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Hunger is Health: The Association Between Food Insecurity and Diabetes in the Primary Care Center (PCC) at Grady Hospital in Atlanta, GA

By

Bella A. Girovich

MPH

Hubert Department of Global Health

_____

Committee Chair
Amy Webb-Girard, PhD

Hunger is Health: The Association Between Food Insecurity and Diabetes in the Primary Care Center (PCC) at Grady Hospital in Atlanta, GA

By

Bella A. Girovich
B.A., American University, 2014
Emory University 2017

Thesis Committee Chair: Amy Webb-Girard, PhD

An abstract of
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Abstract

Background

With a prevalence of 48.1 million people in 2014 living in food-insecure households in the United States (Alisha Coleman-Jensen, 2015), food insecurity is one of the largest public health issues of our time. Similarly, a cross-sectional analysis of National Health and Nutrition Examination Survey (NHANES) data from 1999-2002 showed a statistically significant increased prevalence of diabetes among mildly food insecure and severely food insecure at 10.0% and 16.1%, respectively (Seligman, Laraia, & Kushel, 2010). Given the data that the prevalence of diabetes is associated with food insecurity, there is a need for further research on the prevalence of food insecurity among diabetic populations.

Objective

The goals of this thesis were to (1) estimate the prevalence of food insecurity among diabetics at Grady, (2) determine if there is an association between food security and diabetes status, (3) emphasize the need to address socio-contextual determinants of health, and (4) ascertain if it is appropriate to incorporate food security measures into electronic medical records.

Methods

The study was conducted through a cross-sectional design. 323 patients were included into the sample. Patients were given a questionnaire that included questions regarding age, sex, race, household income, number of people in the household, zip code, diabetes status, the USDA 2-item food security screener, and SNAP utilization. The primary outcome was a combined variable of prediabetes and type 2 diabetes. Patients that screened positive for food insecurity were given resources to help them access food in Atlanta.

Results

The overall prevalence of food insecurity among the patient population surveyed was 53.5%. Among diabetic patients (those with both prediabetes and type two diabetes), the prevalence of food insecurity was 62.5%. In multivariable logistic regression analyses, the odds of having diabetes was 2.6 times greater (95%CI 1.7-4.1) among food insecure compared to food secure patients. The effect remained statistically significant after controlling for sex, race, and income [2.6 (95%CI 1.5-4.4)]. Gender significantly modified the association between food insecurity and diabetes with greater odds of diabetes among men with food insecurity (5.1 95%CI 2.5-9.8) compared to women (1.5 95%CI 0.8-2.8)].

Conclusions

The associations between food insecurity and diabetes as well as the high prevalence of both conditions give evidence that food insecurity should be addressed in clinical settings. This study makes the case that electronic medical records should include measures of food insecurity for appropriate referral. More research, especially longitudinal, is necessary to continue to examining this association.

Key words

Food security, nutrition, type 2 diabetes, hospital, electronic medical records

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Chapter One: Introduction

As of 2014, type two diabetes touched the lives of 29.1% of Americans, giving it the status of a public health epidemic. While the United States spends millions of dollars on type two diabetes prevention every year, the number of cases continues to grow. In that same year, 48.1 million people in the United States were living in food insecure households (Alisha Coleman-Jensen, 2015). This number is equal to the entire population of Georgia, Florida, New York, and Washington State combined.

Endocrinologists recommend that diabetic patients consume more fruits and vegetables, as these are protective against developing cardiovascular disease. However, most physicians fail to address the non-clinical parts of a patient's life that may hinder their ability to access fresh produce. Transportation, income, and availability of produce can be barriers to consuming fresh produce. Diabetes is influenced by social, behavioral, and political factors" (Carney, 2015) that extend beyond a physician's care. These factors can translate to the food security status of a patient. Food security is the "state of being without reliable access to a sufficient quantity of affordable, nutritious food" (Agriculture, 2014).

In 2012, the United States spent $245 billion on diabetes prevention, research, and treatment. Medical direct costs were $176 billion, and the country spent $69 billion in reduced productivity, disability, and premature death (Spieker & Pyzocha, 2016). There are disparities in who reaps the benefits of diabetes initiatives. As the cost of diabetes continues to rise, those harmed most by the disease become marginalized and require incrementally more care and treatment.

While the prevalence of diabetes among all Americans is decreasing, the rates for minorities continues to rise (Geiss et al., 2014). Research has thus far been unable to determine the role of the environment in diabetes diagnosis. Exploring "upstream" social aspects of patients' lives may help understand the root causes of type two diabetes. Understanding the patient's environment can help providers create more appropriate treatment plans. Improved relationships between patient and provider can yield increased compliance. When patients are able to adhere to their treatment plans, they are set up for success in achieving their health goals.

Researchers are beginning to explore the relationship between food security and diabetes. Longitudinal studies have suggested that food insecurity may be a risk factor for diabetes (Gucciardi, Vahabi, Norris, Del Monte, & Farnum, 2014). Experiencing food security and diabetes simultaneously can negatively impact food choices, diabetes management, diet, glycemic control, hypoglycemia, weight status, comorbidities, healthcare utilization, and mental health.

Chapter Two: Review of the Literature

Overview of Type Two Diabetes

While there are various types of diabetes, type 2 diabetes is the most common ("Facts About Type 2"). A body that has developed type 2 diabetes cannot efficiently use insulin. Excessive consumption of fat and carbohydrates cause the pancreas to produce increased amounts of insulin. Eventually, the pancreas is no longer able to keep blood glucose levels in a normal range even with this extra insulin. Risk factors associated with type two diabetes include family history, overweight or obesity, unhealthy diet, physical inactivity, aging, high blood pressure, ethnicity, and impaired glucose tolerance ("Risk Factors").

Economic Implications of Type Two Diabetes

In 2012, diabetes management cost the United States $245 billion (ADA, 2013). Most of this money is allocated towards later stage complications of the disease rather than prevention, outpatient treatment, and management. Americans with diabetes spend 2.3 times more on medical expenditures than those without diabetes (Herman, 2013). Public-private partnerships have invested millions of dollars in diabetes prevention. The first example was the Diabetes Prevention Program (DPP), which was followed by translational programs and other models. The total costs of these programs per person are $5881, $424, and $1160, respectively (Li R, 2015).

Determinants of Type Two Diabetes

Type 2 diabetes can be treated with lifestyle changes, oral medication such as pills, and insulin. The most intense form of treatment is insulin therapy. This means that the pancreas is producing little to none of its own insulin ("Treatment & Care"). Insulin serves as the “key” that

allows glucose to enter the body's cells and fuel the body's muscles. When insulin is not working correctly, glucose will stay in the blood stream and cause the cells to be "starved for energy." Over a lifetime, this can cause complications to the eyes, kidneys, nerves, and heart. Diabetes can also cause of other morbidities such as nephropathy (damage to small blood vessels in the kidneys), neuropathy (damage to the nerves throughout the body), retinopathy (eye disease), and pregnancy complications ("Complications of Diabetes").

The United States medical system is grounded in "downstream" strategies for public health. This means that the system prioritizes addressing an individual's illnesses once he or she is already sick. Public health is beginning to advocate for more upstream approaches to prevention and treatment. Recognizing social, political, and economic factors can help change the course of negative health outcomes (Lori Dorfman, 2013).

New guidelines emphasize that determining what to eat is often the most challenging part of managing diabetes (ADA, 2013). While nutrition therapy is vital for proper diabetes management, not all families have the ability to choose what foods they eat. These food insecure households lack the ability to make choices about the foods that they eat.

Empowerment and Mental Health

Mental health and physical health are especially symbiotic in the case of type two diabetes (Hood, 2012). Psychological distress impairs glucose tolerance, even in those without diabetes (Black, 2002). Stress can cause diabetics to stop taking medications, avoid being socially and physically active, and become pessimistic about the future (Black, 2002). Food insecurity can amplify the already large amount of obstacles that type two diabetics face daily. Diabetics can also face differential treatment by race and gender (CDC, 2007).

Nutrition therapy only works if it is based on preferences, appropriate access, willingness, and ability (ADA, 2016). Food sovereignty, or the ability to choose what foods one purchases and consumes is a privilege that is not accessed by all. Having to disregard preference when choosing foods can lead to disempowerment in diabetics. Feelings helpless makes the lifelong battle to manage this disease that much more difficult.

Access to Health Care

Access to health care (or lack thereof) can be both a cause and effect of type two diabetes. For example, housing policies such as HOPE VI forced people living in public housing developments to relocate to another area of the city. Compared to African American women nationally, HOPE VI residents experienced twice the rate of diabetes (Danya E. Keene, 2011). Relocation due to HOPE VI and other policies separates patients from their primary health care systems. In Atlanta, those impacted by the policy lost access to medical care as well (Cooper et al., 2012).

National Diabetes Prevention Program

The National Diabetes Prevention Program (DPP) is one of the most successful diabetes interventions to date. The DPP determined best practices for decreasing risk of diabetes ("The Diabetes Prevention Program (DPP), 2002). DPP was the first randomized control trial in diabetes prevention (Diabetes Prevention Program Research, 2009). The four groups tested consisted of: 1. lifestyle intervention group, 2. medicine (metformin) group, 3. placebo group, and 4. medicine (Rezulin) group. The fourth group was discontinued. The lifestyle intervention group received counseling, motivational support, diet, exercise, and behavior modification. This group reduced their diabetes risk by 58%, regardless of race or gender (income was not

controlled for). Those in the metformin group reduced their risk by 31%, but this was most effective among those participants who were >60 pounds overweight. After the DPP, public-private partnerships tried to scale-up this approach. Approaches that were in groups, shorter in duration, and led by community members were as effective (and sometimes more) than the DPP (Ali, Echouffo-Tcheugui, & Williamson, 2012). Thus, it may be possible to replicate the outcomes of the DPP in a cost-effective manner. The challenge remains to motivate Americans to take part in such programs. It is particularly difficult to attract low-income patients to participate in offshoots of the DPP, even among safety-net hospitals and clinics (CDPH).

Disparities in Diabetes Prevalence

In the investigation of diabetes, it is important to recognize racial differences in diabetes prevalence overall.

Table 1: Incidence and Prevalence of Type 2 Diabetes Across Various Racial/Ethnic Groups

Study	Race	Results
(Harris, 1998)	Non-Hispanic White	5.0%*
	Mexican American	5.6%*
	Non-Hispanic Black	6.9%*
(Brancati, Kao, Folsom, Watson, & Szklo, 2000)	Non-Hispanic White	10.2%^
	African American	17.3%^
(Geiss et al., 2014)	Non-Hispanic White	7.6%*
	Asian American	9.0%*
	Hispanic	12.8%*
	Non-Hispanic Black	13.2%*
	American Indian or Alaska Native	15.9%*
(Link & McKinlay, 2009)	White	7.5%*
	Hispanic	11.6%*
	Black	12.8^

*=Prevalence
^=Incidence

A 2009 study found that there is significant variation between diabetes prevalence by race and socioeconomic status (Link & McKinlay, 2009). It appears that socioeconomic circumstances are a stronger determinant of diabetes than genetics. Upper income Americans have lower rates of diabetes than those of lower socioeconomic status. However, upper income minorities exhibit higher prevalences of diabetes than upper income Whites. It is vital not to overestimate the importance of race in diabetes incidence.

Disparities in Type Two Diabetes Management

The high cost of diabetes treatment is associated with non-adherence to medications (Bailey et al., 2012; Williams, Steers, Ettner, Mangione, & Duru, 2013; Zhang, Lee, & Meltzer, 2014). Lifestyle changes, such as consuming healthier diets, can prevent the onset of pre-diabetes and type 2 diabetes (Marrero, 2006). However, food insecurity can serve as a major barrier to healthier eating. In a qualitative study of food insecurity, one patient commented that by "the end of the month, I start getting out of food… but I have to eat something, 'cause if I don't eat behind my [insulin] shot, that shot will make you so sick. I just eat anything I can find during that time just to keep me from getting sick'" (Seligman, Jacobs, López, Tschann, & Fernandez, 2012). This causes hypoglycemia if a patient does not have adequate carbohydrates to consume relative to the amount of insulin taken, as well as hyperglycemia when a patient eats "anything I can find during that time." Increasing physical activity can also protect against type two diabetes. Lack of access to places such as recreational centers and parks can hinder diabetes management and prevention.

Health literacy is another barrier that causes disparities in diabetes management. In a 2003 study, 41% of Hispanic-Americans, 24% of African American, and 9% of Non-Hispanic

Whites had below basic health literacy skills. (Mark Kutner, 2006). Low health literacy is associated with poor glucose control and higher risk of diabetes. In one study of participants with diabetes, only 38% knew the signs and symptoms of hypoglycemia, compared to 73% of those with sufficient health literacy (Chew, 2004). A person with both diabetes and low health literacy may have trouble explaining their symptoms and understanding necessary tasks for managing the disease.

Differential access to health care by race and socioeconomic status leads to disparities in diabetes management (Narayan, Boyle, Thompson, Sorensen, & Williamson, 2003). The ADA recognizes that access to health care is an important determinant of health outcomes. Inequalities in health care delivery need to be addressed in the specific context of type two diabetes (ADA, 2016).

Social Determinants of Health

Randomized controlled trials have proven that lifestyle and pharmacologic interventions are cost-effective (Herman, 2013). However, it is clear that these interventions are either not enough, or not accessible to all Americans.

Disparities in access to diabetes treatment “among racial and ethnic groups may contribute to the higher rates of diabetes among these populations” (Merck). Racial and ethnic minorities are disproportionately affected by type two diabetes. These are the same groups that are largely in poverty, uninsured, and live in areas that contain “substandard housing,… low-income neighborhoods with plentiful fast-food restaurants but lacking in grocery stores that carry healthy foods,… [and] a lack of sidewalks and crime-free parks [that] also may discourage the daily physical activity needed to maintain a healthy lifestyle” (CDC, 2007).

Addressing social determinants of health at a societal should become a priority. Social determinants of health are “conditions in the environments in which people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks” (ODPHP, 2010). These include those that address advertising, food availability and price, and even tax policies. By addressing social determinants of health, it is possible to increase access to diabetes care, education, and treatment.

Food Insecurity

Lack of access to healthy food is a social determinant of health in type two diabetes prevention, treatment, and management. Food insecurity can lead to many coping mechanisms that can be detrimental to health. The cost of medical treatment can be an important issue for families that struggle to put food on the table. This could lead to choosing food over medicine or vice versa. Those with low health literacy may also have trouble complying to health recommendations. They may struggle with reading food labels and making appropriate food choices (Speirs, 2012). Health illiteracy compounds the difficult choices families must make for affordable foods.

Definition and Measurement

According to the USDA, food insecurity is “the limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways” (USDA, 2014). In 2006, this definition evolved to include:

Box 1: USDA Definition of Food Security. Source: Adapted from (USDA, 2014)

Food Security

- **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.

Food Insecurity

- **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

The USDA also decided to ensure that food insecurity was defined as a separate entity from hunger, in which food insecurity is the "*household-level* economic and social condition," whereas hunger is an "*individual-level* physiological condition that may result from food insecurity" (USDA, 2014).

Internationally, there are various ways to define the "pillars" that make up food insecurity. The World Food Programme (WFP) uses three pillars, whereas the Food and Agriculture Organization uses four ("What is food security?,") (Brian Thompson, 1996).

Box 2: Pillars of Food Security. Adapted from (WFP) (Brian Thompson, 1996).

Organization	Pillars
WFP	• Food availability • Food access • Food utilization
FAO	• Availability • Stability of supply • Access • Utilization by the body

Food insecurity can make it difficult for clinicians to interpret symptoms (Clinical Training: Food Insecurity Screening). A person that food insecure and diabetic may find that taking insulin in the absence of sufficient food can lead to hypoglycemia.

Implementation of Food Insecurity Screening in Clinical Settings

The U.S. Household Food Security Survey module is a 3-stage, 18-item screener designed to assess the prevalence of food insecurity. A 2-item screener has been developed and validated based on this original. with high sensitivity and specificity to the original module for adults (E. R. Hager et al., 2010). The food security screener can be found in Box 3.

Box 3: USDA Food Security Module 2-Item Screener

I'm going to read you two statements that people have made about their food situation. For each statement, please tell me whether the statement was **often true**, **sometimes true**, or **never true** for your household in the last 12 months.

1. "We worried whether our food would run out before we got money to buy more." Was that often true, sometimes true, or never true for 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,

Currently, most clinical settings do not conduct food security screenings. Recent recommendations suggest incorporating screening tools into EMRs and standard provider protocol. This would include screening at every visit to the health clinic, and alerting primary care providers of a positive screen. Patients that screen positive could then be given resources for accessing food. Recommendations also suggest training all staff to understand a positive screen ("2016/17 ICD-10-CM Diagnosis Code "; Clinical Training: Food Insecurity Screening). There are existing codes in the International Classification of Diseases for this purpose, and the code Z659 shows that a screen has taken place, and the code Z59.4 means "lack of adequate food and water" ("2016/17 ICD-10-CM Diagnosis Code ").

National Food Insecurity

In 2014, 14% of American households were food insecure during at least one point in the year (Alisha Coleman-Jensen, 2015). This number has barely shifted in the past half-decade. 61% of food insecure households continue to benefit from federal nutrition assistance programs.

Food Insecurity in Georgia

In Georgia, 1 in every 5 citizens is food insecure. This prevalence of 18.5% prevalence is even higher than the national level ("The Face of Hunger in Georgia," 2016). Food insecurity and poverty are highly associated with one another. With a minimum wage rate of $5.15/hour, Georgia is “one of only two states with minimum wage rates under the federal rate” ("American Community Survey Profile. 2010-2014 estimate.,") ("Employment Standards Admin," 2016).

Food Deserts

The 2008 Farm Bill prompted the USDA to study geographical access to food throughout the United States (United States Department of Agriculture, 2009). The Farm Bill defined a new term, “food deserts,” to mean that there is “limited access to affordable and nutritious food, particularly such an area composed of predominantly lower income neighborhoods and communities.”

Food deserts were originally defined as “living far from a supermarket, where 1 mile was used in urban areas and 10 miles were used in rural areas” ("Definitions,"). Low-income census tracts and access to vehicles are sometimes included in food desert analysis. Increased access to supermarkets, rather than convenience stores, usually results in healthier diets (Larson, Story, & Nelson, 2009). In urban areas, neighborhood disparities can manifest themselves in the form of negative health outcomes.

Food Insecurity and Diabetes

Type two diabetes can make management of food insecurity much more difficult. Food insecure individuals have poorer self-reported diabetes self-efficacy (Ippolito et al., 2016). There is little research done on the prevalence of food insecurity within a population of type

two diabetic patients. In 2014, 1/3 food insecure households had a person in the household with diabetes ("Feeding America's Response to Diabetes and Food Insecurity," 2015). Households that are food secure spend a median of $45/person on food each week. In comparison, food insecure households spend $35/person (Seligman & Schillinger, 2010). This expenditure deficit makes it difficult to prioritize “diabetic friendly” foods such as vegetables, fruits, and protein, and much easier to spend it on inexpensive and easily accessible foods, which are usually highly processed and carbohydrate-rich.

Research has only just begun to incorporate food insecurity variables into datasets. One study of food insecurity found a national prevalence of 42.7% (n=16,651) (Kushel, Gupta, Gee, & Haas, 2006). This is much higher than the national prevalence of food insecurity because this population (n=16,651) was only low-income adults. Using data from the National Health and Nutrition Examination Survey (NHANES), Kushel et. al found that 6% of adults with diabetes self-reported as food insufficient, which translates to represent over 568,600 Americans (95% CI, 369,400- 768,800) (Nelson, Cunningham, Andersen, Harrison, & Gelberg, 2001). Another NHANES study found that among subjects who had a self-reported diagnosis of diabetes (n=428), 8.1% of them were food insecure (Seligman, Laraia, & Kushel, 2010).

Secondary data such as Electronic Medical Records (EMRs) have been used to retrospectively analyze the association between food insecurity and type two diabetes. Data from the Pregnancy, Infection and Nutrition study found that, “marginal food insecurity” was associated with gestational diabetes (OR 2.76, 95% CI 1.00-7.66) (Barbara A. Laraia, Siega-Riz, & Gundersen).

Food insecurity has repeatedly been positively associated with type two diabetes. Among safety-net clinic patients, food insecurity is positively associated with type two diabetes and low socioeconomic status, as well as lower adherence to lifestyle behaviors and decreased glycemic control (Heerman et al., 2016). Race has also been proven to be a variable positively associated with food insecurity (Strings, Ranchod, Laraia, & Nuru-Jeter, 2016). Using nationally representative data, there is a consistently positive association between food insecurity and type two diabetes and/or its determinants, including overweight, obesity, and comorbidity with other metabolic syndromes (Hilary K. Seligman) (Kushel et al., 2006) (Marjerrison, Cummings, Glanville, Kirk, & Ledwell, 2011; Seligman et al., 2011; Seligman, Jacobs, López, Tschann, & Fernandez, 2012; Seligman et al., 2010; Seligman & Schillinger, 2010). Finally, a meta-analysis of literature on the association between food insecurity and diabetes in North America found that not only is the prevalence of food security among diabetics higher than among non-diabetics (9.3% vs. 6.8%), but also found that each year of earlier diagnosis with diabetes increases the likelihood of experiencing food insecurity by 4% (Gucciardi, Vahabi, Norris, Del Monte, & Farnum, 2014).

Gaps in the Literature

There is an urgent need for efficacy studies to intervene in the pathways between food insecurity and diabetes. However, these strategies cannot be implemented nor developed without evidence. Cross-sectional data hinders the ability to generalize the results (Mayer, McDonough, Seligman, Mitra, & Long, 2016). Longitudinal studies would be useful to further this limited research. Participants recruited through medical centers also represent non-institutionalized people. This leaves out those who are institutionalized and those who are

homeless (Nelson et al., 2001). It is difficult to control for all potential confounders, especially "medical co-morbidities, health literacy, substance use, and access to care" (Essien et al., 2016). The self-reported data of variables such as weight, BMI, and diabetes status can also be problematic (Barbara A. Laraia et al.). It has also proven difficult to compare the time frame of food insecurity to that of diabetes, because "the frame of food insecurity questions is wider than that of the HbA1c measurement." HbA1c data may not capture food insecurity during the time of data collection.

Grady Hospital

Grady Hospital, founded in 1892, is located in downtown Atlanta ("Learn About Us," 2016). Grady's mission is to "become the leading public academic healthcare system in the United States." Grady hopes to accomplish this by serving as a model for quality healthcare improvement. Furthermore, Grady prides itself on understanding the needs of the community it serves. Under the Affordable Care Act, Hospitals must implement new strategies for quality improvement (CHNA). Therefore, it is important to begin to think of upstream tactics to address health outcomes, food security being one of them.

Grady's Primary Care Center manages chronic illness including asthma, high cholesterol, and diabetes. Treatment can also include risk assessment, lifestyle counseling, and referral to specialists if necessary. Grady Hospital recognizes that it is a main source of health care for many low-income Atlanta residents. In 2015, Grady tried to address this by launching a 1115 waiver, which helps the hospital bring in federal funds even though the state of Georgia opposes expanding Medicaid. This "Georgia Plan," according to one of Grady's Vice Presidents

Matt Hicks, is a strategy to bring health care to those who are uninsured while also "minimiz[ing] the burden on the state's budget" (Miller, 2015).

Target Population

Grady Hospital primarily serves Fulton and DeKalb Counties. The median age of Fulton and DeKalb Counties is 34, with most residents age 18-44 and less than 9% over the age of 65. 16% and 17% of the population live below the poverty line in Fulton and DeKalb Counties, respectively. While Fulton and DeKalb Counties have the largest number of hospitals in all of Georgia, 34% of Fulton County and 84% of DeKalb County live in a Health Professional Shortage Area (HPSA), meaning that there are not enough medical professions in the area.

Figure 2 shows income levels of the two counties, and shows that there are many census tracts in which 40-80% of the population live below 250% of the U.S. Federal Poverty Line. Furthermore, the percentage of the population over the age of 25 without a high school diploma is concentrated in the southernmost ends of Fulton and DeKalb counties. Education, socioeconomic status, and poverty are highly associated with one another, and the lower one factor is may impact how an individual experiences the other two.

In comparison to Georgia's rate of 19% uninsured, Fulton County has a similar rate 18% uninsured residents, compared to DeKalb County's 23%. Less than 16% of Georgia residents are enrolled in Medicaid, compared to 20% and 17.5% in Fulton and DeKalb Counties, respectively.

Gaps and Summary of Aims

There is little research conducted on the relationship between lack of food and type two diabetes. This is despite evidence that the inability to access food is an "independent predictor"

of diabetes control. Food insecurity makes it difficult to "follow a diabetic diet" that is inexpensive yet also low in fat and carbohydrates (Seligman et al., 2012).

This study aims to estimate the prevalence of food insecurity among prediabetics and diabetics at Grady. Furthermore, this research aims to determine if there is an association between food security and diabetes status, which would emphasize the need to address socio-contextual and upstream determinants of health. Finally, this study hope to ascertain if it is appropriate to incorporate measures of food security into electronic medical records (EMRs).

Chapter Three: Methodology

Study Design

Grady staff and administration are interested in the prevalence of food insecurity and other socio-contextual determinants of health as they transition to a value-based hospital system in 2017. This cross-sectional research study sought to determine the prevalence of food insecurity among a convenience sample of type two diabetic patients at the Primary Care Center of Grady Hospital from January 2016-March 2017.

Data Collection Site

All data were collected in the Primary Care Center of Grady Hospital in Atlanta, Georgia. Grady Hospital primarily serves Fulton and DeKalb counties, but accepts patients from metro-Atlanta and beyond; Grady serves over 21,000 patients with Type II diabetes. In 2016, Georgia had a coverage gap of 309,000 uninsured nonelderly adults, 69% of whom were people of color and 56% of whom were female (Garfield, 2016). As a non-for-profit hospital, Grady serves to help close this gap.

Sample Size and Recruitment of Subjects

With a confidence level of 95% and an anticipated prevalence of 46% (Seligman et al., 2012), the sample size needed to confidently estimate food insecurity in this population is 384 diabetic patients. Inclusion criteria consisted of patients age 18+ at Grady Memorial Hospital in the Primary Care Center. Of all patients surveyed, exclusion criteria included those who did not complete the entire survey due to refusal or interruption by a nurse or physician. A convenience sampling approach was used to recruit patients. Investigators could enter one of the four “pods” of the Primary Care Center. These pods are Yellow, Green, Purple, and Orange.

The investigator would then scan the pod for the flags outside each examination room, and would only enter a room upon viewing a black flag, indicating that the patient is waiting to be seen by the doctor. Investigators requested permission from patients to enter the examination room and talk to them about the study while patients that were waiting to be seen by the provider. After introducing the study, the patient was given the opportunity to either consent to participate or decline to participate. Investigators were sure to inform the patient that if the doctor came to the examination room while the survey was being administered, the investigator would promptly end the survey and leave the room.

Data Collection

To determine the prevalence of the independent variable (prediabetes or type 2 diabetes), the survey tool asked, “In the past 12 months have you been told that you have:” with the options being “Pre-diabetes,” “Type 2 diabetes,” and “High blood sugar.” This question is asked to not only determine the prevalence of type two diabetes, but the amount of people who have any form of cardio-metabolic issues related to blood sugar, which could eventually develop into type two diabetes. The response options for this variable were dichotomous, in which the participant could answer “yes” or “no” to each option. Food insecurity was assessed using the United States Department of Agriculture (USDA) two-item validated screener for food insecurity (ref, box 1). The two-item screener asks about perceived concern over food supply and not having enough money to get more food over the past 12 months. The original 18-item household food security screening tool developed by the USDA has a complex coding system to determine if a participant is food insecure, as well as to what degree of food insecurity the participant is experiencing. On the other hand, the 2-item screener used in this study is very

simple to interpret. An affirmative response to these questions has a sensitivity of 97% and a specificity of 83% when compared to the complete 18-item Food Security Scale (Gitterman et al., 2015).

In addition to the two-item screener, the study team queried patients' familiarity with and use of SNAP in the previous 12 months including if the patient had applied for SNAP in the past 12 months, if he/she was approved and if he/she used SNAP

Lastly, the survey captured demographic details including age, sex, race, household income, number of people in the household, zip code. Age, sex, race, annual household income, number of people in the household were asked to determine whether any of these variables could act as a confounder on the prevalence of food insecurity among diabetics. Zip code was asked to be enable visual representation of the prevalence of food insecurity and diabetes among Grady patients throughout the Atlanta area

Data collection was conducted systematically with a script to account for differences between co-investigators. While there was some variation in time of day, day of the week, and month, most surveys were conducted between 8:00 AM – 12: 00 PM Monday-Friday. The team excluded Tuesdays from data collection because the Primary Care Center offers fewer services and thus sees significantly fewer patients.

Three weeks into survey administration, a nurse in the Morehouse pod did not approve of data collection in that Pod. However, the Morehouse Pods do not differ from the Emory Pods in population. Most of the data were collected in the Emory pods.

Enumerator Training, Ethics and Informed Consent

Investigators were trained on the survey and its potential sensitivity due to the subject matter of food insecurity. Additionally, investigators were trained to read each question and response in the survey before the participants responds and only to record one answer per question.

Emory University and Grady Hospital review boards reviewed and approved informed consent documents, protocols, and tools. Written consent was obtained and stored with the PI in a protected space. Interviews were conducted in the examination room, rather than the waiting room, so that privacy was upheld. Name of subjects was not collected, and results from the survey were not linked to medical records nor disclosed to the patient's physician. Information was de-identified by giving each participant a new unique identifier. Participants had the ability to stop the questionnaire at any time with no penalty.

Variables and Specification

The primary independent variable for the analysis was diagnosis with type 2 diabetes, which was determined by self-diagnosis through the questionnaire. The primary dependent variable for the analysis is food insecurity, which was measured using an adapted version of the U.S. Department of Agriculture's Food Security Survey Module (two-item version).

Prediabetes and type two diabetes are both represented separately in the data. However, because the risk of developing type two diabetes is 5-10% higher in the following year among those with prediabetes compared to the normal population (Tabak, Herder, Rathmann, Brunner, & Kivimaki, 2012), the primary outcome of *"diabetestotal"* was coded as prediabetes plus type two diabetes.

For both questions in the 2-item screener, an answer of "never true" is coded as "food secure." Conversely, a response of "often true" or "sometimes true" for either question is coded as screening positive for food insecurity. "Don't know" or refusal to answer is coded as "." or as missing data.

Collection and Distribution of Resources

If patients screened positive for food insecurity based on the 2-item screener, the team provided resources and referrals for patients to improve their access so food. Coordination between PI and representatives from Feeding America, Grady Hospital, and Atlanta Community Food Bank allowed for appropriate resources to be obtained. An infographic was developed to provide to patients that contained information regarding names of food banks, addresses, telephone numbers, days and hours of operation, counties served, and identification and referral requirements. See appendix for infographic.

Data Analysis and Variable Specification

Household income was captured and recorded as tertiles: <$10,000, <$10-24,999, or ≥25,000. According to existing literature, $10,000 is an appropriate cut-off point for monthly spending on fruits and vegetables, because income categories at this level up to around $70,000 spend an average of $53/month on fruits and vegetables (B. A. Laraia, Leak, Tester, & Leung, 2017). Once a family reaches $70,000, average produce spending rises to $76/month. However, after discussing income levels of patients with Grady staff, it became clear that $25,000 was an appropriate upper level cutoff for the questionnaire.

The number of people in the household question was divided into quartiles: < 5 years old, 5-18 years old, 18-65 years old, and over 65 years old. This is due to literature explaining

that while food insecurity is a household-level indicator, the level of food insecurity can differ amongst individuals *within* a household. For example, in 2015, around 50% of food-insecure households with children consisted of only adults with food insecurity, while children were not affected (Alisha Coleman-Jensen, 2015). This signifies that "parents and caregivers often are able to maintain normal or near-normal diets and meal patterns for their children, even when the parents themselves are food insecure." Zip code was used in Geographic Information System software to visually map pockets of food insecurity in the greater Atlanta area.

All analyses were conducted using SAS 9.0. The main purpose of this study was descriptive, and thus the primary analyses were descriptive in nature to estimate the prevalence of food insecurity and diabetes in this population. Chi square analysis tested for differences in proportions by diabetes status. Logistic regression assessed associations between food insecurity and diabetes adjusting for sex, race, and income.

Chapter Four: Results

The research team invited 343 subjects to participate in the study. Refusal rate of selected subjects was 9.41 % (n=20), which left 323 participants who completed the survey. Prevalences for high blood sugar, prediabetes, type 2 diabetes, and overall diabetes (prediabetes and Type II diabetes combined) were 15.8%, 14.9%, 36.8%, and 50.3%, respectively. The overall prevalence of food insecurity among the patient population surveyed was 53.5%. Among diabetic patients (those with both prediabetes and type two diabetes), the prevalence of food insecurity was 62.5%. Overall, 98.0% of participants reported having heard about SNAP benefits; In terms of SNAP usage, 45.6% of food secure and 72.5% of food insecure patients reported accessing SNAP benefits in the previous 12 months.

Compared to those without diabetes, a significantly greater proportion of diabetics were African-American (53.8%), had an income between $10,000-24,999 (77.3%), were approved for SNAP (60.6%) or were food insecure (62.5%; Table 2). Participant age, sex and having a child under the age of 18 in the household did not differ by diabetes status (Table 2).

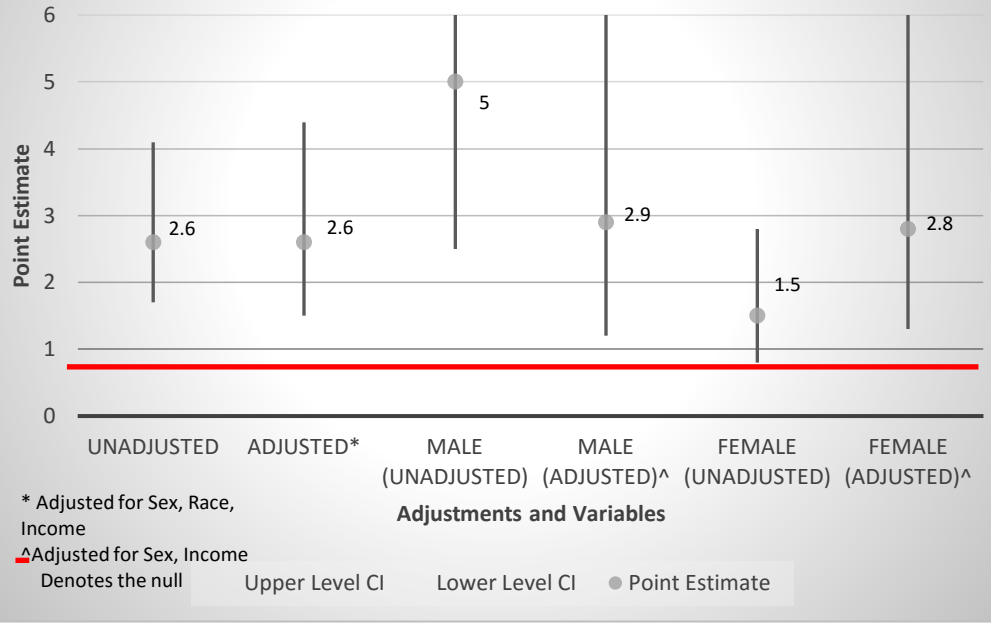
In multivariable logistic regression analyses, the odds of having diabetes was 2.6 times greater (95%CI 1.7, 4.1; Figure 1) among food insecure compared to food secure patients. The effect remained statistically significant after controlling for sex, race, and income [2.6 (95%CI 1.5, 4.4); Figure 1]. Gender significantly modified the association between food insecurity and diabetes with greater odds of diabetes among men with food insecurity (5.1 95%CI 2.5-9.8) compared to women [(1.5 95%CI 0.8-2.8), Figure 1].

The maps created from the data served to highlight zip codes represented in this study and the degree of diabetes status and food security that existed in those locations. Therefore,

these data are not generalizable and only representative of this specific subset of Grady's Primary Care Center patients. All three maps show that most of the patients are from Fulton and DeKalb counties, which is to be expected. The "Diabetes by Zip Code" map (Figure 2c) suggests that there is clustering of type two diabetes and prediabetes in the central regions of Fulton and DeKalb counties. For food insecurity (Figures 2a, 2b), the majority of zip codes representing both the response "never true" as well as "often true" to the first item of the food security screener are in Fulton county, with most "often true" zip codes overall being located near the border of Fulton and DeKalb counties. For the second question of the screening tool, some of the "often true" zip codes reverted to "somewhat true" zip codes.

Table 2. Descriptive Characteristics overall and by diabetes status for 323 Patients Attending the Primary Care Unit at Grady Hospital from January-March 2017. Data are presented as n(%) and p values are estimated using chi-square analysis.[1]					
Variable		Overall, 323(100%)	Nondiabetic, 156(48.30%)	Diabetic, 167(50.30%)	P value[2]
Age (mean)		63.5	63.4±8.5	63.7±6.7	0.6
Sex					0.9
	Male	160(49.5%)	78(48.8%)	82(51.2%)	-
	Female	163(50.5%)	78(47.9%)	85(52.2%)	-
Race					<0.0
	White	16(5.0%)	11(68.8%)	5(31.3%)	-
	AA	292(90.4%)	135(46.2%)	157(53.8%)	-
	Latino	5(1.6%)	0(0.0%)	5(100%)	-
	Other	10(3.1%)	10(100%)	0(0.0%)	-
Income					<0.0
	<10,000	70(53.9%)	61(48.8%)	64(51.2%)	-
	10,000-24,999	25(19.2%)	15(22.7%)	51(77.3%)	-
	≥25,000	35(27.0%)	39(59.1%)	27(40.9%)	-
SNAP Usage					
	Applied	191(60.1%)	76(39.8%)	115(60.2%)	<0.0
	Approved	180(94.2%)	71(39.4%)	109(60.6%)	0.7
	Applied and not Approved	11(5.8%)	5(45.5%)	6(54.6%)	-
Food Security Status					<0.0
	Food Secure	147(45.5%)	90(61.2%)	57(38.8%)	-
	Food Insecure	176(54.5%)	66(37.5%)	110 (62.5%)	-
	[1] "Diabetes" is defined as the combination of self-reported prediabetes and Type 2 diabetes. [2]P value estimated from chi-square analysis.				

Figure 1. Odds of Diabetes with Food Security for 323 Patients Attending the Primary Care Unit at Grady Hospital from January-March 2017. Odds ratios and confidence intervals are estimated using logistic regression analysis.



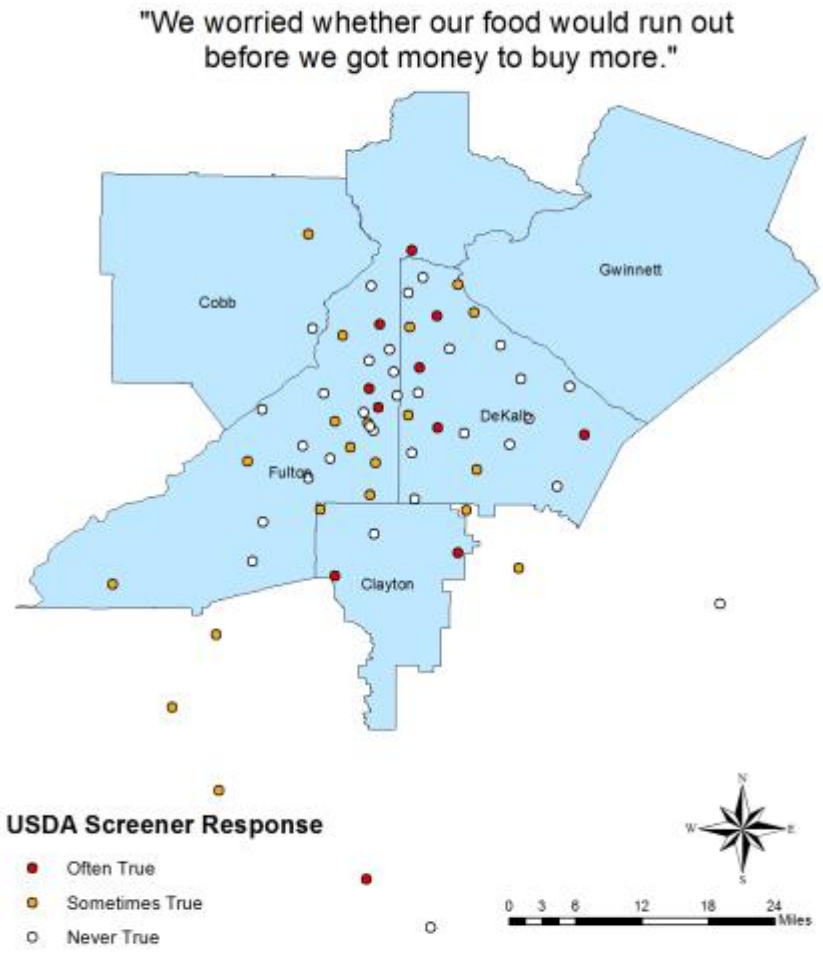


Figure 2a: Geographic Distribution to USDA 2-Item Screener First Question (USDA). Results from 323 Patients Attending the Primary Care Unit at Grady Hospital from January-March 2017.

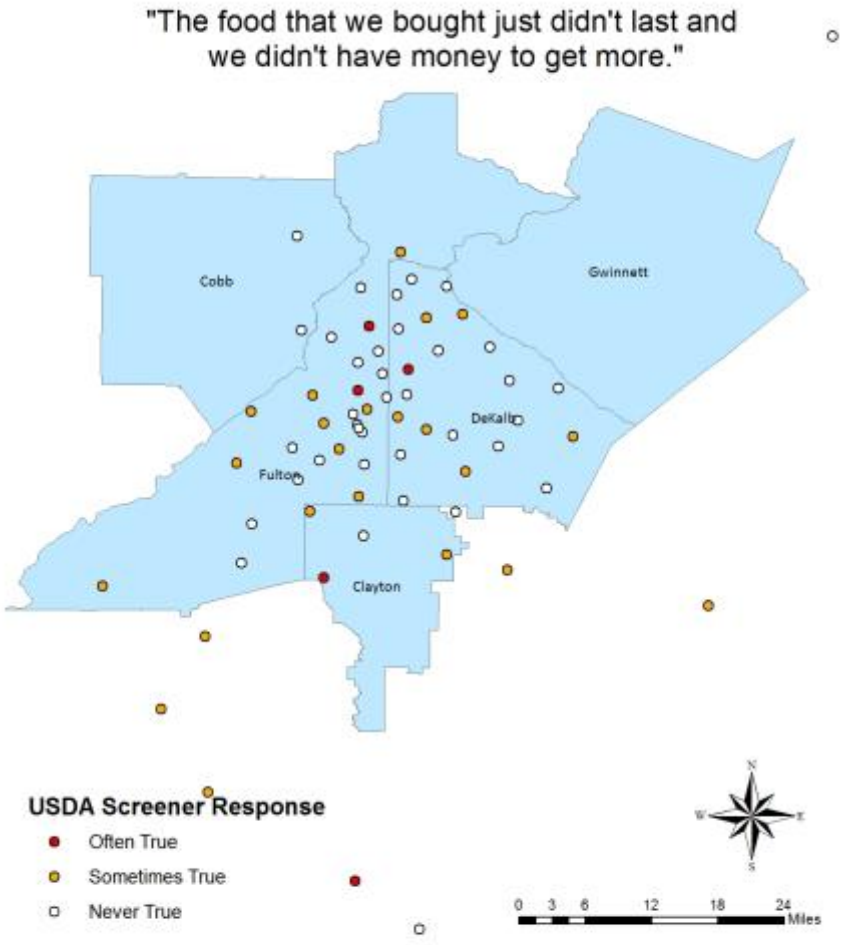


Figure 2b: Geographic Distribution to USDA 2-Item Screener Second Question (USDA). Results from 323 Patients Attending the Primary Care Unit at Grady Hospital from January-March 2017.

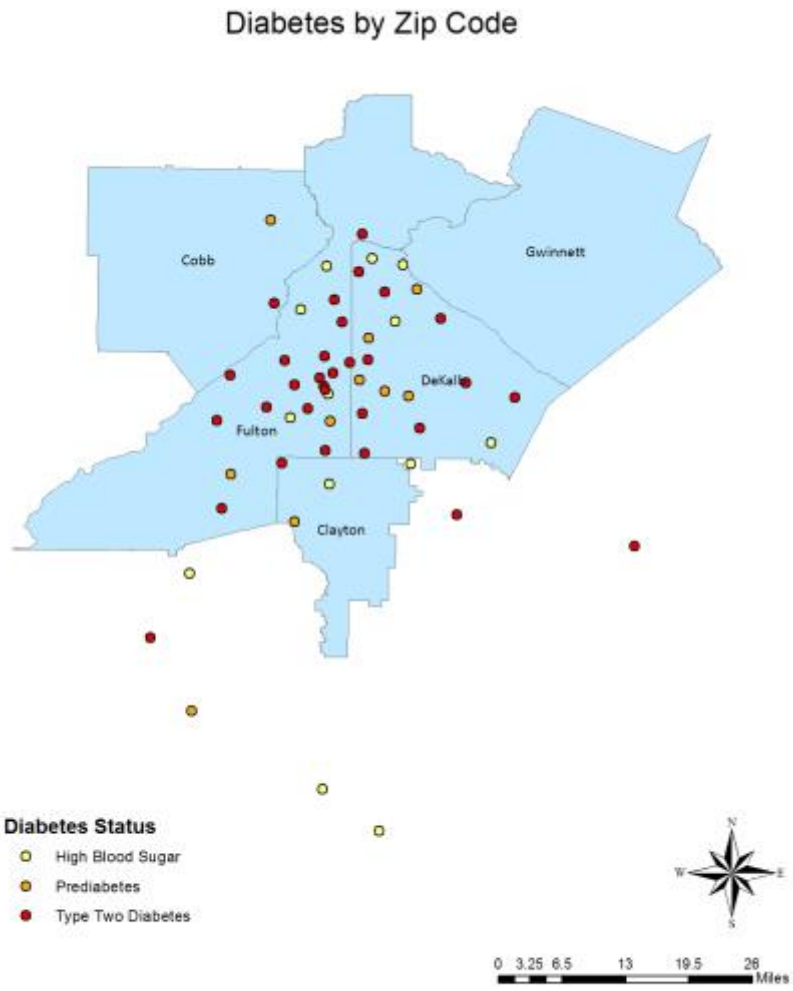


Figure 2c: Geographic Distribution of Diabetes Status by Zip Code. Results from 323 Patients Attending the Primary Care Unit at Grady Hospital from January-March 2017.

Chapter Five: Discussion

Summary of Results

This study of low-income patients receiving outpatient care at Grady Hospital Primary Care Unit noted high overall prevalence of food insecurity (54.5%) and diabetes (50.3%) when measured as the combination of prediabetes (14.9%) and type 2 diabetes (36.8). Of concern is that those with prediabetes or type 2 diabetes had significantly higher prevalence of food insecurity (64%). Odds of diabetes was significantly higher among respondents screening positive for food insecurity [2.6 (95%CI 1.7-4.1)], even following adjustment for potential covariates; though, in stratified analyses the effect appeared much stronger in men [5.1 (95%CI 2.5-9.8)] compared to women [1.5 95%CI 0.8-2.8)].

Food Insecurity

The prevalence of food insecurity overall (54.5%) was consistent with, though higher, than the prevalence found in other studies with low-income Americans. For example, in a study using the National Survey of America's Families (NSAF), Kushel et al noted a prevalence of 42.7% using the full 18-item tool (Kushel, Gupta, Gee, & Haas, 2006). Similarly, analyses of NHANES data noted a 10.2% of food insecurity among clinically documented type two diabetics (Seligman et al., 2010).

The higher prevalence of food insecurity compared to these other studies also reflects the general trends when comparing the national prevalence of food insecurity in the general population with prevalence of food insecurity in DeKalb and Fulton counties. In 2014, the national prevalence using the full USDA tool was 12.7% (ERS, 2015) and 20% in both DeKalb and Fulton Counties (GDPH, 2016). If DeKalb and Fulton County prevalences of food insecurity are

20%, and Grady serves many low-income residents of both counties, it is not surprising that the data from Grady's Primary Care Center are higher than other studies focusing on national samples of low-income populations. The higher prevalence may also be due to the tool used in this study. Previous studies in low income populations have used the 2-item tool (Seligman et al., 2012) while the surveys used to estimate national and county level prevalence utilize the full USDA tool (Barbara A. Laraia et al.). Additionally, those classified as food insecure are likely only those who meet criteria for moderate or severe food insecurity as marginal food security is traditionally classified as food secure in USDA reporting schemes (USDA, 2014).

Food Insecurity and Diabetes

More alarming than the prevalence of food insecurity is the high prevalence of food insecurity among diabetics (prediabetes and type 2 diabetes, 62.5%) surveyed at Grady. The prevalence of prediabetes (14.6%) and diabetes (36.3%) in this study population were also much higher than the 9.3% reported in nationally representative surveys of diabetes in the U.S in 2014 (Gucciardi et al., 2014). The population in this study is disproportionately affected by food insecurity and diabetes.

The linkages between food insecurity and diabetes among vulnerable populations have significant clinical relevance. The socio-contextual environment can compromise a person's ability to effectively manage his or her medical conditions. Feeding America's initial Diabetes Pilot provided healthy food and medical referrals and saw improved blood sugar control, medication adherence, and reduced diabetes distress ("Feeding America's Response to Diabetes and Food Insecurity," 2015). Out-of-pocket costs of health care might force a household that was otherwise economically secure into a food insecure situation. Additionally,

people burdened by both diabetes and food insecurity are more likely to have overnight hospitalizations and emergency room visits due to hypoglycemia (Gucciardi et al., 2014). Those who are food insecure also report increased diabetic complications (Barbara A. Laraia et al.). To effectively address diabetes in low-income populations, food insecurity cannot be ignored.

Maps

Valuable information can be extrapolated from looking at maps of the study data. There are some patients that come from outside of the 5-county metro Atlanta region. This suggests a lack of sufficient primary care infrastructure closer to home. Patients may be food insecure in part because of a lack of access to reliable transportation. Needing to travel long distances to access medical care can be an additional burden on low-income patients.

Strengths and Limitations

Cross-sectional surveys are not generalizable beyond their specific population. This study was also limited by its small sample size, which was largely due to lack of personnel and time constraints. Self-reported diabetes status was a limitation of the study, as well as self-reported food security status. Self-report can introduce bias into the study. Patients may present themselves in favor of cultural norms (Dodd-McCue, 2010). In the case of this study, participants may have stated to the investigator that they were not diabetic, not food insecure, or both. This would underestimate the amount of diabetic and food insecure participants in the population. Accessing objective measures of metabolic status was not possible due to lack of access to medical records.

Self-reported measures on experience-based food security are the current standard of practice. The extended 18-item USDA food security tool and the 2-item screener have both

been validated for food security assessment in the United States (Hager et al., 2010). However, the classification of individuals and households as food secure or not differs between the two tools which may result in overestimation of food insecurity when using the 2-item screening tool (J. T. Cook et al., 2013; USDA, 2014). The full 18-item tool allows for households to be classified as "high food security, marginal food security, low food security, or very low food security," which all have different health implications (Hager et al., 2010). Conversely, the 2-item survey is used for screening purposes. Therefore, an affirmative answer to either question would result in a positive screen. This means that answering "sometimes true" to one of the questions would cause a person to screen positive. This would overestimate the prevalence of food security in the population. The tool does not differentiate between mild or marginal food insecurity and severe food insecurity. On the other hand, the USDA does take this into account (USDA, 2014). Existing literature shows that marginal food insecurity is more similar to food insecurity than food security (J. T. Cook et al., 2013). Furthermore, marginal food insecurity is positively associated with adverse health outcomes (Hager et al., 2010). It is important that those with marginal food insecurity are not categorized as food secure, as they could then be left out in treatment and distribution of vital resources.

The sample size calculation was based on the 2007 prevalence of diabetes at Grady. Since the prevalence was so high, a change in the number of diabetics would have only have marginally shifted the sample size requirement. An outdated population estimate may decrease the generalizability of the results.

Data collection occurred over a three-month window. ADA recommendations are for type 2 diabetics to have their glycated hemoglobin (HbA1C) checked every six months (ADA,

2016). Therefore, there is the slight possibility that, because we did not use EMRs, a subject may have come to the clinic and been analyzed twice. Holidays may account for different food insecurity status; thus data was collected January- March may not accurately represent year-round status. There was not a statistically significant difference in the outcomes from one month to the next (data not shown). Data collectors attempted to collect data at various times of day. Most patients had morning appointments, thus morning became the primary time for data collection.

Since the study occurred in a hospital, certain assumptions can be made. These participants represent a population with either greater access to medical care, greater health care burden, or both. Berkson's bias was also introduced (Westreich, 2012). This means that participants from a hospital are more likely to have a disease than those who are not in a hospital. This bias results in an overestimation of the prevalence of diabetes that is not generalizable outside of hospital populations. Subjects may have participated in the study to discuss food security and diabetes issues. Participants may not recall diagnoses and thus would have been misclassified by exposure. Grady is a hospital that serves low-income communities. People from low-income communities are more likely to be food insecure (Larson, Story, & Nelson, 2009) and thus these food insecurity prevalence estimates are not generalizable to non-low-income populations.

Participants also answered questions about federal assistance programs. Participants sometimes responded "never true" to the 2-item screener questions. These same patients responded that they had SNAP benefits. This implies that they met the poverty thresholds for

federal assistance. SNAP may have mitigated the experience of food insecurity in these participants.

Public Health Implications and Future Research

One of the aims of this study was to ascertain if it is necessary to integrate food security screenings into electronic medical records (EMRs). We noted a high prevalence of food insecurity during screening in this population of predominantly low-income patients, especially among those with prediabetes or Type II diabetes. Food insecurity compromises patients' ability to adhere to dietary recommendations, limiting their capacity to manage their disease and prevent progression and related complications (Gucciardi et al., 2014). As such, identification of food insecurity among patient populations and linking patients with necessary supports is critical to ensuring better health outcomes for these populations. One strategy to facilitate identification and remediation of food insecurity and its impacts on diabetes management is to integrate food security screening into EMRs. Inclusion in EMRs would include protocols for referral as well. Referring patients to local food banks, food distribution programs, SNAP, and WIC, is proven to be useful (America, 2014). Case managers or skilled outreach workers could address patients that screen positive.

It is also necessary to recognize child food insecurity. Child food insecurity can continue to plague a child through adulthood and even be inter-generational (Sun et al., 2016). These consequences begin in infancy and can cause a multitude of issues including: birth complications, low birth weight, delayed development, chronic health conditions, poorer quality of life, school tardiness, and behavioral problems (America, 2015; J. T. Cook & Frank, 2008). If there is an association between food insecurity and diabetes in adults, it is likely that

this association also exists in children (J. Cook, 2009). Breaking this cycle earlier in the life span may mitigate the likelihood that a child will develop type two diabetes in his or her lifetime. With a growing epidemic of children developing type two diabetes in the United States, it is important to address child food insecurity (St. Onge, Motycka, & Rose, 2006). Pediatricians can address child food insecurity by “prescribing" nutrition programs. They can also help patients access to programs such as SNAP and WIC (Weill, 2017).

Burgeoning research on food security and diabetes shows the need for further development of this association. The existing research is cross-sectional. Longitudinal studies would be useful to determine temporality of variables. Cluster-randomized controlled trials have been conducted internationally to determine the efficacy of various interventions on food security (Fernald et al., 2016; Stewart et al., 2013; Weiser et al., 2015). Intervention research on food insecurity with an emphasis on improving management and control of chronic diseases like diabetes, is lacking in the US. It would be useful to design randomized controlled trials in both urban and rural populations in the United States. This could determine if it is possible to improve diabetes management domestically by promoting food security. These types of studies could determine a causal relationship between food insecurity and diabetes, rather than simply an association. While there is growing research on the types of foods that diabetic patients should eat, there is little research *how* to afford and prepare these foods (Seligman et al., 2012). This is especially true among low-income populations that may not be familiar with many of the foods they are taught to eat in diabetes education courses. Evidence-based research could inform policy-makers, nutrition educators, anti-hunger groups, and others of the need to address food insecurity in the United States.

Recommendations

Clinical practitioners and centers are beginning to recognize hunger among their patients. Kaiser Permanente implemented a model called clinic-to-community integration (CCI). To do this, they first used the 2-item food insecurity screener in a hospital. Those who screened positive were given a card with the Hunger Free Colorado Hotline. The Hotline helped individuals access federal assistance programs, food pantries, and initiatives such as "meals on wheels."

Kaiser's model recognizes that food insecurity is an issue in the given population. Grady Hospital has many patients who are both type two diabetic and food insecure. Grady can use these results to secure provider buy-in and integrate food security screening into EMRs. Food security screening and treatment plans can be provided without disrupting workflow. Patients need references for appropriate resources. Referral forms could authorize permission for ACFB to contact patients directly. Data collection, monitoring, and evaluation are also necessary. These data can note gaps in the referral process and meet unmet challenges. Grady Hospital can engage local policy-makers to improve access to food on a larger scale. When policy makers are invited to the proverbial table, tangible and sustainable change can occur (Stenmark, 2015).

Food insecure individuals rely on SNAP and other food assistance programs (America, 2016) but other factors may hinder food access including lack of transportation, lack of access to produce, and food deserts. One way to increase benefits of SNAP for diabetic patients would be identify strategies that overcome these additional barriers. For example, the USDA is conducting a two-year pilot that will allow SNAP users to purchase food from places such as Amazon, ShopRite, and Safeway, thereby overcoming many of the non-financial access barriers

to healthier foods (McDaniels, 2017). Georgia may benefit from similar programs, but this would require approval from the government on a state level.

SNAP and federal assistance programs increase healthy eating behaviors (CBPP, 2017). A $30 increase in SNAP can have many benefits. These include an estimated 1.48% increase in vegetable consumption and a 2.52% decrease in fast food consumption (Jared Bernstein, 2016; Patricia M. Anderson, 2016). On a policy level, it would be wise to advocate for and strengthen food assistance programs. These can have a positive impact on health outcomes at a macro level.

The current state of diabetes remains bleak. However, the association between food insecurity and diabetes provides medical leverage points for action. These leverage points can include integration of food security screenings into electronic medical records, conversations between patient and provider about access to food, and dissemination of resources to patients. Recognizing the implications that food insecurity has on health gives hope that it is possible to mitigate the negative health outcomes that may arise from lack of access to healthy food.

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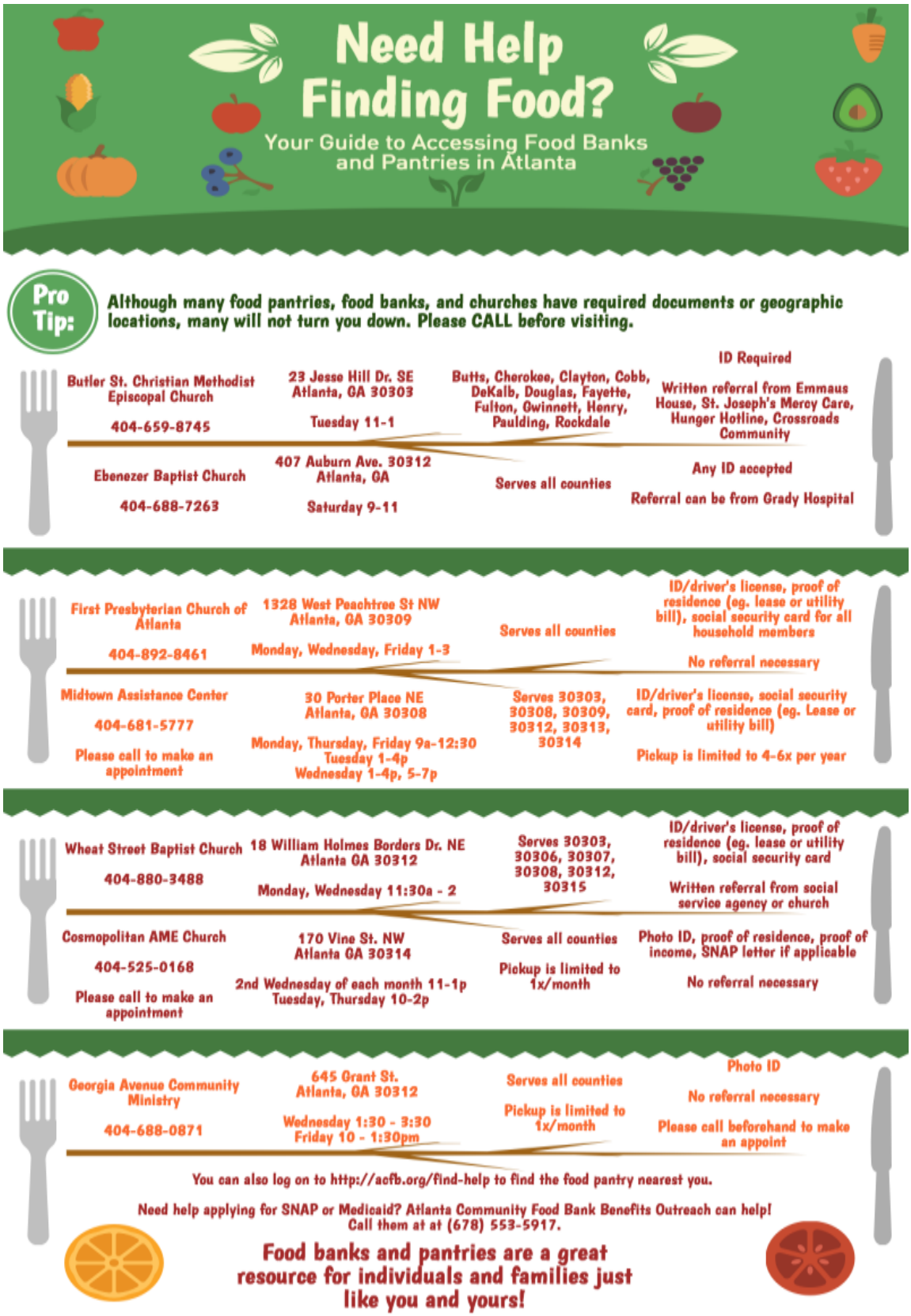
Appendices

A. Grady Health System Community Assets

Health	Wellness	Philanthropic
• Hispanic Health Coalition of GA Health Education, Assessment, and Leadership Clinic (HEAL) • The Center for Black Women's Wellness, Inc. • Federally Qualified Health Centers (FQHCs) • Public Health Department clinics • Hospitals • Georgia Charitable Care Network • Feminist Women's Health Center • Health MPowers • Diabetes Association of Atlanta • Healthy Mothers Healthy Babies Coalition of Georgia	• DeKalb Initiative for Children and Families • Center for Pan Asian Community Services • Communities in Schools Atlanta • CHRIS Kids, Inc. • Atlanta Housing Authority – Quality of Life Initiative • Georgia Growers • Georgia Organics • YMCA of Metro Atlanta • YMCA of Greater Atlanta • Boys and Girls Clubs of Metro Atlanta • Georgia Coalition for Physical Activity and Nutrition • Voices for Georgia's Children Atlanta Community Food Bank • Atlanta Public Schools • Fulton County Board of Education • City of Decatur Schools • DeKalb County Board of Education • Agape Community Center • Atlanta Neighborhood Development Partnership • Community Assistance Center City of Refuge • Open Hand • The Sheltering Arms Early Education and Family Centers • Care and Counseling Centers of Georgia	• Grady Health Foundation • United Way of Greater Atlanta • Kaiser Permanente Community Benefit • Healthcare Georgia Foundation • R Howard Dobbs, Jr. Foundation • Atlanta Women's Foundation • Woodruff Foundation Community Foundation of Greater Atlanta • Goodwill Industries • Just Heart Foundation • Coca-Cola Foundation • American Red Cross • Action Ministries • North Fulton Community Charities

B. Infographic Distributed to Survey Participants



C. Food Security Screening Tool

Identifier:

Date: _ _ / _ _ / 2017

Day: M Tu W Th F

Time: _ _ : _ _ AM PM

Introduction

Hi _____. My name is Bella Girovich. I'm a student at Emory University working on a project between Grady Hospital and the Atlanta Community Food Bank. The purpose of our project is to better understand where Grady's patients come from and to identify ways to help patients get enough food in the days after they leave the hospital. Grady and ACFB want to help link patients to places, both near Grady and within their neighborhoods, where they can get food.

I have a short survey that I'd like to ask you. It is a quick survey that will take less than 5 minutes. Your participation is completely voluntary. I won't be asking for your name so the information that you provide will be completely confidential. I will be asking for some demographic information, but this is solely for the purpose of furthering the research. Neither your doctor nor anyone else will be able to see your responses. If there are any questions that you are not comfortable with, you do not have to answer them and you are free to stop the survey at any time. Do I have your permission to continue with this interview? **[Obtain consent]**

Do you have any questions before we begin?

Demographics

Age: _____

Sex:

- ☐ Male
- ☐ Female
- ☐ Other
- ☐ Prefer not to disclose

Race:

- ☐ White
- ☐ African American
- ☐ Latino
- ☐ Other/multiple

Annual Household Income:

- ☐ <$10,000
- ☐ $10,000-24,999
- ☐ ≥$25,000
- ☐ Declined to state

Number of people in household:

< 5 years old: _____

5-18 years old: _____

18-65 years old: _____

> 65 years old: _____

Zip code: _____

In the past 12 months have you been told that you have:

☐ Pre-diabetes
☐ Type 2 diabetes
☐ High blood sugar

2-Item screener:

I'm going to read you two statements that people have made about their food situation. For each statement, please tell me whether the statement was often true, sometimes true, or never true for your household in the last 12 months.

1. "We worried whether our food would run out before we got money to buy more." Was that often true, sometimes true, or never true for your household in the last 12 months?
   ☐ Often true
   ☐ Sometimes true
   ☐ Never true

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 your household in the last 12 months?
   ☐ Often true
   ☐ Sometimes true
   ☐ Never true

SNAP:

I am now going to ask you some questions about food assistance.

1. Are you familiar with SNAP?
   a. Also known as food stamps.
   ☐ Yes
   ☐ No
   ☐ Don't Know

*If yes,

1.2 Have you applied for SNAP in the past 12 months?
   ☐ Yes
   ☐ No
   ☐ Don't Know

1.3 Were you approved for benefits?
   ☐ Yes
   ☐ No
   ☐ Don't Know

Closing

That's the end of the survey. Thank you so much for taking the time to answer my questions.