

CHARACTERIZING FOOD INSECURITY IN LOW INCOME WOMEN AT RISK  
OF TYPE 2 DIABETES

By

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## *Abstract*

Populations who are food insecure are at risk for negative health outcomes, such as development of diabetes and other chronic diseases, as well as greater barriers to achieving optimal health. Therefore, a descriptive analysis was carried out to understand which characteristics were associated with food insecurity at baseline in a sample of low-income women at risk of type 2 diabetes. The analysis was conducted in the context of a diabetes prevention program carried out at a Federally Qualified Health Center (FQHC) in Tucson, Arizona. Participants included women with a history of gestational diabetes or prediabetes. Baseline measurements were collected by trained research staff. Forty-six percent (n=21) of participants were categorized as food insecure, through the use of the Hunger Vital Sign. The characteristics which were different among the two groups were waist circumference, diastolic blood pressure, BMI and Health Insurance. The most significant differences were waist circumference and BMI, with greater values in the food insecure group. This analysis suggests that food insecurity may disproportionately affect those who are already at increased risk of the development of type two diabetes. Food insecurity may pose a great challenge to management of lifestyle and therefore make it harder to manage diabetes prevention.

## *Introduction*

Food insecurity has been linked to increased risk of negative health outcomes, such as development of diabetes and other chronic diseases. Research has also shown that food insecurity also poses barriers to access to healthcare, which further leads to negative health outcomes. This is a great concern, especially amongst low income families. It is important to further study this relationship in specific populations, such as those at risk for type 2 diabetes. This is important as low income groups have higher levels of food insecurity and food insecurity

is associated with increased risk for developing disease, such as type 2 diabetes. Because of this, those who are food insecure and are already at an increased risk of developing type 2 diabetes, may be much more negatively impacted. Therefore, a descriptive analysis was conducted to understand which demographic characteristics were associated with food insecurity at baseline in this sample. This analysis is being done in the context of a diabetes prevention program. This program is aimed at testing the effectiveness of a family-focused lifestyle behavior change intervention program designed for mothers with a history of gestational diabetes or prediabetes at a Federally Qualified Health Center (FQHC) in Tucson, Arizona. This program is specifically tailored for at-risk Latinx women and children, who comprise a majority of the FQHC patient population. Baseline data were analyzed to understand which sociodemographic variables were associated with food insecurity in this sample of women, which as research shows, is a risk factor for poor health outcomes, including type 2 diabetes.<sup>1,2</sup>

### *Literature Review*

According to the USDA, food insecurity is defined as “a household-level economic and social condition of limited or uncertain access to adequate food.”<sup>3</sup> Food insecurity is also understood as “limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways”<sup>1</sup>. In the US, as of 2018, it is estimated that 11.1 percent of household are food insecure, with 4.3 percent of those being categorized with very low food security, meaning that at least one household member’s food intake was reduced and their eating patterns were disrupted at times, due to lack of financial resources or other resources necessary for obtaining food<sup>4</sup>. As a social determinant of health, which are “conditions in the environments in which people live, learn, work, play,

worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks”, food security status is an important factor in the health of people.<sup>5</sup>

In general, food insecurity is associated with poor health outcomes as well as higher healthcare costs, for both adults and children.<sup>6</sup> In this way, food insecurity is a social determinant of health which contributes to health disparities. A systematic review which explored the relationship of food insecurity to dietary outcomes in a population of women, concluded that a majority of studies found that women who are food insecure have lower consumption of a variety of foods such total fruits and vegetables, total grains, and meats<sup>7</sup>. Food insecurity was also negatively associated with the intake of various critical macronutrients such as protein and total fat, and micronutrients such as calcium, iron, magnesium, folate, and vitamins A and C.<sup>7</sup> Therefore, those who are food insecure may not be getting the adequate nutrition that they need. Food insecurity is also associated with overweight and obesity.<sup>8</sup> This could be due to variety of mechanisms, including a lack of adequate nutrition. Furthermore, food insecurity is associated with increased risk for cardiovascular disease. Seligman et al. claim that food insecurity is associated with self-reported hypertension and hyperlipidemia, along with laboratory/examination evidence of hypertension along with diabetes.<sup>9</sup>

Other studies have also noted food insecurity as a risk for poor glycemic control. Landry et al., studied the impact of food security on glycemic control in a population of low-income primarily Hispanic/Latino children. They concluded that food insecure children had poorer glycemic control and greater insulin resistance compared to food secure children.<sup>2</sup> Additionally, Seligman et al. claim that adults with severe food insecurity are more likely to have diabetes than their food secure counterparts.<sup>10</sup> Even after controlling for a variety of factors, studies have shown that food insecurity is significantly associated with poor glycemic control<sup>1</sup>. Not only is

poor glycemic control in diabetic populations an issue but so is dyslipidemia. A study using a nationally representative sample of the US, reported that in diabetic adults, food insecurity was associated both with poor glycemic and cholesterol control.<sup>1</sup> According to this study, 2.1 million diabetic adults have poor glycemic control, and of these, nearly 25% are food insecure, and 70% of this food-insecure population has poorly controlled cholesterol.<sup>1</sup>

Just as food insecurity is linked to poor physical health, recent literature also shows that insufficient quality of food is significantly and positively associated with psychological distress.<sup>11</sup> This is seen in many populations, including adults of all ages, college students, parents and those living with chronic disease.<sup>11</sup> Therefore, not only are food insecure populations at higher risks for obesity, diabetes and other chronic diseases, but also for the development of depression, anxiety, stress. This is further exemplified by a 2010 study which investigated the relationship between food security and health in female WIC participants. Mathews et al. concluded that food insecurity significantly increased the chances of lower mental health score along with “seldom or never eating 2 1/2 cups of vegetables per day”.<sup>12</sup> These studies suggest food insecurity poorly affects both general health and mental health. Finally, those which are food insecure also tend to have poor access to care, often leading to delays in seeking care.<sup>13</sup> In total, these studies highlight the detrimental effects of food insecurity, it is therefore important to explore what other factors may be associated with food insecurity.

In understanding that food insecurity has the potential to negatively impact physical and mental health, it is important to determine how to accurately measure food insecurity. The USDA has an eighteen-item Core Food Security Module (CFSM) which adequately measures food security, however, two-item screens have been designed to ease the identification of those who may be food insecure, as well as ease participant burden.<sup>6</sup> A study which explored different

combinations of two item questions from this eighteen-item screen, determined that each combination had high sensitivity for US populations and high-risk groups in comparison with the CFSM.<sup>6</sup> All combinations have sensitivity and specificity acceptable for clinical use, however, the combination of items 1 and 2 have been the most widely disseminated and are recommended by the American Academy of Pediatrics.<sup>6</sup> This combination of questions, 1 and 2, are known as the Hunger Vital Sign. Other studies have also deemed the Hunger Vital Sign as “sensitive, specific, and valid among low-income families with young children”.<sup>14</sup> The two questions asked in this screen are (1) “Within the past 12 months we worried whether our food would run out before we got money to buy more” and (2) “Within the past 12 months the food we bought just didn’t last and we didn’t have money to get more”.<sup>14</sup> The sensitivity and specificity of this screen has deemed this screen able to correctly identify households which are food-insecure and food secure.

It is important to investigate which factors influence risk for food insecurity as previous research has shown that food insecurity poses risk for the development of disease and poor mental health. Studies have also shown that the Hunger Vital sign is a valid screening tool for identifying families with food insecurity. Therefore, identifying which families are food insecure with the use of this tool, and characterizing which factors are associated with it, will help us further understand this complex issue. Our findings will also be used by the Federally Qualified Health Center with whom we partnered in this study to further understand their patient population and the problems which they may face.

### *Research Methods*

*Participants:* Women, ages 18+ years, who are at risk of T2D (based on metabolic phenotype and medical history).

*Procedure:* Baseline data from 46 participants in a family-focused diabetes intervention study were collected and analyzed. This study was conducted at a Federally Qualified Health Center (FQHC). Half of participants were randomized to an intervention, consisting of 2-hour weekly sessions focused on nutrition, physical activity and stress management, and the other half were randomized to a wait-list control group. Measurements were conducted by trained research staff following standardized measurement procedures at the FQHC. Baseline measurements, including height, weight, A1C, blood pressure waist circumference, along with surveys which prompted participants to provide information regarding their diet quality, physical activity, and sociodemographic data, including food security (assessed with the 2-item Hunger Vital Sign) were conducted by trained research staff.

*Data Analysis:* Assessment of food security was completed using the Hunger Vital Sign. Descriptive statistics were used to characterize sociodemographic and health characteristics, and statistical analysis, including t-tests, Wilcoxon Rank-Sum Test, and Fisher's Exact Test, were used to determine whether these characteristics differed by whether or not participants identified themselves as food insecure. For continuous variables, the difference between means of the two groups (Food secure and food insecure) were measured, for those variables with a normal distribution, a t-test was conducted (waist circumference, systolic blood pressure, diastolic blood pressure and BMI). The remaining continuous variables which did not have a normal distribution (Age and HbA1c) were analyzed using the Wilcoxon Rank-Sum Test. For the categorical variables of ethnicity, race, income, benefits, insurance, employment and education, the difference in frequency between the two groups were measured using Fisher's Exact Test. P-values less than 0.05 were considered as statistically significant.

*Results*

Forty-six percent (n=21) of participants met the criteria of food insecure. Table 1 summarizes the sociodemographic and health characteristics of study participants, further separated by food security status. Table 1 also displays the P-values, demonstrating significant statistical differences between the two groups for these characteristics. The characteristics which were different among the two groups were waist circumference, diastolic blood pressure, BMI and health insurance.

**Table 1. Demographic, Socioeconomic, and Health Characteristics of Study - Mothers (n=46)**

	<b>Food Secure (25 = 54%)</b>	<b>Food Insecure (21= 46%)</b>	
<b>Characteristics</b>	<b>Mean (SD)</b>		<b>p-value</b>
Age (years)	41.4 ± 6.1	39.6 ± 6.1	0.42
Household Size (number)	5 ± 1.4	5.2 ± 1.2	0.75
Waist Circumference	104.7 ± 10.1	117.7 ± 18	0.004*
Systolic Blood Pressure	121 ± 12.8	115.3 ± 12.2	0.12
Diastolic Blood Pressure	73.6 ± 9	68.5 ± 6.3	0.03*
A1C	6.04 ± 1.3	5.8 ± 0.4	0.57
BMI	32.4 ± 4.6	36.4 ± 6	0.01*
	<b>Frequency (%)</b>		
Ethnicity			
<i>Hispanic</i>	22 (88%)	17 (81%)	0.16
<i>Non-Hispanic</i>	3 (12%)	4 (19.01%)	
Race			
<i>White</i>	15(60%)	9 (43%)	0.18
<i>Black/African American</i>	1(4%)	2 (10%)	
<i>Pacific Islander</i>	0	0	
<i>American Indian/Alaska Native</i>	1 (4%)	5 (24%)	
<i>Other</i>	8 (32%)	5 (24%)	
Household Income			
<\$25, 000	14 (56%)	8 (38%)	0.14
\$25,000-49,999	9 (36%)	12 (57%)	
\$50,000-74, 999	0	1 (5%)	
>\$75, 000	2 (8%)	0	
Household Benefits~			
<i>Social security (SS)</i>	1 (4%)	0	0.08
<i>SNAP/Food stamps</i>	4 (16%)	10 (48%)	
<i>Medicare</i>	0	0	
<i>WIC</i>	4 (16%)	2 (10%)	
<i>Veterans Affairs (VA)</i>	0	1 (5%)	

<i>Unemployment</i>	0	0	
<i>Other</i>	1 (4%)	0	
<i>SNAP and WIC</i>	1 (4%)	2 (10%)	
<i>SNAP and other</i>	1 (4%)	0	
<i>SS, WIC, and VA</i>	0	1 (5%)	
<i>None</i>	14 (56%)	6 (29%)	
Health Insurance			
<i>Kidscare</i>	1 (4%)	0	
<i>Private insurance</i>	2 (8%)	3 (14%)	
<i>AHCCS/Medicaid</i>	16 (64%)	13 (62%)	0.05*
<i>Medicare</i>	0	0	
<i>Other</i>	1 (4%)	5 (24%)	
<i>Uninsured</i>	5 (20%)	0	
Employment			
<i>Employed</i>	15 (60%)	14 (67 %)	
<i>Unemployed (Seeking work)</i>	3 (12%)	5 (24%)	0.21
<i>Unemployed (Non seeking work)</i>	7 (28%)	2 (10%)	
Education			
<i>Less than High School</i>	11 (44%)	5 (24%)	0.17
<i>Highs School/ GED</i>	4 (16%)	8 (38%)	
<i>More than High School</i>	10 (40%)	8 (38%)	

~SNAP- Supplemental Nutrition Assistance Program; AHCCCS- Arizona Health Care Cost Containment System; ~Households may select more than one benefit received \*p-values < 0.05

T-test for normally distributed continuous variables: waist circumference, systolic blood pressure, diastolic blood pressure and BMI.

Wilcoxon Rank-Sum Test for Age and HbA1c.

Fisher's Exact Test for categorical data: Ethnicity, Race, Income, Benefits, Insurance, Employment and Education.

### *Discussion*

This study examined the characteristics associated with food insecurity in a sample of women already at an increased risk for type two diabetes. Overall, the results show that characteristics different between those who were food secure and food insecure among the two groups were waist circumference, diastolic blood pressure, BMI, and health insurance. The most significant differences were waist circumference and BMI, with a greater waist circumference and greater BMI observed in the food insecure group. These results are consistent with other studies that conclude that food insecurity is associated with overweight and obesity.<sup>8</sup> Indicators of overweight and obesity may be potentially related poor diet quality. Studies have shown that poor diet quality is associated with food insecurity.<sup>7</sup> Therefore, poor diet quality could be contributing

to increased waist circumference and BMI. A possible next step for this study would be to determine the diet quality in this study sample, and then determine if there are further associations between diet quality, food security and disease risk in this sample. This would lead to further understanding of the mechanisms which may contribute to disease risk for those who are food insecure. The food insecure group had a lower average diastolic blood pressure compared to the food insecure group. This does not support prior studies of food insecurity and chronic health conditions, which suggested that food insecurity is associated with greater self-reported and measured hypertension.<sup>9</sup> Differences between food insecure and food secure groups were statistically significant when it came to health insurance. All participants in the food insecure group reported some form of health insurance, whereas 20% of the food secure group were uninsured. Upon closer examination, it is difficult to interpret whether differences in health insurance are associated with food security status in a meaningful way. Federally Qualified Health Centers by definition serve low income and under-insured persons. Therefore, while there are statistically significant differences between the two groups in health insurance status exist, it is possible that both groups have equal access to care through El Rio.

This study had several limitations, including a small sample size and the use of the Hunger Vital Sign. Even though the Hunger Vital Sign has proven to be a valid tool in screening for food security, it still is a 2-item screen and may not be as detailed as other tools such as the 18 item USDA screen. This may result in less people being identified as food insecure who may qualify if given the 18-item screen. Several studies have already shown that food insecurity is associated with increased risk for poor health, including type two diabetes.<sup>1,2,8,9,10</sup> This analysis suggests, that in addition to this, food insecurity may disproportionately affect those who are already at increased risk of the development of type two diabetes. Food insecurity may pose a great challenge to

management of overweight and obesity and therefore make it harder to prevent and manage this chronic condition.

### *Conclusions*

This descriptive analysis highlights the importance of addressing and understanding food insecurity in at risk groups. In our sample of 46 women with gestational diabetes or prediabetes served by a FQHC, almost half of participants identified as food insecure, and in those women, type 2 diabetes risk factors (specifically high BMI and waist circumference) were disproportionately observed compared to those who were food secure. This is relevant for the Federally Qualified Health Center with whom we partnered, as this study demonstrates that a large proportion of their population is potentially food insecure, and that this status was associated with risk factors for type 2 diabetes.

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