with hunger | 3% food insecure with hunger |
| Spent $70.86 +/- 44.97[a] | Spent $38.67 +/- 23.52[a] |
| | Dietary intake changes: |
| | 78% ate more vegetables |
| | 44% ate more fruits |
| | 44% had decreased weight and waist size |

[a] Grocery expenditures from "Research Brief: Food Insecurity is Decreased by Adopting a Plant-Based, Olive Oil Diet," by M. M. Flynn and A. Schiff, 2011, *Journal of Hunger & Environmental Nutrition, 6,* p. 509.

As seen above, there may be a potential benefit to providing those who are food insecure with more knowledge of how to consume a plant-based diet in order to increase health outcomes and decrease the effects of food insecurity.

**Perceived Benefits and Barriers**

While the potential for increased health is available, many factors contribute to whether one decides to act on the knowledge that is present. Two of these factors are the

perceived benefits and barriers to consuming fruits and vegetables or a plant-based diet. Lea and Worsley (2003) found that the main barrier to adherence to a vegetarian diet was the enjoyment of meat. Others included unwillingness of family members to consume these types of foods or the belief that humans are meant to eat meat. Benefits to a plant-based diet as identified by participants included an increase in fruits and vegetables, decrease in saturated fat intake, weight control, and disease prevention.

Interestingly, one recent study exploring the knowledge, perceptions, and barriers of plant-based diets as a management tool among adults with type 2 diabetes reported that 66% of participants would be willing to try a plant-based diet to manage their diabetes with appropriate support (Lee, McKay, & Ardern, 2015). However, barriers identified by these participants included family eating preferences, meal planning skills, preference to eat meat, food cost, ease of cooking, and time constraints (Lee et al., 2015). Both of these were identified by Lea and Worsley (2003) among a sample of participants without diabetes. It appears that appropriate support is key in willingness to try a new, unfamiliar diet.

**Cost of foods.** Another potential barrier to eating a plant-based diet or several plant-based meals a week could be its perceived cost. However, Table 10 shows that plant-based foods are often, but not always, less expensive than animal foods by the pound (U.S. Department of Agriculture, 2008, 2013). In addition, the serving sizes obtained from a pound of each food are generally higher for plant-based protein foods than animal-based protein foods (U.S. Department of Agriculture, 2008, 2013). It is

important to note that while Table 10 shows cost per pound, often the cost per kilocalorie is used. When looked at through available kilocalories, meats are much more dense.

Table 10

*Cost and Number of Servings per Pound of Selected Fresh Foods*

| Type of food | Cost/pound | Number of servings |
|---|---|---|
| Ground beef[a] | $3.45 | 3–5 oz servings (15 oz) |
| Pork chops[a] | $3.98 | 3–5 oz servings (15 oz) |
| Leg broiler with bone[a] | $1.65 | 3–5 oz servings (15 oz) |
| Red kidney beans[b] | $1.25 | 6.3 cups |
| Pinto beans[b] | $0.81 | 6.3 cups |
| Lentils[b] | $1.02 | 6.8 cups |
| Black beans[b] | $1.07 | 6.3 cups |
| Kale[b] | $2.19 | 3.6 cup equivalents |
| Sweet potatoes[b] | $0.90 | 2.1 cup equivalents |
| Carrots[b] | $0.77 | 3.2 cup equivalents |
| Potatoes[b] | $0.48 | 2-3 cup equivalents |
| Broccoli[b] | $1.84 | 2-3 cup equivalents |
| Sweet corn[b] | $1.80 | 1-2 cup equivalents |
| Apples[b] | $1.07 | 3-4 cup equivalents |
| Bananas[b] | $0.45 | 2 cup equivalents |
| Oranges[b] | $0.57 | 1-2 cup equivalents |

*Table 10 (continued)*

| Type of food | Cost/pound | Number of servings |
|---|---|---|
| Grapes[b] | $1.68 | 2-3 cup equivalents |

[a] Adapted from "Meat Price Spreads," 2013. Retrieved November 7, 2015, from the U.S. Department of Agriculture website: http://www.ers.usda.gov/data-products/meat-price-spreads.aspx#.UokuF9JwqSp

[b] Adapted from "Fruit and Vegetable Prices," 2008. Retrieved November 7, 2015, from the U.S. Department of Agriculture website: http://www.ers.usda.gov/data-products/fruit-and-vegetable-prices.aspx#.UokuGNJwqSp

Research has shown that while fats, oils, and sweets have the lowest food cost, meat again has the highest per serving (Connell et al., 2012). Interestingly, milk was the second highest, with grains, fruits, and vegetables all priced lower per serving. Considering this, it is interesting to note that Wiig and Smith (2009) reported that meat represented the largest portion of the food budget for those who were in low-income households and likely to be food insecure. The monetary amount spent on meat, while the largest, was also for some families 50% of the budget for food. Finally, when the cost of food was based on total price or unit price and not energy cost (or cost per kilocalorie), produce had a lower cost than snacks (Lipsky, 2009). It is apparent that these families could potentially reassign portions of their budget to better include plant foods that, as seen in the above table and study findings, are less expensive and provide more servings.

**Social Cognitive Theory and Health Maintenance**

Social relationships contribute to health through social support, social influence, social engagement, and access to resources (Berkman, Glass, Brisette, & Seaman, 2000). Many of the aforementioned factors also influence health maintenance. The factors that

influence maintenance of health include social support, or the emotional, instrumental, appraisal, and informational support provided by others, the social influence or shared norms around health behaviors, and access to resources such as goods, services, and opportunities (Berkman et al., 2000). Another aspect that contributes to health behavior maintenance is self-efficacy, which is based on the capabilities one has as well as the influence of the environment in which one lives (Bandura, 1986, 1997). Capabilities encompassed under self-efficacy can include one's knowledge, beliefs, skills, and motivation while influences of the environment can be social, economic and political (Bandura, 1986, 1997). Self-efficacy plays an important role in human functioning because it affects behavior both directly and indirectly through its impact on things such as goals, outcome expectations, and perceived barriers and facilitators in the social environment (Bandura, 2004). All of these influences play a key role in the change and maintenance of health behavior. For the current study, the health behavior is a change of dietary habits.

**Summary**

Food insecurity is correlated to chronic diseases such as obesity, diabetes, and cardiovascular risk factors (Drewnowski & Darmon, 2005; Gooding et al., 2011; Holben & Pheley, 2006; Metallinos-Katsaras et al., 2012; Ray et al., 2012; Sarlio-Lahteenkorva & Lahelma, 2001; Seligman et al., 2007, 2010; Tarasuk et al., 2013; Tayie & Zizza, 2009; Townsend et al., 2001). Plant-based diets and an increase in fruit and vegetable consumption have the ability to prevent or decrease these chronic diseases and risk factors (Barnard et al., 2006, 2007; Joshipura et al., 2001; Murtaugh et al., 2007; Steffen

et al., 2005; Tonstad et al., 2013; Tucker et al., 2005). Very little research has been conducted to study the relationship between food insecurity and the benefits of switching to a plant-based diet. To further this area of research, the current study aimed to determine areas that should be focused on with greater intention to promote knowledge of the benefits an increase in plant-foods may have as well as enable successful interventions.

# Chapter 3: Methodology

## Research Design

The current study aimed to investigate the knowledge and perceptions of plant-based diets and its associated benefits and barriers among adults with type 2 diabetes and varying levels of food security. This study included in-depth face-to-face interviews with adults to explore: (a) food security among adults with type 2 diabetes; (b) barriers to fruit and vegetable consumption among adults with diabetes who may also be food insecure; and (c) perceptions and knowledge of plant-based diets among adults with diabetes who may also be food insecure. In-depth interviewing is a qualitative technique involving intensive one-on-one interviews with a small number of participants (Patton, 1987). This technique was chosen to avoid participant influence on responses, gain the most information possible from each participant, and to ensure that the participants feel comfortable and safe when talking about their experiences with food insecurity and fruit and vegetable consumption. In addition to a qualitative interview, participants also filled out six different surveys for further demographic and descriptive information, described below. The Ohio University Institutional Review Board approved the protocol; the approval document is located in Appendix A.

## Setting

Research participants were recruited from outpatient clinics affiliated with the Ohio University Diabetes and Endocrine Center, including the Diabetes Free Clinic, as well as through an Ohio University Athens Campus faculty and staff ad hoc email. These clinics primarily serve surrounding counties in Appalachian southeastern Ohio and

West Virginia. Attending physicians and staff at the Ohio University Diabetes and Endocrine Center facilitated recruitment. Recruitment proceeded in one of two ways. If recruited from a clinic, participants were: a) identified as a type 2 diabetes patient; b) screened for eligibility through a screening questionnaire; and c) contacted from the research team by telephone to schedule an interview. If recruited through the faculty and staff email, participants: a) emailed the research team to show interest in participating; b) were contacted by the research team through telephone, screened for eligibility through a screening questionnaire, and if eligible scheduled for an interview.

**Sampling Procedures**

We used purposive sampling (Pope & Mays, 2000) to identify and select English speaking patients, aged 30-70 years, diagnosed with type 2 diabetes for at least 2 years, HbA1c below 14.0% based on self-report, with varying levels of food security. Exclusion criteria included adults with severe psychopathology, cognitive or visual impairment, other types of diabetes such as type 1 or gestational diabetes, schizophrenia, and bipolar disorder. Adults with type 2 diabetes and varying levels of food insecurity were recruited by flyers placed in southeastern Ohio medical area clinics and hospitals as well as an ad hoc OU Athens Campus faculty and staff email. This population was chosen as those with type 2 diabetes tend to also have risk factors such as overweight and obesity, hypertension, and other cardiovascular disease indicators. A screening questionnaire, located in Appendix B was conducted to determine eligibility for the study. All levels of food security were included. All participants provided informed written consent and received compensation for their time.

**Questionnaires**

In addition to sociodemographic information and health characteristics (e.g., age, race/ethnicity, level of education, marital status, occupation, diabetes duration, hemoglobin $A_{1c}$), food security, produce intake, diabetes self-care behaviors, diabetes distress and depression information was gathered from the same participants to allow a description of the study population. Immediately before the interview portion and after filling out the demographic questionnaire (located in Appendix C), each participant completed a survey that included the following instruments:

**Food security measurements.** *USDA Household Food Security Survey Module* (HFSSM) (Andrews, Nord, Bickel, & Carlson, 2000) is a set of questions regarding food sufficiency and security within the Food Security Supplement to the Current Population Survey as provided by the U.S. Department of Agriculture. The HFSSM asks 10 questions for households without children and 18 questions to those with children. Specifically, questions are asked about difficulty meeting needs due to a lack of appropriate resources, food access, and stress or worry. The questions asked can be found in Appendix D. Based on the responses to these questions, households receive a food insecurity scale score and are assigned to a category.

**Fruit and vegetable intake and behavior measurements.** The *13-item Tool to Assess Psychosocial Indicators of Fruit and Vegetable Intake in Low Income Communities* (Townsend & Kaiser, 2005) is a questionnaire that is used to determine diet quality using five indicators within a low-income population that is likely to be food

insecure. It uses six constructs with a maximum score of 6, enabling easy analysis. It is located in Appendix E.

The *7-item Food Behavior Checklist for a Limited Resource Audience* (Townsend, Kaiser, Allen, Joy, & Murphy, 2003) is a validated questionnaire that evaluates the amount of fruits and vegetables that are consumed by participants as well as associated behaviors. It is written specifically for those who have limited resources and are likely to be food insecure. It is located in Appendix E.

**Diabetes and depression measurements.** *Patient Health Questionnaire* (PHQ-9) is a 9-item depression scale derived from the full Patient Health Questionnaire (Kroenke, Spitzer, & Williams, 2001). Items were scored on a 4-point scale, ranging from "Not at all" (0 points) to "Nearly every day" (3 points). Counts of each response category were multiplied by the value and added to produce a total score. This multipurpose instrument is useful for screening, diagnosing, monitoring, and measuring severity of depression. PHQ-9 scores of 5, 10, 15, and 20 correspond to mild, moderate, moderately severe, and severe depression (Kroenke et al., 2001). The questionnaire is in Appendix F.

*Problem Areas in Diabetes Scale* (PAID)-5 (McGuire et al., 2010) is a reliable and valid short version of the Problem Areas in Diabetes Scale (PAID) comprising five of the emotional-distress questions of the full PAID items (PAID-5, with items 3, 6, 12, 16, 19) (Polonsky et al., 1995; Weinger & Jacobson, 2001; Welch, Weinger, Anderson, & Polonsky, 2003; Welch, Jacobson, & Polonsky, 1997). Scores are converted to a 100-point scale with 100 representing high diabetes distress and zero representing low

diabetes distress. The PAID is sensitive to changes in glycemic control and high PAID scores are associated with lower self-reported adherence to treatment recommendations (Weinger, Butler, Welch, & La Greca, 2005). The PAID-5 has satisfactory sensitivity (94%) and specificity (89%) for recognition of diabetes-related emotional distress. The questionnaire is in Appendix F.

*Self-care Inventory-R* (SCI-R) (Weinger et al., 2005) is a 14-item survey that measures the self-reported frequency of self-care behaviors on a 5-point Likert scale and has been validated for use with type 2 diabetes populations (Weinger et al., 2005). Four additional items inquiring about checking feet, eating heart healthy foods, looking at blood glucose patterns, and knowing about blood pressure, adult glucosylated hemoglobin (A1C), and lipids were included. Scores are converted to a 100-point scale with 100 representing patients performing all self-care behaviors and zero representing not self-care behaviors. The survey is in Appendix F.

**Interview Strategy**

A semistructured interview that consisted of open-ended questions and probes was used. The interview guide can be found in Appendix G. A trained interviewer conducted the interviews at university sites. The interviews began with general questions to elicit participants' spontaneous opinions and experiences. Questions and probes became more focused in subsequent questions to ensure the participants' discussed type 2 diabetes self-care, food insecurity, fruit and vegetable consumption, and knowledge of plant-based diets. Interviews were digitally audio-recorded and transcribed, with a code being given to each interview in order to maintain anonymity of participants. Using the

standard qualitative procedure of constant comparison, subjects were sampled until data saturation occurred. (To date, we have not achieved data saturation, but recruitment will continue through the fall and winter until data saturation is reached.) Data saturation is the accepted standard to determine the actual sample size. We anticipated that a sample of 20 to 25 participants would achieve data saturation.

**Data Analysis**

Demographic factors and health characteristics were assessed using descriptive statistics and presented as means and standard deviations or sample size and percentages. Frequencies of individual question responses were also calculated. Analyses were conducted with Microsoft Excel (Redmond, Washington: Microsoft, 2010).

For the qualitative analysis, the multidisciplinary research team, consisting of a health behaviorist and a nutrition graduate student, analyzed the data according to the principles of content and thematic analyses (Boyatzis, 1998; Pope & Mays, 2000). First, the team performed content analysis by independently marking and categorizing key words, phrases, and texts to generate the initial codes. Initial codes were discussed and discrepancies were resolved via group consensus to develop the thematic framework, which was applied to all transcripts by the graduate student. After all the transcripts were coded and reviewed, they were entered into NVivo 10 software (QSR International; Victoria, Australia) to further organize and group codes into themes. The group then met to agree on the final themes.

To support credibility (validity), we triangulated data sources and investigators (Miles & Huberman, 1994). We converged multiple data sources, including in-depth

interviews, questionnaire data, participant observation (e.g., participant affect, behaviors) and field notes (i.e., written accounts of what happens during the interviews) to verify the consistency of our findings. Basic sociodemographic characteristics of participants were also summarized using descriptive statistics from the questionnaires. Transferability (external validity) was supported via thick descriptions and verbatim quotations included in the data. Confirmability (objectivity) of the data was supported via tracking the decision-making process with an audit trail (Miles & Huberman, 1994; Russell & Gregory, 2003). The audit trail is a detailed description of the research steps conducted from the development of the project to the presentation of findings.

# Chapter 4: Results

Ten adults with type 2 participated in in-depth face-to-face interviews lasting between 30-70 min. Ninety percent of participants had PAID-5 scores equal to or lower than 7, indicating low levels of diabetes-related emotional distress. Sixty percent of participants had scores indicating minimal depression on the PHQ-9, with 20% showing mild depression, 10% moderate depression, and 10% showing moderately severe depression. Ninety percent of participants rated their diet quality as good or higher; one participant rated his diet quality as fair. A summary of the participant demographics is provided in Table 11, including scores from the fruit and vegetable and diabetes and depression surveys.

Table 11

*Demographic, Health, and Survey Characteristics of Participants*

| | Mean ± SD ($n$ = 10) | Range |
|---|---|---|
| Age (years) | 54 ± 10 | 36-66 |
| Diabetes duration (years) | 8.6 ± 6.1 | 3-20 |
| Hemoglobin $A_{1c}$ (%) | 7.1 ± 0.7 | 6.1-8.1 |
| Body mass index (kg/m$^2$) | 32.8 ± 3.7 | 26.3-38.7 |
| Female | 50% | |
| White | 90% | |
| Married | 60% | |
| Retired | 10% | |
| Food secure | 100% | |
| # of fruit servings/day | 1.7 ± 0.9 | 1-4 |
| # of vegetable servings/day | 2.4 ± 1.3 | 1-5 |
| PHQ-9 | 5.0 ± 4.9 | 0-15 |
| PAID-5 | 5.6 ± 3.8 | 2-16 |
| SCI-R | 57.9 ± 7.9 | 42.4-69.4 |

It is important to note that the current sample was 100% food secure. Because of this, we were not able to address the full extent of the research questions we sought to explore. We were unable to address the proposed research questions due to recruitment

and time limitations. Results below exhibit the knowledge, perceptions, and barriers to plant-based diets as identified by participants with type 2 diabetes and high food security.

Transcript identifiers are used with quotations indicating participant number, gender, age, and reported number of daily fruit (F) and vegetable (V) servings. Intercoder reliability was 93.39%. Three major themes emerged from the data analysis: (a) knowledge and perceptions of plant-based diets, (b) barriers to a plant-based diet or increased fruit and vegetable consumption, and (c) perceived negative effect of fruit on hemoglobin $A_{1c}$.

**Theme 1: Knowledge and Perceptions of Plant-Based Diets**

Half of the participants said they did not have knowledge about plant-based diets. Participants who did have knowledge about plant-based diets explained their interpretation based off of their personal life experiences:

> Well, I have two daughters who are vegetarians and two son-in-laws that are vegetarians, and one of the son-in-laws was vegan for a while and two of my grandchildren are also vegetarian. So I think I know quite a lot about it . . . I know how to get protein without meat. Like my little grandson who has all the allergies, his protein sources are peanut butter, and eggs, and hummus would be his main protein sources . . . Black beans and rice. I know the rice doesn't have much protein but the black beans do. (1D 7, female, age 65, 1.5 F, 3.5 V)
>
> I know a lot now. As I said, my mother was a dietitian. I always knew that more fruits and vegetables are better for you, but she was also trained during a time where they didn't really consider beans as protein, where you still needed to have

> meat . . . I learned a lot more about cheese than I think I ever wanted to learn and I like cheese, so that was hard giving that up, but I've been lactose intolerant for a really long time, so giving up milk wasn't a problem . . . Alternatives to meat and meat products, that was excellent. I think the meat, meat products, if you told me I'd be cooking tofu, I'd have looked at you like you were out of your mind, but I've learned how to cook it and kinda like it, so if it's cooked well, done well. (ID 6, female, age 60, 4 F, 5 V)

While some participants explained a plant-based diet based on personal life experiences, other participants made educated guesses of what a plant-based diet would entail:

> I would assume that a plant-based diet would be either primarily plants or only plants. I think I would struggle with that. But I mean I have friends and colleagues that are vegetarians and vegans both. So, I see the things they eat and wonder how they sustain themselves on those things. But I can see–I can see the value in those as well. But also being a nurse, knowing that you would also need to make up for, then, a lack of some vitamins, minerals, electrolytes, those types of things, I can see that as being a challenge, too. (ID 4, female, age 36, 2 F, 4 V)

When asked if a plant-based diet was healthy, the majority of participants agreed that it was, although this response was most often given without further reasoning:

> Well, they seem to be pretty healthy, so yeah, I'd say it's probably good. (ID 8, male, age 51, 1 F, 2 V)
>
> Yeah, absolutely. (ID 1, male, age 49, 1 F, 2 V)

Some participants provided a minor explanation as to why they thought a plant-based diet was healthy:

> Well, the fact that they have fiber in 'em and something else. Just what's the ingredients are in the plants that's good for you. (ID 2, male, age 55, 2 F, 1 V)
>
> Yeah, I think you can sustain on just vegetables. Yeah. I saw on TV one time some of the strongest animals in the world all they eat is grass. If you take a thoroughbred horse and all he eats is grass and straw and he's pretty healthy. (ID 3, male, age 63, 1 F, 1 V)

Even though participants believed a plant-based diet was healthy, they also voiced concerns regarding micronutrient and protein intake, the satiation level this type of diet might provide, and a plant-based diet among children:

> A lack of some vitamins, minerals, electrolytes, those types of things, I can see that as being a challenge, too . . . I think it can be very healthy if you are getting your requirements of what you're lacking. So, if you're lacking protein that you're making sure that you're getting it in some other form. I struggle with seeing how a vegan would get that at all without oral supplements of some sort. A vegetarian–I know we have vegetarians that some will eat eggs and peanuts and those types of things and get protein. But my only concern would be that if my daughter came to me and said, "I'm gonna be a vegetarian," my concern would be to make sure that she was getting all of those nutrients that she wouldn't be getting with that type of diet . . . So, I think as long as you were making up for, in some way, however you could for what you wouldn't be getting from those items, I

would think it would be wonderful. I think it would be very heart healthy. (ID 4, female, age 36, 2 F, 4 V)

I think it's healthy but I do worry about my two grandchildren. I don't think it's healthy for children to be vegetarian but they are and I worry that they're not getting enough protein and enough variety in their diet . . . I think it's fine for the adults but I don't think that you should force children to be vegetarians. (ID 7, female, age 65, 1.5 F, 3.5 V)

My perception of a plant-based diet would be that it's not enough to fill me up, in all honesty. I think it is a healthy way to go… (ID 9, female, age 37, 1.5 F, 2, V)

Only 1 participant was following a plant-based diet. She believed a plant-based diet was healthy because she could see the benefits in her blood glucose control:

I know there's a lot of controversy about not eating meat and whether or not you have enough protein and being anemic. I was anemic before I started this and I ate meat all the time, so I don't think anemia in itself is a reason not to do it. I think finding the source of the anemia is the reason why you might be anemic. I think the numbers have demonstrated that it works. Between the two of us, we've lost about 125 pounds. Again, our blood pressure is normal. My diabetes is becoming under control. Again, it's not where I'd like it to be but it's much better than where it was a year ago. I never had high cholesterol so I can't say that cholesterol has been affected, but the numbers demonstrate, yes, this does work. When I've done an entire week of purely plant-based, my blood sugar levels are fabulous. If I go off even with one thing, I notice the spike in my blood sugar

> levels. So it's like, okay, well, you don't have to convince me. I can see it. (ID 6, female, age 60, 4 F, 5 V)

Participants were asked for their personal opinion of a plant-based diet and of those who follow one. This group of participants had an indifferent approach to their views:

> It's admirable. If they have the drive and the steadfast to stay on something like that, that's awesome. I walk down the street and see a piece of chocolate, and there you go, again. So that makes it tough. And I know some people like that. It's very admirable that they can stick to that. (ID 1, male, age 49, 1 F, 2 V)
>
> I think it's a personal choice. And I don't look down or up at it. It's just something that other people do, and it is something that other people do. (ID 5, female, age 66, 1 F, 1.5 V)
>
> To each his own. If they like that, that's fine. It doesn't bother – you know. (ID 8, male, age 51, 1 F, 2 V)

During the interview, participants were asked to identify the fruits and vegetables they typically consumed on a regular basis. The most common vegetables (consumed by 4 or more participants regularly) were green beans, peas, carrots, broccoli, cauliflower, tomatoes, onion, corn, and cucumbers. The most common fruits (consumed by 4 or more participants regularly) were grapes, apples, pineapple, bananas, strawberries, raspberries, and peaches. In addition, participants responded to questions in a survey about the number of servings of fruits and vegetables they consumed daily. On average,

participants consumed 2.4 ± 1.3 servings of vegetables per day and 1.7 ± 0.9 servings of fruits per day.

**Theme 2: Barriers to a Plant-Based Diet or Increased Fruit and Vegetable Consumption**

When asked about potential barriers to the consumption of a plant-based diet or increased fruit and vegetable consumption, six different barriers were identified. These included time, spoilage of produce, access and convenience, cost, deprivation of certain food groups, and family and friend support. The most common barrier reported by the participants was time:

> Time, a lotta time, being busy and you don't have time to prepare everything you want to, so you look for the fast thing to grab and go. That stop the vegetables or preparing sometimes. (ID 1, male, age 49, 1 F, 2 V)
>
> Well, I think definitely the time. (ID 4, female, age 36, 2 F, 4 V)
>
> Time and shopping. 'Cause if you get fresh, you have to fix fresh, and so if you buy on Monday and you can't cook till Thursday, then you've wasted food because a lot of it needs to be used up within the next couple of days. So I think just time and shopping is the most difficult. (ID 6, female, age 60, 4 F, 5 V)

Participants identified spoilage of produce as another barrier to consumption of a higher number of fruits and vegetables:

> Actually, that it doesn't spoil before I get to it. That's the biggest concern. Except for the bananas. You let them spoil. (ID 1, male, age 49, 1 F, 2 V)

> But a lot of–one of the biggest challenges is that they don't get eaten quick enough when they're fresh. (ID 4, female, age 36, 2 F, 4 V)
>
> I think one of my challenges is I think this is true in my household. If something is gonna go bad, we'll take bananas and turn it into banana bread, but I don't think let's make pesto real quick, or let's do something, or let's freeze, whatever. So I think we throw away food that we're not using rather than trying to find a repurpose for it or do something with it in the last minute. (ID 9, female, age 37, 1.5 F, 2 V)

Some participants also discussed the issues of access to fresh fruits and vegetables and convenience:

> For some people, there could be–unless you had the ability of growing your own, there may be a lack of access. I know that around here, and in some other areas that are even more rural, it's not always easy to get fresh fruits and vegetables. (ID 4, female, age 36, 2 F, 4 V)
>
> The convenience of it, yeah, because if I'm working, I'm working a 60-hour week. (ID 5, female, age 66, 1 F, 1.5 V)

Another common barrier identified by the participants was the cost of following a plant-based diet:

> Anything that you go through the store and–I didn't really pay too much attention to this until I became diabetic, but when you start looking at the much healthier stuff, it's also much more expensive. (ID 1, male, age 49, 1 F, 2 V)

> I guess my assumption would be that it can get costly to be able to get enough of a variety to sustain yourself and make it interesting. (ID 9, female, age 37, 1.5 F, 2 V)

Interestingly, several participants also stated that consuming a plant-based diet would be similar or less in price compared to a typical American diet:

> It'd probably be less expensive . . . Just 'cause the cost of meat is I mean… (ID 3, male, age 63, 1 F, 1 V)

> I would think, even though fruits and vegetables are expensive, I think that if . . . you were cutting out breads and snack cakes and chips and things like that, and meat, which is, right now, extremely expensive, especially ground beef, or cow-based products, I wouldn't see that there would be much . . . of a difference . . . I would venture to guess that maybe you're not sustained as long . . .So, I guess, maybe if you were eating more to stay fulfilled, then it might be a little bit. But I would think that once you would eliminate all of those other things, that it' probably be about even. (ID 4, female, age 36, 2 F, 4 V)

> Probably about the same. (ID 10, male, age 55, 2 F, 2 V)

One participant with experience in purchasing a plant-based diet provided her input on the cost of the diet:

> Well, initially it's expensive . . . because you are not using the stuff that's already in your cupboard . . . because you're replacing things and those things that you're replacing it with are a little more costly . . . Now that we're not buying meat, I really can't say that our grocery bill has increased. It's a little bit lower, not

> significantly lower, but a little bit lower, but we're not buying meat . . .We're buying more vegetables and we're buying them more frequently, so if you're looking at vegetables and fruit, you're buying them more frequently . . . But again, overall I think about in terms of meals, so if I make a pot of beans . . .So you think about it, that's two, four, five meals off of a pot of beans versus when we cooked meat, you would eat the meat and then you didn't really have much in terms of leftovers… (ID 6, female, age 60, 4 F, 5 V)

Another barrier to consuming a plant-based diet was deprivation of and difficulty giving up certain food groups. These participants enjoyed consuming meat and dairy products and did not want to give these foods up to follow a plant-based diet:

> I would say for most people, because most people are not vegan, that it would be difficult. They just don't follow it because it would be kind of tough to. Giving up the chocolate, the meats and stuff, that's kinda tough. (ID 1, male, age 49, 1 F, 2 V)
>
> Just breaking old habits. (ID 3, male, age 63, 1 F, 1 V)
>
> I think, for some people, just that it would be a complete lifestyle change from what they're used to. And for a while, you would still crave things. And so, it would almost be like withdrawal of some sort, trying to get past those things. (ID 4, female, age 36, 2 F, 4 V)
>
> Probably just the nondairy and no meat. (ID 10, male, age 55, 2 F, 2 V)

Finally, lack of support from family members and friends was also mentioned as a barrier to following a plant-based diet:

My husband makes it difficult for me because he insists on eating a lot of heavy carbohydrate diet and he makes that difficult for me because I have to cook for him. (ID 7, female, age 65, 1.5 F, 3.5 V)

Well, my son will only eat about two vegetables . . . The kids won't generally eat anything green. (ID 4, female, age 36, 2 F, 4 V)

Like I say, my wife doesn't like to cook as much. She's a good cook, but she just doesn't wanna cook as much as she used to . . . she says, "If you need somebody to get the recipes out of those diet books, you better get somebody else to cook for you. (ID 3, male, age 63, 1 F, 1 V)

I think going out socially, if you go somewhere, and they've prepared food for you, and it has meat in it, that could be a problem. You wouldn't want to offend people. (ID 7, female, age 65, 1.5 F, 3.5 V)

**Theme 3: Perceived Negative Effect of Fruit on Hemoglobin $A_{1C}$**

When discussing fruit consumption and preferences, half of the participants expressed concern regarding the effect of fruit on their blood glucose levels and hemoglobin $A_{1c}$ levels:

I mean I did have grapes last night for a snack, which is probably not a good thing, actually, 'cause of the sugars. (ID 1, male, age 49, 1 F, 2 V)

I've discovered that eating a peach or an apple will send it up, so I'm trying to concentrate more on vegetables than on fruit, but I sometimes eat some fruit. (ID 7, female, age 65, 1.5 F, 3.5 V)

> The sugars, 'cause it will spike them. I've gotta be real careful not so much on the vegetable side, but on the fruit side I've gotta be careful. (ID 8, male, age 51, 1 F, 2 V)

These participants reported avoiding certain fruits or limiting their intake because of the perceived negative effect on blood glucose levels and hemoglobin $A_{1c}$:

> That was one of the first things my doctor ever said was the sugar is sugar no matter where even if you get it from fruits. So I just I try to eat more vegetables . . . I don't eat a lotta fruits, 'cause I think it adds to the sugar intake… (ID 3, male, age 63, 1 F, 1 V)

> I try to avoid the most sugary fruits, because I think fruits is sort of a trick. If I had my choice, I'd be eating pineapple, but that's so high in sugar that there's no real value in doing that. (ID 5, female, age 66, 1 F, 1.5 V)

However, some participants did understand the value in eating fresh fruits and voiced concerns about not reaching daily recommendations:

> I realized when I took the survey I don't eat nearly as much fruit as I'm supposed to, but we try to have balanced meals. (ID 9, female, age 37, 1.5 F, 2 V)

One participant reported checking his blood glucose levels after consuming different fruits as a method to find which fruits would not greatly increase his blood glucose:

> By testing . . . what I found I can do is apples and bananas on a limited basis, and that's pretty much all I've found so far that I can do. (ID 8, male, age 51, 1 F, 2 V)

Interestingly, the participant following a plant-based diet did not withhold from fruits and still found the diet useful for blood-glucose control. She reported consuming, on average, 4 servings of fruit per day and reported consuming a wide variety:

> Apples, oranges, bananas, pears, strawberries, blueberries, raspberries, watermelon, kiwi. We will eat pineapple and did I say bananas? Grapes. We really like peaches and nectarines, we like a lot. We've tried starfruit. It's all right, and we've tried–oh, there's another kind of melon. It's a different kind of melon. But we've done cantaloupe and honeydew. (ID 6, female, age 60, 4 F, 5 V)

# Chapter 5: Discussion

This qualitative study aimed to explore the knowledge, perceptions, and barriers of a plant-based diet and increased fruit and vegetable consumption among participants with type 2 diabetes and varying levels of food security.

## Characteristics of Participants

**Demographic characteristics.** Ten adults with type 2 diabetes participated in this study. Collectively, participants were 53.7 ± 10.15 years of age, with diabetes duration lasting 8.6 ± 6.14 years, hemoglobin $A_{1c}$ levels of 7.1 ± 0.72%, and BMIs of 32.79 ± 3.74. They were primarily White/Caucasian and working full-time. Fifty percent of participants were female, and 60% were married. All participants were living in the Appalachian region of Ohio.

According to the 2008-2012 American Community Survey of the U.S. Census Bureau, the majority of residents in rural Appalachia are more likely to be White/Non-Hispanic (Pollard & Jacobsen, 2014). In Appalachian Ohio, 91.8% of residents were White/Non-Hispanic (Pollard & Jacobsen, 2014). Rural Appalachian residents are also more likely to be under the poverty line, uninsured, as well as of a lower education level (Pollard & Jacobsen, 2014). While our participant characteristics were similar in ethnicity, none of our participants identified being under the poverty line or struggling financially. Additionally, the majority of participants were faculty and staff at Ohio University in Athens, Ohio and held higher level college degrees.

**Food security.** Approximately 17.4 million families, or 14.0% of American households, experienced food insecurity at some point during the year in 2014 (Coleman-

Jensen et al., 2015). In Appalachian Ohio, levels of food insecurity have been found to be even higher. The average rate of food insecure households in America was 10.1% in 1999, whereas the average rate in southeastern Ohio was 27.2%. Twenty percent of those households were food insecure with hunger (Holben & Pheley, 2006).

It was expected that participants in the current study would be of varying levels of food security, as we aimed to recruit participants so as to achieve a representative sample of food insecurity in this region. However, all participants in this study were highly food secure, identifying no issues with food access or quality through the HFSSM. This was a major limitation to our study and will be discussed in further detail in the limitations section of this chapter.

**Diabetes distress and depressive measures.** Past literature has found an association between type 2 diabetes and a higher prevalence of depression. For example, among 29 subjects with type 2 diabetes in Saudi Arabia, 37.9% had also been diagnosed with depression (Gemeay et al. 2015). Another study assessed depression among 515 type 2 diabetes patients using the PHQ-9 in Bangladesh; results showed that 61.9% of participants had some level of depressive symptoms, with 26.2% of those being moderate to severe depression (Islam, Rawal, & Niessen, 2015). Rates of depression among those with type 2 diabetes in rural Appalachian Ohio and West Virginia are similar (De Groot et al., 2007). Of those with type 2 diabetes, 31% of participants reported clinically significant levels of depressive symptoms (De Groot et al., 2007).

One study analyzed the bidirectional association between type 2 diabetes and depressive symptoms. Among participants with depressive symptoms, the incidence rate

of type 2 diabetes was 22% as compared to 16.6% among those without the same depressive symptoms (Golden et al., 2008). Among those who were treated for type 2 diabetes, the incidence rates of elevated depressive symptoms reached 61.9% as compared to only 36.8% for participants with normal fasting glucose (Golden et al., 2008). Importantly, research has also shown a link between diabetes, depression, and diet quality. More specifically, a healthy diet has been shown to reduce depressive symptoms among people who have type 2 diabetes (Dipnall et al., 2015).

Due to this association, participants in the current study completed surveys related to distress and depression. These included the Patient Health Questionnaire-9 measuring depression and the Problem Areas in Diabetes Scale-5 measuring diabetes-related emotional distress. Participants showed low levels of diabetes-related emotional distress. The majority of participants also showed minimal levels of depression; however, 40% of participants showed signs of mild depression or greater. Only 1 participant showed moderately severe depression.

Interestingly, 90% of participants in the current study rated their diet quality as either "good" or "very good" when given a range from "excellent" to "poor." Only 1 participant rated diet quality lower, choosing a rating of "fair"; this participant did show signs of mild depression. However, the participants with scores corresponding to moderate and moderately severe depression on the PHQ-9 both rated their diet quality as "good." It is possible that the discrepancy between the current population's ratings and the literature is due to the small, unrepresentative population in this study. Alternatively, it is also possible that participants rated their diet quality higher than what they actually

perceived it to be in order to provide a socially desirable response. However, no conclusions can be made or statistical associations observed due to the small sample size of the current study.

**Produce intake and related behaviors.** The average self-reported daily fruit intake among the current population was 1.7 servings (ranging from 1-4), while the average for vegetables was 2.4 servings (ranging from 1-5). The daily recommendation for fruit intake in a 2,000-calorie diet is 2 cups, while for vegetables it is 2.5 cups (Byrd-Bredbenner, Moe, Beshgetoor, & Berning, 2013). The survey provided to the participants showed pictures of what a typical serving size looked like for both fruits and vegetables; however, it is still unclear what each individual participant considered to be one serving. Regardless, it appears that the current population is, on average, consuming less than the recommended amount of fruits and vegetables per day. In addition, only 60% of participants planned to incorporate more vegetables, and only 50% planned to incorporate more fruit into their diet.

When looking at past research, it is not uncommon for people with diabetes to consume less than the recommended levels of certain micronutrients. For example, Japanese patients with diabetes consumed less than the estimated average requirement for vitamins A, thiamin, C, calcium, magnesium, and zinc (Kobayashi et al., 2013). Adults with diabetes and related foot complications found that calcium, folate, magnesium, riboflavin, vitamin A, and zinc were all below the recommended dietary intakes (Pitt et al., 2007). While the current study did not measure the levels of micronutrients being consumed, it does provide a potential explanation for why lower levels of micronutrients

are seen among those with type 2 diabetes. Specifically, lower levels of fruit and vegetable consumption could be a reason.

One explanation why lower levels of fruits and vegetables might be seen among people with type 2 diabetes could be due to a lack of knowledge. This population may not have had adequate diabetes and nutrition education; in fact, only 3 participants in the current study identified having met with a dietitian to discuss food and type 2 diabetes. Additionally, only about half of those who are diagnosed with type 2 diabetes end up receiving education (Ali et al., 2013). While this is a concern because of the effect it might have on the levels of fruits and vegetables being consumed, it could also potentially result in poor diabetes control overall because of misunderstandings of how certain foods affect the body and blood glucose.

***Perceived impact of fruit on blood glucose levels.*** Another reason lower produce intake has been found, specifically for fruit, could be due to the perceived effect fruit has on the body and one's blood glucose levels. Half of the participants in the current study reduced their fruit intake or avoided certain fruits because of the effect these fruits had, or were perceived to have, on their blood glucose. Some participants found the effect certain fruits had on their blood glucose by testing; others simply assumed that the sugar in fruit would greatly increase it.

According to the American Diabetes Association, fruits do need to be included in the meal plans of those with type 2 diabetes as they provide essential vitamins, minerals, and fiber (American Diabetes Association, 2015). However, because of their carbohydrate content, fruit is a food group that does need to be accounted for when

planning meals. Tips are provided to those with type 2 diabetes on the ADA website who are using different meal plan methods, such as carbohydrate counting, the plate method, and the glycemic index (GI) (American Diabetes Association, 2015).

The ADA also provides information regarding the glycemic index of fruits. According to the ADA, because fruits are comprised of fructose and fiber, most fruits have a low GI value (American Diabetes Association, 2015). The ADA considers low GI foods to have a GI value of 55 or less, medium GI foods to have a GI value between 56-69, and high GI value foods to have GI values of 70 or greater. Table 12 below shows a list of the most common fruits that the current participants consumed and their glycemic load per serving. It is interesting to note that nearly all of them have a low GI value.

Table 12

*Glycemic Load of Fruit per Serving*

| Fruit | Glycemic index (glucose=100) | Serving size (grams) | Glycemic load per serving |
|---|---|---|---|
| Apples | 39 ± 3 | 120 | 6 |
| Grapes | 46 ± 3 | 120 | 8 |
| Bananas | 52 ± 4 | 120 | 12 |
| Strawberries | 40 ±7 | 120 | 1 |
| Raspberries[a] | 31 ± 8 | 100 | 2 |
| Pineapple | 59 ± 8 | 120 | 7 |
| Peaches | 42 ± 14 | 120 | 5 |

*Note.* Adapted from "International Table of Glycemic Index and Glycemic Load Values: 2002," by K. Foster-Powell, S. H. A. Holt, and J. C. Brand-Miller, 2002, *American Journal of Clinical Nutrition, 76,* pp. 30-32.
[a] Adapted from "International Tables of Glycemic Index and Glycemic Load Values: 2008," by F. S. Atkinson, K. Foster-Powell, and J. C. Brand-Miller, 2008, *Diabetes Care, 31*(12), p. 23.

Because of the lower fruit and vegetable intake among this population, the literature showing lower levels of micronutrient consumption among those with type 2 diabetes, and the misunderstanding of how fruits affect blood glucose, diabetes education with a strong focus on nutrition should be considered for all patients when they are first diagnosed.

**Knowledge, Perceptions, and Barriers of Plant-Based Diets Among Participants**

**Knowledge.** When looking back at research question one—does knowledge of plant-based diets among type 2 diabetes patients vary by food security level—it must be

kept in mind that the current sample was entirely food secure. Therefore, the question we answered was knowledge of plant-based diets among type 2 diabetes patients with high food security. Among those who did participate, only half had knowledge of plant-based diets. Of these 5, only 2 (20% of participants) were able to thoroughly explain what types of foods a plant-based diet consisted of; the other 3 made educated guesses. Similarly, a recent study looking at the knowledge of plant-based diets among 98 diabetes patients, of whom 68% had type 2 diabetes, found that 89% of patients had not heard of using a plant-based diet to manage type 2 diabetes (Lee et al., 2015). Overall, the participants in the current study had a lack of knowledge regarding plant-based diets; only 2 truly had a knowledge base surrounding this type of diet due to either consuming a plant-based diet or having family members who did. Limited knowledge and information regarding plant-based diets has been previously identified in the literature as a barrier to the adherence of such diets (Hardin-Fanning, 2013; Lea et al., 2006).

The majority of participants believed a plant-based diet is healthy. Interestingly, even those who said they lacked knowledge of plant-based diets believed them to be healthy. When asked why they believed it was healthy to consume this type of diet, participants commented on the fiber found in fruits and vegetables and provided examples of animals that were strong but consumed a plant-based diet. Participants have identified increased fiber as a health benefit of plant-based diets in past literature, as well (Lea, Crawford, & Worsley, 2006).

Only 1 participant had been following a plant-based diet. During the 1 year this participant consumed a plant-based diet, she found that a plant-based diet better regulated

her blood glucose levels. She noted that when eating non-plant-based foods, she would see an increase in her blood-glucose levels. She had lost weight by using a plant-based diet, and her blood pressure levels were normal. Her use of a plant-based diet was able to appropriately manage her diabetes. Comparatively, in the recent study by Lee et al. (2015), it was found that only 8 of the 98 participants were using any form of a plant-based diet to control their type 2 diabetes. Three of those 8 had been following the diet for less than 1 year.

***Misconceptions surrounding a plant-based diet.*** Other participants had concerns and misconceptions about plant-based diets. These misconceptions were regarding adequate protein intake in a plant-based diet, reaching adequate levels of micronutrients, the satiation of this type of diet, and a plant-based diet among children. Because the purpose of the current study is to address plant-based diets among adults with type 2 diabetes, only the first three misconceptions will be addressed.

One misconception was that adequate protein intake would not be able to be reached through a plant-based diet. While it is true that animal foods provide the complete array of essential amino acids, or otherwise called high-quality proteins, it is also true that combining certain plant foods can give an individual the same essential amino acids that are found in animal foods. For example, any combination of whole grains, nuts, seeds, or legumes will provide all of the essential amino acids. Brown rice served with black beans would be an example of this. Additionally, some plant foods, namely soy and quinoa, do provide the essential amino acids.

While the recommended intake for protein does depend on activity levels, weight, and individual goals, the average daily intake required for a person is 0.8 g of protein per kilogram of body weight (Byrd-Bredbenner et al., 2013). The average weight of the men in the current population was 213 pounds or 96.6 kg, with average protein requirements at 77.3 g. The average weight of the women was 198 pounds or 89.8 kg, with their average protein requirement being 71.8 g. It is of importance to note that this group of participants all had BMIs in the overweight (greater than 25) and obese (greater than 30) categories, resulting in a higher level of required protein for weight and muscle maintenance than for those within a normal BMI range. Table 13 shows a selected number of protein sources among plant-based foods.

Table 13

*Plant-Based Protein Sources*

| Food | Serving size | Protein (g) |
|---|---|---|
| Black beans, cooked | 1 cup | 15 |
| Tofu, regular | 4 oz | 10 |
| Tempeh | 1 cup | 31 |
| Lentils, cooked | 1 cup | 18 |
| Chickpeas, cooked | 1 cup | 15 |
| Quinoa, cooked | 1 cup | 8 |
| Peanut butter | 2 Tbsp | 8 |
| Almonds | ¼ cup | 8 |
| Spinach, cooked | 1 cup | 5 |
| Broccoli, cooked | 1 cup | 4 |

*Note.* Adapted from "Protein in the Vegan Diet," 2013. Retrieved November 7, 2015, from R. Mangels and the Vegetarian Resource Group website: https://www.vrg.org/nutrition/protein.php

Another misconception was that micronutrient levels would be inadequate in a plant-based diet. Participants did not identify the specific micronutrients of which they were concerned. However, some micronutrients commonly brought up as a concern in a plant-based diet include calcium, iron, and vitamin $B_{12}$ (Tuso et al., 2013). Contrary to this belief, all three of these micronutrients can be found or incorporated into a plant-based diet. Table 14 provides information regarding the amount of these micronutrients

in a selected number of plant-foods. The foods chosen for the table are plant-based foods in which these micronutrients are more abundantly found.

While considering the sources of these micronutrients in a plant-based diet, it is also important to keep in mind the recommended intake levels of each. The recommended intake for calcium is 1,000 milligrams (mg) per day; however, women over 50 and men over 70 should be consuming 1,200 mg per day. For $B_{12}$, the recommended intake is 2.4 micrograms (μg) per day. Finally, for iron, the recommended intake is 18 mg per day for women and 8 mg per day for men; women over the age of 51 have a reduced need of 8 mg per day. It is important to note that plant-based sources of iron, also known as non-heme iron, are less readily absorbed by the body (Byrd-Bredbenner et al., 2013). Because of this, a person typically needs to consume higher levels than the daily recommendation in order to meet the recommended levels. Vitamin C can also aid in the absorption of iron (Byrd-Bredbenner et al., 2013).

Table 14

*Calcium, Iron, and Vitamin $B_{12}$ in a Plant-Based Diet*

| Micronutrient | Food item | Serving size | Amount of micronutrient |
|---|---|---|---|
| Calcium | Mustard greens, cooked | 1 cup | 165 mg |
| | Turnip greens, cooked | 1 cup | 197 mg |
| | Kale, cooked | 1 cup | 94 mg |
| | Collard greens, cooked | 1 cup | 268 mg |
| | Tofu (calcium sulfate processed) | 4 oz | 253 mg |
| | Tempeh | 1 cup | 184 mg |
| | Navy beans, cooked | 1 cup | 126 mg |
| | Almond butter | 2 Tbsp | 111 mg |
| Iron | Kidney beans, cooked | 1 cup | 5.20 mg |
| | Soybeans, cooked | 1 cup | 4.50 mg |
| | Black beans, cooked | 1 cup | 3.61 mg |
| | Quinoa, cooked | 1 cup | 2.76 mg |
| | Lentils, cooked | 1 cup | 6.59 mg |
| | Cashews | 2 oz | 3.40 mg |
| | Spinach, cooked | 1 cup | 6.43 mg |
| $B_{12}$ | Supplemental vitamin | 1 vitamin | Amount varies |
| | General Mills Cheerios | 1 cup | 1.9 µg |
| | General Mills Whole Grain Total | 1 cup | 6.0 µg |
| | Nutritional yeast (Red Star T-6635+)[a] | 2 tsp | 2.4 µg |

*Note*. Adapted from "The USDA National Nutrient Database for Standard Reference," 2001. Retrieved November 7, 2015, from the U.S. Department of Agriculture website: http://ndb.nal.usda.gov

[a] Adapted from "Vitamin B12 in the Vegan Diet," 2013. Retrieved November 7, 2015, from R. Mangels and the Vegetarian Resource Group website: http://www.vrg.org/nutrition/b12.php

While a plant-based diet should be able to provide adequate levels of calcium and iron with proper planning, supplementation with a multivitamin can be used as a

precaution. The use of a multivitamin is also a way in which a person following a plant-based diet could incorporate vitamin $B_{12}$ into the diet.

Finally, the last misconception that participants voiced was in regard to the satiety of a plant-based diet. Participants did not think that a diet consisting entirely of plant-based foods would be enough to keep them full during the time between meals. However, both protein and fiber have been found to aid in satiety (Byrd-Bredbenner et al., 2013; Weigle et al., 2005). A plant-based diet is able to provide an abundance of both when planned carefully. If a person consuming a plant-based diet plans an adequate amount of plant-based protein for meals that are appropriately spaced throughout the day, it is likely that the protein amount and the fiber found in these plant sources, in addition to the fruits, vegetables, and whole grains being consumed, will keep them feeling full.

**Perceptions and opinions.** Opinions towards plant-based diets and of those who consumed them were indifferent. Again, this was among our population of people with type 2 diabetes and high food security. All of the participants in the current study agreed that diet was a personal choice; some even said that others who followed a plant-based diet were admirable due to their resolve of sticking with such a diet. When asked if they would incorporate plant-based meals into their own diet, all of the participants said they would be willing to consider adding a few plant-based meals during the week to their current diet. One question that was not asked in the current study was if participants would be willing to follow a trial-plant based diet, instead of simply incorporating plant-based meals. However, Lee et al. (2015) did ask this question. Surprisingly, approximately two-thirds of the diabetes patients (66%) responded that, with appropriate

support, they would be willing to try a plant-based diet as an option to manage their diabetes for a total of 3 weeks.

Even with such indifferent opinions, some participants voiced that they would likely never move to a completely plant-based diet. The main reason given by participants was their enjoyment of and desire to eat meat; this barrier towards a plant-based diet has been found in past literature as well (Lea & Worsley, 2003; Lee et al., 2015). Opinions and perceptions of a plant-based diet are critical in regard to potential self-efficacy related to plant-based diets based on the Social Cognitive Theory of health behavior and will be discussed in further detail later on in the chapter.

**Barriers.** While a lack of education, the perceived effect that fruit has on blood glucose, and the enjoyment of meat have already been discussed, there are several more barriers to a plant-based diet and increased fruit and vegetable consumption that participants identified. These included time, spoilage of produce, access to fresh fruits and vegetables and convenience, cost, difficulty of giving up certain foods, and lack of support from family members and friends. All of these perceived barriers are valid, real concerns and need to be addressed if we hope to move patients with diabetes towards a more plant-based diet.

***Time.*** Participants identified time as a barrier to the consumption of a plant-based diet. Reasons given were not enough time to plan out an adequate plant-based meal, to shop for the appropriate food, and then to also prepare the meal due to the added burden of extra plant-foods such as vegetables. The majority of the participants were leading busy lifestyles working full-time, and many of them were also responsible for the

preparation of food for their family or partner. Time constraints have been identified as a barrier to a plant-based diet among those with type 2 diabetes previously (Lee et al., 2015).

***Spoilage.*** Secondly, spoilage of produce was identified as a barrier to the consumption of a greater amount of fruits and vegetables. Participants spoke about the fact that when they do attempt to incorporate fruits or vegetables into their diet, many times they are not able to consume the produce before it has already passed its peak ripeness or has begun to spoil. While this could be a matter of more frequent shopping, participants did identify time—and specifically the time spent shopping—as a barrier, as well.

***Access and convenience.*** Access to fresh fruits and vegetables and convenience was another barrier identified by the participants. While 1 participant spoke about not being able to find the fresh produce she preferred at her local markets, another spoke about the issue of a lack of access to any fresh fruits and vegetables in a rural area. The latter idea is known as a food desert, or a low-income area where access to fresh foods such as fruits and vegetables is limited (Hardin-Fanning, 2013). However, this can be in a rural or urban setting, depending on the types and locations of markets in the surrounding area.

Past research has analyzed the barriers to a Mediterranean diet among participants with cardiovascular disease living in a rural food desert in Appalachia (Hardin-Fanning, 2013). A Mediterranean diet is another diet in which plant-based foods are emphasized, and plant-based diets have been shown to aid in the management and prevention of

cardiovascular disease (Bhupathiraju et al., 2013; Hu et al., 2014; Hung et al., 2004; Joshipura et al., 2001; Tanaka et al., 2013; Tucker et al., 2005). The participants in this study identified several barriers; namely, the difficulty of changing past habits, access to the fresh foods required by the diet, cost of these foods, difficulty of preparation, family attitudes, and limited knowledge (Hardin-Fanning, 2013). Many of these are barriers that the current study's participants identified in regard to consuming a plant-based diet for type 2 diabetes. Importantly, there was agreement that access was a barrier. While access to fresh fruits and vegetables was not an issue for individuals in the current participant group, many people living in Appalachian Ohio are living in rural areas with a lack of transportation, are of a low-income group, and are experiencing food insecurity (Holben & Pheley, 2006). Because of this, access to fresh produce is an important issue to overcome in this area.

***Cost.*** Another barrier to consuming a plant-based diet or increased amounts of fresh produce was cost. Participants spoke more about healthier foods being more expensive than about a financial inability to do so. All of the current participants said they did not have any issues affording food. What is interesting is that the barrier among this group in regard to cost appears to be a desire to spend less on food, and that in order to spend less, they feel as though a plant-based diet would not be plausible. Reasons given as to why a plant-based diet would be more expensive included the need to buy a large enough variety to keep it interesting as well as to reach levels of satiety. Cost is a commonly identified barrier when asking about adherence to plant-based diets (Hardin-Fanning, 2013; Lee et al., 2015).

However, several participants thought that a plant-based diet would be equal to or less than the cost of a regular American diet. They identified the reduced amount of money that would be spent on meat, processed foods, and dairy products as the main reasons. The participant who did follow a plant-based diet explained that the diet was initially more expensive, but that after a short period of time the price evened out and is now slightly less than what she had previously been spending on a typical American diet. The reason for the initial cost increase was due to replacing items that would no longer be consumed; namely, animal products and other processed foods. The experience of this participant aligns with the study by Flynn et al. (2013) who found that several plant-based meals per week were able to lower the average grocery costs of those who participated.

***Food deprivation.*** The difficulty of giving up certain foods was identified as a barrier to moving towards a plant-based diet. As mentioned earlier, several participants reported that their desire to eat meat outweighed the desire to consume a plant-based diet. In addition, other participants identified the general difficulty of breaking old habits and attempting to avoid foods one had previously enjoyed. This unwillingness to alter one's diet is not new; several other studies have found the same barrier to a plant-based diet (Hardin-Fanning, 2013; Lea et al., 2006; Lee et al., 2015). The plant-based participant in the current study said that it took high blood glucose and hemoglobin $A_{1c}$ levels in addition to weight gain before she made the choice to change her dietary habits. To change her outlook on deprivation, she said she focused on what she was allowed to eat

and on making better choices; she also attended an educational program regularly. Clearly, changing dietary habits is a difficult task and takes time.

***Family and friend support.*** Finally, participants identified a lack of family support as a barrier to consumption of a plant-based diet. This has been seen in the previous literature (Hardin-Fanning, 2013; Lea et al., 2006; Lee et al., 2015). One participant spoke about relying on his wife for prepared meals; she told him, "If you need somebody to get the recipes out of those diet books, you better get somebody else to cook for you" (ID 3, male, age 63, 1 F, 1 V). Another participant identified her husband as a barrier as she had to cook for him and he would not change his dietary habits to better suit her needs. Other participants had children who would only eat certain fruits and vegetables. Similarly, participants spoke about the social aspect surrounding eating, such as family gatherings, social events with friends, or going to restaurants. They felt that it would be difficult to adhere to such a strict diet when attending these events and that one might offend the person who prepared the food.

**The Social Cognitive Theory**

The Social Cognitive Theory provides a guide to aid in the understanding of the different facets of health behavior change. Social relationships contribute to health through social support, influence, and engagement, as well as by providing access to resources (Berkman et al., 2000). Social support comes in different forms; namely, emotional, instrumental, appraisal, and informational support. The maintenance of health requires social support, the social influence or shared norms around health behaviors, and access to resources such as goods, services, and opportunities (Berkman et al., 2000).

Another aspect contributing to health behavior maintenance is self-efficacy, based on the capabilities one has regarding knowledge, beliefs, skills, and motivation as well as the influence of the surrounding environment, whether social, economic and political (Bandura, 1986, 1997). Self-efficacy plays an important role in human functioning because it affects behavior both directly and indirectly through its impact on things such as goals, outcome expectations, and perceived barriers and facilitators in the social environment (Bandura, 2004).

The current study aimed to learn more about the knowledge, perceptions, barriers, and behaviors regarding plant-based diets and fruit and vegetable intake among those who had type 2 diabetes and varying levels of food security in order to determine what factors were of importance and needed to be addressed when creating interventions for this type of population in regard to the incorporation of and adherence to a plant-based diet. Table 15 provides an overview of participant responses regarding plant-based diets using the Social Cognitive Theory as a guide to aid in understanding the results as they pertain to the different facets of health behavior change, in this case, movement towards a more plant-based diet.

Table 15

*Overview of Participant Responses and the Social Cognitive Theory*

| Major theme | Minor theme | Description of participant responses |
|---|---|---|
| Social support | Emotional | Lack of support from family |
| | Instrumental | "Watching" of diet; no meal plans mentioned |
| | Informational | Lack of diabetes and nutrition education from dietitian |
| Self-efficacy | Knowledge | Identified lack of knowledge surrounding plant-based diets |
| | Beliefs | Majority believed plant-based diets to be healthy; some concerns voiced about adequacy of diet related to protein and micronutrient intake, satiety |
| | Motivation | Unwilling to give up certain foods |
| Shared norms | Family | Family did not share same values of healthy eating |
| | Friends | Concerns regarding social situations with friends |
| Access | Resources | Lack of access to fruits and vegetables in rural areas of Appalachian Ohio (did not affect current population) |
| Environment | Economic | Lower income levels and higher food insecurity levels in Appalachian Ohio (did not affect current population) |

Overall, we identified several barriers preventing participants from following, or being willing to follow, a plant-based diet. These perceived barriers, if looked at through the Social Cognitive Theory, may be due to each participant's self-efficacy regarding plant-based diets; namely, their plant-based diet related knowledge, beliefs, skills, and

motivation. We found a lack of knowledge about plant-based diets among the majority of participants in this study. Regardless of the lack of knowledge, the majority of participants still believed that a plant-based diet was healthy. However, without the knowledge of what types of foods actually comprise a plant-based diet, knowledge and skills regarding how to prepare such foods, or the motivation to make a behavior change towards a plant-based diet, the belief that a plant-based diet is healthy is almost meaningless. All aspects of self-efficacy need to be in support of plant-based diets before a behavior change in this direction will occur. Specifically, the perceived barriers among the participants need to be addressed. Even after these barriers are addressed, the benefits must outweigh any remaining barriers to a plant-based diet before behavior change will be able to occur.

The perceived barriers to following a plant-based diet included time, spoilage of produce, access to fresh fruits and vegetables and convenience, cost, difficulty of giving up certain foods, and lack of support from family members and friends. Several of these barriers are related to social support. Emotional support, or rather the lack thereof, was seen in the missing support from family members and friends. Instrumental support was nearly nonexistent; no participants identified having been given a dietary tool with which to manage their diabetes, such as a meal plan. They simply identified paying attention to the foods they were eating. However, some participants were on medication as a form of diabetes management and control. Missing informational support was seen by the lack of diabetes nutritional education among the majority of participants. The norms surrounding diabetes and diet did not seem to be shared by friends or family. However,

the participants identifying family as a barrier to a plant-based diet or a healthier diet in general did not provide information about any past attempts to address the situation. Instead, participants appeared to stick with the norms the family was used to experiencing regarding food. The concerns surrounding food at social events may identify a lack of shared norms, as well. If not a lack of shared norms, it may be attributed to a lack of social emotional support from friends. The reluctance to give up certain food groups could be seen as a lack of motivation, again part of self-efficacy. However, time, spoilage of produce, and cost are all barriers that can be addressed through plant-based diet education. Additionally, the lack of knowledge and skills regarding plant-based diets and how to work with family and friends could be provided through the same educational intervention. Before an educational program can be implemented, however, more questions need to be explored. Table 16 below provides a roadmap for more specific questions that need to be addressed among a larger, more heterogeneous population.

Table 16

*Roadmap for Further Questions*

| Topic | Ideas for main points |
|---|---|
| Knowledge of nutrition and diabetes | 1. How food groups interact with the body with type 2 diabetes<br>2. The use of meal plans or other forms of dietary management<br>3. What counts as a serving size |
| Knowledge of plant-based diets | 1. What a plant-based diet is<br>2. Why a plant-based diet may be a good choice for type 2 diabetes<br>3. The use of meal plans for plant-based diets |
| Health of plant-based diets | 2. Some common health concerns and how to prevent them |
| Cost of plant-based diets | 1. Information regarding the cost of a plant-based diet as compared to a typical American diet<br>2. Higher costing plant-based foods & health value<br>3. Lower costing plant-based foods & health value |
| Plant-based diets in busy lifestyle | 1. How to deal with issues related to time<br>2. How to try to prevent spoilage of produce |
| Family and friends | 1. How to let family and friends know about a new plant-based diet<br>2. How to talk about why a plant-based diet has been chosen |

**Conclusion, Limitations, and Future Directions**

The current study found a lack of knowledge about plant-based diets among the majority of participants diagnosed with type 2 diabetes and high food security. Self-efficacy and social support surrounding the incorporation of a plant-based diet into one's lifestyle remained low due to several identified barriers. These barriers included time, spoilage of produce, access to fresh fruits and vegetables and convenience, cost,

difficulty of giving up certain foods, and lack of support from family members and friends. In order to move this population towards the incorporation of more fruits and vegetables, and eventually a plant-based diet, education connecting type 2 diabetes, nutrition, and details about plant-based diets and the associated barriers needs to be provided to type 2 diabetes patients. However, this study was only a first step in this direction. Future directions are discussed below.

**Limitations.** There were several limitations to the current study. First, the relatively homogenous sample from one region in the Midwestern United States and the small, nonrandomly selected convenience samples may have limited generalizability to the larger population. The inclusion of Ohio University faculty and staff resulting from recruitment issues led to further homogeneity. Additionally, the small sample size did not allow for data saturation. Next, cultural and social variations regarding fruit and vegetable access among adults with type 2 diabetes were not addressed and warrant further study. Following this, social desirability may have influenced participants' reporting of barriers to fruit and vegetable consumption behaviors as well as fruit and vegetable security.

Questions asked in the interview guide may have been too specific; when asked about fruits and vegetables, only fresh produce was questioned. This may have taken away from potential data regarding other forms of fruits and vegetables. Only one question was asked regarding knowledge, which may have resulted in less information than could have been elicited.

One major limitation was the inability to achieve a representative sample of food security among the participants recruited for this study, as food insecurity is very prevalent in the Appalachian Ohio area and has been found to be associated with an increased rate of type 2 diabetes (Holben & Pheley, 2006). Because of this, it is important to learn what people experiencing food insecurity, type 2 diabetes, or both together know and perceive of plant-based diets and associated barriers. If the same, people with both type 2 diabetes and food insecurity could benefit from the same educational intervention outlined above; if different, a separate or additional educational intervention would need to occur. How we can help will be determined on these similarities or differences in their knowledge of plant-based diets.

Finally, because qualitative research is exploratory and provides hypotheses, quantitative research with a larger, more representative sample will need to examine these hypotheses.

**Future Directions.** The current study was only the first step in what will need to be a multistep research process before an educational intervention will be able to occur. Further qualitative studies should be carried out with a larger sample size so as to achieve a representative sample of food insecurity in the Appalachian Ohio region. Recommendations to achieve a more representative sample include recruitment from food pantries and offices addressing jobs and family services. Another recommendation to achieve a representative sample is to offer to travel to potential participants' homes or to the food pantries or offices from which they were recruited for the interview process.

Transportation to the interview locations may have been a barrier preventing potential participants from showing interest and participating.

Additionally, more questions about knowledge should be included in the next qualitative study as the current study asked only one. More specific questions to elicit more information should be used. Questions should remain as neutral as possible so as to not influence participant response, such as with forms of fruits and vegetables. Once the qualitative research on this topic has been exhausted and data regarding the knowledge, perceptions, and barriers to plant-based diets that exists among a participant population with both type 2 diabetes and food insecurity has been saturated, quantitative research will need to be done to test the hypotheses that have been formed.

Once we have the appropriate knowledge, a pilot educational program for those with type 2 diabetes and potential food insecurity may be created in order to receive feedback from actual participants regarding the information in the sessions, and to see if it is something that would be beneficial and of interest to this type of population.

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# Appendix A. IRB Approval Form

OHIO UNIVERSITY
Office of the Vice President for Research

15X011

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

T: 740.593.0664
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www.research.ohiou.edu

The following research study has been reviewed and 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): 7

**Project Title:** Knowledge and Perceptions of a Plant-Based Diet Among Individuals with Type 2 Diabetes and Food Insecurity Living in Rural Appalachian Ohio

**Primary Investigator:** Amanda Culley
**Co-Investigator(s):** Elizabeth Beverly

**Faculty Advisor:** David Holben
(if applicable)

**Department:** Applied Health Sciences and Wellness

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

March 2, 2015
**Approval Date**

March 1, 2016
**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 B. Screening Questionnaire

### Participant Screening

**Knowledge and Perceptions of Plant-based Diets Among Individuals with Type 2 Diabetes and High Food Security Living in Rural Appalachian Ohio**

ID # _____

Name _____

Phone # (H) _____ (W) _____

Best time to call _____

Call completed _____ Not home _____

---

**Screening Questionnaire**

Hello, _____. This is Amanda Culley from Ohio University, one of the researchers on the team for the study about the knowledge and perceptions of plant-based diets among people who have been diagnosed with diabetes and who are experiencing food insecurity. I have several questions I would like to ask you to see if you are eligible for the study, as I was referred to you by your physician and you indicated interest in the study. Can I continue with those questions?

If asked: It should only take about 10-15 minutes at the most to complete the questions.

QUESTIONS:

1. How did you learn of this study?

2. How old are you? _____ *If <30 or >70, then ineligible.*

3. Do you live in the Appalachian region of Ohio?
   _____ yes

   If yes, which county? _____ (Counties eligible include: Adams, Ashtabula, Athens, Belmont, Brown, Carroll, Clermont, Columbiana, Coshocton,

Gallia, Guernsey, Harrison, Highland, Hocking, Holmes, Jackson, Jefferson, Lawrence, Mahoning, Meigs, Monroe, Morgan, Muskingum, Noble, Perry, Pike, Ross, Scioto, Trumbull, Tuscarawas, Vinton, and Washington)

_____ no, *ineligible.*

4. Do you have type 2 (adult-onset) diabetes, which may also be known as 'having sugar' or 'sugar diabetes'?
   _____ I have diabetes
   _____ I do not have diabetes, *ineligible.*

5. How long have you been diagnosed with diabetes? _____ *If < 2 year, then ineligible.*

6. Are you currently under a health care provider's care for diabetes?
   _____ yes _____ no *If no, then ineligible*.

7. What is your current Hemoglobin A1c? _____ *If above 14%, then ineligible.*

8. Have you ever been diagnosed or received treatment for bipolar disorder? _____ yes _____ no *If yes, then ineligible*

9. Have you ever been diagnosed or received treatment for schizophrenia? _____ yes _____ no *If yes, then ineligible*

10. Have you ever been diagnosed or received treatment Alzheimer's disease, dementia or any other form of cognitive impairment? _____ yes _____ no *If yes, then ineligible*

11. Do you have any visual impairment that prevents you from reading or writing? _____ yes _____ no *If yes, then ineligible*

Thank you for answering our questions!

**END INTERVIEW QUESTIONS**

Subject is _____ eligible _____ ineligible

If ineligible: "Unfortunately, you don't meet our eligibility criteria for participating in this particular study, but we appreciate your taking the time to inquire about it."

If eligible, reason _____

If eligible:

(1) Review the purpose of the study.
(2) Ask if the person wants to participate.
(3) If they wish to participate, obtain address to mail consent form and questionnaires and indicate preference for an interview day.

Address:

_____

_____

_____

Forms mailed on: _____

Preferred day to attend interview:
____ Monday ____ Tuesday ____Wednesday ____Thursday _____ Friday

Preferred time to attend interview:
____ Morning ____ Afternoon ____ Evening

Additional Comments:

## Appendix C. Demographic Survey

1. Gender: M F (please circle)

2. Date of Birth: _____/_____/_____

3. Date of diabetes diagnosis: _____/_____/_____

4. Would you describe yourself as:

American Indian / Native American
Asian
Black / African American
Hispanic / Latino
White / Caucasian
Pacific Islander
Other: _____

5. How tall are you? _____feet_____inches

6. How much do you weigh? _____ pounds

7. Education: (please circle number of years completed)

| Grade School | High School | College | Graduate/Professional |
|---|---|---|---|
| 1 2 3 4 5 6 7 8 | 9 10 11 12 | 1 2 3 4 | 1 2 3 4 5 6 7 8 9 10 |

8. Are you retired?

Yes
No

9. What is your marital status?

| Single | Married/Living with partner | Separated | Divorced | Widowed |
|---|---|---|---|---|

## Appendix D. Household Food Security Survey Module

| Question |
| --- |
| 1. "I/We worried whether my/our food would run out before I/we got money to buy more." Was that often, sometimes, or never true for you/your household in the last 12 months? |
| 2. "The food that we bought just didn't last and we didn't have money to get more." Was that often, sometimes, or never true for you in the last 12 months? |
| 3. "We couldn't afford to eat balanced meals." Was that often, sometimes, or never true for you in the last 12 months? |
| 4. In the last 12 months, did you or other adults in the household ever cut the size of your meals or skip meals because there wasn't enough money for food? (yes/no) |
| 5. (If yes to question 4) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months? |
| 6. 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) |
| 7. In the last 12 months, were you ever hungry, but didn't eat, because you couldn't afford enough food? (yes/no) |
| 8. In the last 12 months, did you lose weight because you didn't have enough money for food? (yes/no) |
| 9. In the last 12 months did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food? (yes/no) |
| 10. (If yes to question 9) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months? |
| (Questions 11-18 are asked only if the household included children age 0-18) |
| 11. "We relied on only a few kinds of low-cost food to feed our children because we were running out of money to buy food." Was that often, sometimes, or never true for you in the last 12 months? |
| 12. "We couldn't feed our children a balanced meal because we couldn't afford that." Was that often, sometimes, or never true for you in the last 12 months? |
| 13. "The children were not eating enough because we just couldn't afford enough food." Was that often, sometimes, or never true for you in the last 12 months? |

14. In the last 12 months, did you ever cut the size of any of the children's meals because there wasn't enough money for food? (yes/no)

15. In the last 12 months, were the children ever hungry but you just couldn't afford more food? (yes/no)

16. In the last 12 months, did any of the children ever skip a meal because there wasn't enough money for food? (yes/no)

17. (If yes to question 16) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

18. In the last 12 months, did any of the children ever not eat for a whole day because there wasn't enough money for food? (yes/no)

---

Household Food Security Survey Module (HFSSM) Questions

*Note.* Found in *Food Insecurity and Hunger in the United States*, 2006, eds. Wunderlich & Nord. Sourced from Nord, Andrews, and Carlson (2005).

**Coding of the FSS survey:**

Responses of "yes," "often," "sometimes," "almost every month," and "some months but not every month" are coded as affirmative. The sum of affirmative responses to the 10 questions in the Adult Food Security Scale is the household's raw score on the scale.

Food security status is assigned as follows:

· Raw score zero—High food security among adults

· Raw score 1-2—Marginal food security among adults

· Raw score 3-5—Low food security among adults

· Raw score 6-10—Very low food security among adults

*Note.* This information is free to the public and taken verbatim from:
U.S. Department of Agriculture. (2012). U.S. adult food security survey module: Three-stage design, with screeners. Retrieved October 4, 2014, from http://www.ers.usda.gov/datafiles/Food_Security_in_the_United_States/Food_Security_Survey_Modules/ad2012.pdf

## Appendix E. Fruit and Vegetable Questionnaires

### 13-item Tool to Assess Psychosocial Indicators of Fruit and Vegetable Intake in Low Income Communities

| | |
|---|---|
| Q1. I feel that I am helping my body by eating more fruits and vegetables. | A: Agree, agree or disagree, disagree |
| Q2. I may develop health problems if I do not eat fruits and vegetables. | A: Agree, agree or disagree, disagree |
| Q3. I feel that I can eat fruit or vegetables as snacks. | A: Agree, agree or disagree, disagree |
| Q4. I feel that I can buy more vegetables the next time I shop. | A: Agree, agree or disagree, disagree |
| Q5. I feel that I can plan meals or snacks with more fruit during the next week. | A: Agree, agree or disagree, disagree |
| Q6. I feel that I can eat two or more servings of vegetables at dinner. | A: Agree, agree or disagree, disagree |
| Q7. I feel that I can plan meals with more vegetables during the next week. | A: Agree, agree or disagree, disagree |
| Q8. I feel that I can add extra vegetables to casseroles and stews. | A: Agree, agree or disagree, disagree |
| Q8. How would you describe your diet? | A: Excellent, very good, good, fair, poor |
| Q10. In your household, who is in charge of what foods to buy? | A: I am, shared decision, other person |
| Q11. In your household, who is in charge of how to prepare the food? | A: I am, shared decision, other person |

| | |
|---|---|
| Q12A. I am not thinking about eating more fruit. | |
| Q12B. I am thinking about eating more fruit . . . planning to start within 6 months. | |
| Q12C. I am definitely planning to eat more fruit. | |
| Q12D. I am trying to eat more fruit now. | |
| Q12E. I am already eating 3 or more servings of fruit a day. | |
| Q13A. I am not thinking about eating more vegetables. | |
| Q13B. I am thinking about eating more vegetables . . . planning to start within 6 months. | |
| Q13C. I am definitely planning to eat more vegetables. | |
| Q13D. I am trying to eat more vegetables now. | |
| Q13E. I am already eating 3 or more servings of vegetables a day. | |

**7-item Food Behavior Checklist for a Limited Resource Audience**

Food Stamp Program

# Fruit and Vegetable Checklist

These questions are about the ways you plan and fix food
Think about how you usually do things.

Name _____ Date _____ ID# _____ ☐ Entry ☐ Exit

Choose one answer for each question.

1. 

Do you eat fruits or vegetables as snacks?

○ no ○ yes, sometimes ○ yes, often ○ yes, everyday

2. 


Did you have citrus fruit or citrus juice during the past week?

○ yes ○ no

3. Fruit: How much do you eat each day?

○ none ○ 1/2 cup ○ 1 cup ○ 1 1/2 cups ○ 2 cups ○ 2 1/2 cups ○ 3 cups or more

4. 

Do you eat more than one kind of **fruit** each day?

○ no ○ yes, sometimes ○ yes, often ○ yes, always

5. 

Do you eat more than one kind of **vegetable** each day?

○ no ○ yes, sometimes ○ yes, often ○ yes, always

6. Vegetables: How much do you eat each day?

○ none ○ 1/2 cup ○ 1 cup ○ 1 1/2 cups ○ 2 cups ○ 2 1/2 cups ○ 3 cups or more

7. 

Do you eat 2 or more vegetables at your main meal?

○ no ○ yes, sometimes ○ yes, often ○ yes, everyday

• **Use the accompanying instruction guide when administering this tool.**

• Research and development for this illustrated diet quality checklist were a joint effort of University of California (UC) Cooperative Extension, the California Nutrition Network, UC Davis Design Program and UC Davis Nutrition Department. Authors: Kathryn Sylva, Marilyn Townsend, Anna Martin, Diane Metz.

• The research for this diet quality instrument is available:

Townsend MS, Kaiser LL, Allen LH, Joy AB, Murphy SP. Selecting items for a food behavior checklist for a limited resource audience. Journal of Nutrition Education and Behavior. 2003;35:69-82.

Murphy SP, Kaiser LL, Townsend MS, Allen LH. Evaluation of Validity of Items in a Food Behavior Checklist. Journal of the American Dietetic Association. 2001;101:751-756, 761.

Townsend MS, Sylva KG, Martin A, Metz D, Wooten-Swanson P, Follett J, Keim N, Sugerman S. Visually Enhanced Evaluation for Low-income Clients. J Nutr Educ Behav. 2005; 37 (1):S49.

• Funded by the USDA Food Stamp Program via the California Nutrition Network, UC Cooperative Extension and UC Davis.

CUPS122007

## Appendix F. Diabetes Depression, Distress, and Self Care Questionnaires

### Patient Health Questionnaire 9

Over the last 2 weeks, how often have you been bothered by any of the following problems. Please provide an answer for each question.

| | Not at all | Several Days | More than half the days | Nearly every day |
|---|---|---|---|---|
| Little interest or pleasure in doing things | 0 | 1 | 2 | 3 |
| Feeling down, depressed, or hopeless | 0 | 1 | 2 | 3 |
| Trouble falling or staying asleep, or sleeping too much | 0 | 1 | 2 | 3 |
| Feeling tired or having little energy | 0 | 1 | 2 | 3 |
| Poor appetite or overeating | 0 | 1 | 2 | 3 |
| Feeling bad about yourself – or that you are a failure or have let yourself or your family down | 0 | 1 | 2 | 3 |
| Trouble concentrating on things, such as reading the newspaper or watching television | 0 | 1 | 2 | 3 |
| Moving or speaking so slowly that other people could have noticed? Or the opposite – being so fidgety or restless that you have been moving | 0 | 1 | 2 | 3 |

| | | | | |
|---|---|---|---|---|
| around a lot more than usual | | | | |
| Thoughts that you would be better off dead or of hurting yourself in some way | 0 | 1 | 2 | 3 |

PHQ-9* Questionnaire for Depression Scoring and Interpretation Guide For physician use only

Count the number (#) of boxes checked in a column. Multiply that number by the value indicated below, then add the subtotal to produce a total score. The possible range is 0-27. Use the table below to interpret the PHQ-9 score.

Not at all (#) _____ x 0 = _____
Several days (#) _____ x 1 = _____
More than half the days (#) _____ x 2 = _____
Nearly every day (#) _____ x 3 = _____
Total score: _____

Interpreting PHQ-9 Scores

| Diagnosis | Total Score | For Score | Action |
|---|---|---|---|
| Minimal depression | 0-4 | ≤ 4 | The score suggests the patient may not need depression treatment |
| Mild depression | 5-9 | 5-14 | Physician uses clinical judgment about treatment, based on patient's duration of symptoms and functional impairment |
| Moderate depression | 10-14 | | |
| Moderately severe depression | 15-19 | > 14 | Warrants treatment for depression, using antidepressant, psychotherapy and/or a combination of treatment. |
| Severe depression | 20-27 | | |

* The PHQ-9 is free to the public and is described in more detail at the Pfizer website: http://www.phqscreeners.com/

**Problem Areas in Diabetes Scale (PAID)-5**

Which of the following diabetes issues are currently a problem for you? Circle the number that gives the best answer for you. Please provide an answer for each question.

| | Not a problem | Minor problem | Moderate problem | Somewhat serious problem | Serious problem |
|---|---|---|---|---|---|
| Feeling scared when you think about living with diabetes | 0 | 1 | 2 | 3 | 4 |
| Feeling depressed when you think about living with diabetes | 0 | 1 | 2 | 3 | 4 |
| Worrying about the future and the possibility of serious complications | 0 | 1 | 2 | 3 | 4 |
| Feeling that diabetes is taking up too much of your mental and physical energy every day | 0 | 1 | 2 | 3 | 4 |
| Coping with complications of diabetes | 0 | 1 | 2 | 3 | 4 |

Total scores can range from 0 to 20, with higher scores suggesting greater diabetes-related emotional distress.

**Self-Care Inventory-Revised (SCI-R)**

This survey measures what you *actually do*, not what you are advised to do. How have you followed your diabetes treatment plan in the past 1-2 months? Circle the number that gives the best answer for you. Please provide an answer for each question.

| | Never | Rarely | Sometimes | Usually | Always | |
|---|---|---|---|---|---|---|
| Check blood sugar with meter | 1 | 2 | 3 | 4 | 5 | |
| Look at blood sugar patterns | 1 | 2 | 3 | 4 | 5 | |
| Check blood sugar more often when sick | 1 | 2 | 3 | 4 | 5 | |
| Take the correct dose of diabetes pills or insulin. | 1 | 2 | 3 | 4 | 5 | |
| If on insulin, adjust dosage based on blood sugar results, food and activity | 1 | 2 | 3 | 4 | 5 | Not on insulin |
| Follow meal plan | 1 | 2 | 3 | 4 | 5 | |
| Eat the correct serving sizes | 1 | 2 | 3 | 4 | 5 | |
| Eat heart healthy foods | 1 | 2 | 3 | 4 | 5 | |
| Read food labels | 1 | 2 | 3 | 4 | 5 | |
| Take brisk walks daily | 1 | 2 | 3 | 4 | 5 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Check feet daily | 1 | 2 | 3 | 4 | 5 | |
| Treat low blood sugar with just the recommended amount of carbohydrate | 1 | 2 | 3 | 4 | 5 | Never had low blood sugar |
| Carry quick acting sugar to treat low blood sugar | 1 | 2 | 3 | 4 | 5 | |
| Exercise regularly | 1 | 2 | 3 | 4 | 5 | |
| Wear a Medic Alert ID | 1 | 2 | 3 | 4 | 5 | |
| Come in for clinic appointments | 1 | 2 | 3 | 4 | 5 | |
| Know my blood pressure, A1C and lipid (HDL, LDL) lab results | 1 | 2 | 3 | 4 | 5 | |

Scores on the SCI-R are converted to a score out of 100. Higher scores are associated with higher levels of diabetes self-care

## Appendix G. Qualitative Interview Tools

### Interview Guide

1. How do you manage your diabetes?
   **Probes**
   a. Can you be more specific about the things you do?
   b. What is most difficult for you in managing your diabetes?
   c. What is easiest for you in managing your diabetes?

2. Have you ever struggled with taking care of your diabetes? If so, tell me about that.

3. What do you see as the most important things affecting your A1C and blood sugar levels?

4. What foods do you and your family most often eat at home?
   **Probes**
   a. Why are these foods most commonly eaten at home?
   b. Who does the food shopping in your family?

5. How do you prepare a typical meal with your family?
   **Probes**
   a. Who helps you prepare the meal?
   b. Do you use recipes when you prepare meals?
      —Do you find recipes helpful? Please explain.
   c. What is most challenging about preparing meals?

6. What vegetables do you and your family typically eat on a regular basis?
   **Probes**
   a. Are there any vegetables that you prefer to eat? Your child?
   b. Are there any vegetables that you do not like to eat? Your child?

7. What fruits do you and your family typically eat on a regular basis?
   **Probes**
   a. Are there any fruits that you prefer to eat? Your child?
   b. Are there any fruits that you do not like to eat? Your child?

8. What gets in the way of your eating fresh fruits and vegetables with your meals?
   **Probes**
   a. Examples: cost, seasonality, proximity to food market, transportation, child care, etc.

6. Do you ever worry about not having enough food at home?
   **Probes**

a. How often do you worry about not having enough food? Is this a seasonal concern?
b. Have you ever had to limit the amount of food you eat?
c. Have you ever had to limit the number of meals in a day?

d. Do you ever eat the same type of food over and over again for a long period of time?
- Can you give me an example of a type of food that you have eaten over and over again?

7. What concerns, if any, do you have regarding the amount of food you have at home and how this may affect your family?

8. What would you change about your food situation if you could? Please explain.

9. Do your family members or friends support or interfere with how you take care of your diabetes? Tell me more about that.

10. What else can you tell me about food and taking care of your diabetes?

11. Have you participated in diabetes education? Tell me about that.

**Probes**

b. Did you receive education about nutrition and diabetes? If so, tell me about that.
c. Who provided the education to you?
d. How much education have you had?

12. What do you know about plant-based diets? Tell me more about that.

**Probes**

a. Examples: foods eaten, cost, health of diet, popularity, alternative names etc.

13. What do you think about plant-based diets? Tell me more about that.

**Probes**

a. Do you think plant-based diets are adequate for good health?
b. What do you think about the ease of following a plant-based diet?
-- Any barriers?
c. What do you think about the cost of following a plant-based diet?

14. What is your opinion of others who follow a plant-based diet? Tell me more about that.

15. Are you willing to incorporate plant-based meals into your diet? Why or why not?


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