2019

The Influence of Food Insecurity, Low-Income, and Race on Diabetes Self-Management Practices Among Women with Diabetes

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2019

Abstract

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MS, Hunter College, 1996

BA, Boston University, 1991

Doctoral Study Submitted in Partial Fulfillment

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Abstract

Diabetes is a chronic condition affecting more than 30 million adults living in the United States. Diabetes self-management (DSM) can prevent or delay the complications of diabetes and improve clinical outcomes; however, data show that low-income, food insecurity, female gender, and race contribute to challenges performing effective DSM. The health belief model was the theoretical framework for this cross-sectional study, which examined how food insecurity, low-income, and race affect DSM activities in women with diabetes. The sample population from the 2017 Behavioral Risk Factor Surveillance System survey consisted of 1,842 women with diabetes who were 18 years of age or older, had an annual income of less than $50,000, and were food insecure. Results of the chi square analyses indicated a significant association between food insecurity and DSM activities ($\chi 2 = 48.99$, $p < 0.0001$); however, results showed no significant association between low-income or race ($p > 0.05$). Results of a binary logistic regression model revealed that food secure and younger women had 1.618 and .584 times the odds of having effective DSM activities than food-insecure and older women (OR=1.618, 95% *CI*=1.282 - 2.041, $p < 0.001$; OR=.584, 95% *CI*=.465 - .733, $p < 0.001$, respectively). These results might provide researchers with guidance regarding food insecure and younger women with diabetes who might require additional support for their diabetes management. Tailored public health interventions might lead to positive social change by increasing food stability and nutrition knowledge, potentiating improvements in hemoglobin A1C, a 90-day measure of glucose control, which could reduce risk of diabetes-related morbidity and mortality.

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Dedication

This doctoral study is dedicated to my family and friends who supported my journey with their patience, understanding, and encouragement. To my wonderful husband Jay, without your support I could not have accomplished this goal. You worked double time taking over as chef, “tucker inner”, chauffeur, and weekend warrior to our boys and assured me that you had “everything covered” – and you did it without complaint. To my amazing boys, Michael and Ian, thank you for not complaining (too much) that I couldn’t always tuck you in or be at all of your games. I am hopeful you didn’t feel too neglected during these years and that you were able to see that with hard work and dedication, anything is possible. To my friends I haven’t seen in a while, I’ll be back soon. Thank you for your patience!

Lastly, to my parents, Arlene and Richard, thank you for your encouragement and support. It is because of you that I always strive to do more. You taught me that it is only through hard work, not luck, that success is possible and that sometimes you have to fail in order to succeed. You also taught me that I can do whatever I set my mind to – it’s amazing to me that you were right!

Acknowledgments

I would like to thank my family, friends, and colleagues who supported and encouraged me throughout this journey. I would also like to acknowledge and thank all of my instructors and my committee members: Dr. Vasileios Margaritis, Dr. Aaron Mendelsohn, and Dr. German Gonzalez.

To all of my instructors, thank you for challenging me to think outside of the box and learn how to become a scholar practitioner. You prepared me well for my final "assignment" in this long journey. To my second chair, Dr. Mendelsohn, thank you for your expeditious reviews and valuable feedback. Your advice was instrumental in ensuring I always maintained doctoral level writing. To my university research reviewer, Dr. Gonzalez, as the last person in the review process, you kept your comments focused and returned them in a timely manner. Lastly, to my committee chair, Dr. VM, thank you for your encouragement, wisdom, and patience. In times when I was falling behind, you did your very best to keep me on track. You were patient yet you knew those were the very times I needed a gentle kick in the rear to get going. I greatly appreciate your timely and constructive feedback as well as your guidance in getting through each step in the process.

I am truly grateful to all of you for guiding me throughout this amazing journey!

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Section 1: Introduction and Literature Review

Introduction

According to the Centers for Disease Control and Prevention (CDC, 2017a), diabetes is a chronic condition found in over 30 million adults living in the United States (US). It is among the top 10 causes of death and can lead to severe complications such as kidney failure, cardiovascular disease, and amputations. One quarter of those who have diabetes do not know they have it (CDC, 2017a). There are three main types of diabetes: type 1 diabetes, type 2 diabetes, and gestational diabetes, each with its own unique origin (CDC, 2017a). Type 1 diabetes is diagnosed mainly in children and teens and has an autoimmune component. The body is unable to produce its own insulin and thereby requires an external source. About 5% of the diabetes population has type 1 diabetes (CDC, 2017a). Type 2 diabetes is the most common form and occurs in about 90 to 95% of all diagnosed cases. It manifests over time when the body is unable to produce enough insulin to break down sugars ingested in the body (CDC, 2017a).

Despite the different treatment options, which include lifestyle modifications, medication, and diabetes self-management education (DSME), there is still no cure (CDC, 2017a). The last two decades have seen a threefold increase in adults who were diagnosed with diabetes, with the prevalence increasing with age. Prevalence also varies by ethnicity and education level, a reflection of socioeconomic status, where 12.6% of adults with less than a high school education and 7.2% of adults with more than a high school education have diabetes (CDC, 2017b). Furthermore, by the year 2050, the population of people with diabetes is expected to increase by 481% in Hispanics and

208% in Blacks compared with 113% among their White counterparts. Among men, the rate is expected to increase by 174%, while among women, the expected rate increase is 220% (Vaccaro, Exebio, Zarini, & Huffman, 2014).

One of the recommended treatment options is diabetes self-management (DSM), which has been shown to prevent or delay the complications of diabetes and improve clinical outcomes, reduce healthcare costs, and have a positive impact on quality of life (Beck et al., 2017; Fan & Sidani, 2018; Haw, Narayan, & Ali, 2015; Kamradt et al., 2014; Katula et al., 2017; Lu, Xu, Zhao, & Han, 2016; Vaccaro et al., 2014). However, not all individuals with diabetes have the ability to manage their own care. For racial minority groups, the barriers to DSM activities may include individual health beliefs and low health literacy (Ricci-Cabello et al., 2014). Low-income women with diabetes have greater challenges related to effective DSM due to their life circumstances, which include a greater demand for caregiving, not having disposable income, and poor or no access to adequate healthcare (Fritz, 2017). Mansyur, Rustveld, Nash, and Jibaja-Weiss (2016) found that perceived support associated with self-efficacy and DSM activities among Hispanic men and women had a positive association with self-efficacy among women, but not among men. Bhaloo, Juma, and Criscuolo-Higgins (2017) posited that the DSM activities of women were influenced by a strong support system. When this did not exist, they were more vulnerable to low engagement levels of DSM activities and were more susceptible to poor outcomes (Bhaloo et al., 2017).

For those who are food insecure and of poor socioeconomic status, effective DSM can also be a challenge (Fritz, 2017; Ippolito et al., 2017). According to Ippolito et al.

(2017), food insecure individuals are more susceptible to poor eating habits, which stem from their limited access to nutrient-dense and nutritious foods, binge eating when food is available, and having to choose between healthy eating and paying bills. All of these can lead to poor glycemic control and a low level of DSM activity (Ippolito et al., 2017). For low-income individuals with diabetes, there are fewer resources to devote to managing their chronic conditions, making it a challenge to comply with the prescribed DSM activities (Fritz, 2017). Low-income individuals also face barriers to accessing healthcare services due to lack of insurance or, in some cases, high copays, which force them to choose between seeing a healthcare professional and paying the bills (Vest et al., 2013).

It is, therefore, necessary to understand what influences DSM activities in order to be able to tailor programs to improve practice as indicated. The purpose of this study was to determine whether risk factors of income status and food insecurity influence DSM practices and whether DSM practices were further influenced by race when food insecurity and low-income were constant. The American Diabetes Association (ADA) holds the position that DSME should be provided to all patients diagnosed with diabetes to improve patient outcomes (Powers et al., 2015). Both income level and food insecurity have a detrimental effect on DSM practices. There is a greater likelihood low income or food insecure individuals will engage in unhealthy behaviors such as smoking, being sedentary, following a poor diet, and being non-adherent to medication (Chan, DeMelo, Gingras, & Gucciardi, 2015; Fritz, 2017; Ippolito et al., 2016; Lyles et al., 2013; Vest et al., 2013). Ethnic minorities may also have more challenges than non-minority groups adhering to and engaging in DSM activities such as following a healthy diet and getting

enough exercise (Ricci-Cabello et al., 2014). DSM can be positively influenced by individually tailored education programs (Beck et al., 2017); however, data remains elusive in their contribution to DSM practices among different racial/ethnic women with diabetes.

Johnson et al. (2014) found significant racial and ethnic differences in all of the five DSM activities, which included blood glucose monitoring, foot checks, non-smoking, physical activity, and healthy eating, among non-insulin users. Specifically, engagement in blood glucose monitoring and foot care was the greatest among American Indian/Alaskan Natives (AIAN). Asian/Native Hawaiian or other Pacific Islander (API) had the lowest engagement in these activities. Compared with non-Hispanic Whites, Hispanics had 1.5 times the odds of consuming their daily intake of fruits and vegetables and not smoking, whereas AIAN had higher odds of monitoring their blood glucose levels daily. Among insulin users, there were only differences for blood glucose monitoring and foot checks. In general, those on insulin had higher engagement in diabetes self-care activities regardless of racial identity. While this study investigated racial differences in DSM activities among insulin and non-insulin users, they neglected to explore whether income level, food security status, or gender contributed to the level of engagement for DSM activities. Using the most recent Behavioral Risk Factor Surveillance System (BRFSS) dataset, a health-related risk behavior telephone survey, which included questions on food insecurity and diabetes self-management activities, this study investigated whether there was a relationship between income level and food

security status and DSM practices among women with diabetes and whether the relationship still existed across all races.

For individuals living with diabetes, having the knowledge and skills necessary for the proper management of diabetes is critical in the management of their disease. Self-management can prevent or delay the complications of diabetes and improve clinical outcomes, reduce healthcare costs, and have a positive impact on quality of life (Beck et al., 2017). Understanding whether racial differences in DSM extend to income level and food security status among women will allow for more tailored individualized approaches to diabetes self-management education and support (DSMES), which could lead to positive social change and improved outcomes within this population. It is also possible to use these results to determine which ethnic groups have the greatest need for support and further education.

In Section 1, I highlight the foundation of the study, which includes the purpose of my study, the research questions I addressed, hypotheses, the theoretical foundation upon which I based my study, an extensive review of the literature related to the key variables, and the scope and significance of this research. Section 2 addresses the research design and rationale, methodology, and threats to validity. In Section 3, I describe how the data were collected and reported on the baseline characteristics of the study population. Results are also shared in this section in both textual and graphic formats. Finally, in Section 4, I interpret the findings and describe how these results align with or contradict current literature and describe the key limitations of the study. I will make recommendations for future research based on the strengths and shortcomings

of the current study and describe the social change impact based on my findings. Each section concludes with a robust summary of my findings.

Problem Statement

Diabetes is a chronic condition whereby the body is unable to process food into energy, leading to an excess amount of glucose circulating in the blood stream (CDC, 2017a). Though the risk of developing diabetes is similar between men and women, the potential for negative outcomes can be quite different. For example, the risk of heart disease for women, which is the greatest killer of American women, as well as stroke, is higher than men with diabetes (U.S. Department of Health and Human Services [HHS], 2017). Women with diabetes also have a lower quality of life and survival rate following a myocardial infarction (HHS, 2017).

Low-income individuals are also at a higher risk for diabetes and are more likely to suffer from food insecurity (Ippolito et al., 2017). Food insecurity is defined as households or individuals with limited or uncertain access to wholesome and nutritious food (Strings, Ranchod, Laraia, & Nuru-Jeter, 2016; Torres, De Marchis, Fichtenberg, & Gottlieb, 2017). In patients who have diabetes, this poses an additional level of risk as it can contribute to poor glycemic control and the inability to properly self-manage their condition (Ippolito et al., 2017). DSM has been shown to reduce the risk of associated morbidity and mortality (Fritz, 2017). However, not all individuals with diabetes have the ability to manage their own care. Low-income women with diabetes have greater challenges involving effective DSM due to their life circumstances, which include a greater demand for caregiving, not having disposable income, and poor or no access to

adequate healthcare (Fritz, 2017). For those who are food insecure and of poor socioeconomic status, effective DSM can also be a challenge (Fritz, 2017; Ippolito et al., 2017).

Johnson et al. (2014) investigated whether race influenced diabetes self-care activities, which included monitoring blood glucose, diabetic foot checks, abstaining from smoking, engaging in physical activity, and following a healthy diet. They also investigated whether self-care activities were further differentiated by insulin use. For individuals not using insulin, there were varying levels of engagement for each of the self-care activities among different racial groups. The highest level of engagement in blood glucose monitoring and foot care was among AIAN. To the contrary, the API group had the least engagement in blood glucose monitoring and foot care. Hispanics compared to non-Hispanic Whites had 1.5 times the odds of consuming their daily intake of fruits and vegetables and not smoking and AIAN had higher odds of monitoring their blood glucose levels daily. Among those on insulin, the differences were only significant with select self-care activities such as blood glucose monitoring and foot checks and were not significantly different across racial groups. With the significant differences within the study population for both demographic and socioeconomic characteristics, it is difficult to ascertain whether these differences played a role in the outcome of this study and whether looking at a more homogeneous and gender-specific sample where income level and food insecurity status were equivalent and the same significant differences in DSM practices would be present.

Income level influences physical activity, one of the measures of DSM activity (Kari et al., 2015). The types of food consumed is also influenced by income level, race, and gender, especially among those with lower income levels (Storey & Anderson, 2014). The differences in what influences DSM activities in men and women were explored by Chlewbowy, Hood, and La Joie (2013) revealing that women and men have different barriers and facilitators to DSM behavior. Women's acceptance of their diabetes helped facilitate positive engagement in DSM activities, while men were motivated by having a positive outlook. Barriers to DSM activities in women were more focused on the financial and emotional burden they felt with diabetes, whereas men felt their limited knowledge in how to properly manage their diabetes and the lack of personal time at work hindered their ability to monitor their blood sugar levels and eat an appropriate diet (Chlewbowy et al., 2013). In a similar study investigating the motivating factors of men and women to engage in recommended DSM activities, Bhaloo et al. (2017) found a greater risk for nonadherence and worse outcomes, specifically in the ability to reach hemoglobin A1C (A1C) targets and reduce diabetes-related risk factors, due to less support from family members for DSM activities in women as compared to men (Bhaloo et al., 2017).

DSM has been shown to reduce morbidity and mortality associated with diabetes (Fritz, 2017). It is therefore necessary to understand what influences DSM activities in order to be able to tailor programs to improve practice as indicated. According to Johnson et al. (2014), among non-insulin users, each racial group had different levels of engagement in blood glucose monitoring, foot checks, physical activity, smoking, and

healthy nutrition intake. Among insulin users, on the other hand, the racial differences seem to be mitigated whereby differences in engagement could only be seen for blood glucose monitoring and foot checks when comparing insulin users and non-insulin users but not when comparing different racial groups (Johnson et al., 2014). While these results can be used to tailor DSMES programs, they do not address the social and economic differences present within this same study population.

Income level has implications for DSM activities, which include not having enough money to buy nutritious foods such as whole grains, fruits, and vegetables and not being able to partake in adequate levels of physical activity (Kari et al., 2015; Storey & Anderson, 2014). Individuals with food insecurity also have challenges complying with a healthy diet as they lack access to nutritious food (Ippolito et al., 2017). Women with diabetes required more support from their spouses and family to help maintain the prescribed DSM activities. Unfortunately, they were often under-supported making it difficult to perform their DSM activities (Bhaloo et al., 2017). Women also felt more burdened with having diabetes and blamed themselves for getting sick. To a greater extent than men, women saw their disease as something they needed to hide, making compliance with certain DSM activities, such as blood glucose monitoring and healthy eating, more challenging (Chlewbowy et al., 2013). Therefore, this study explored whether food insecurity status and low income influence DSM practices in women with diabetes. It also explored whether there was an association between race and DSM practices in women when food insecurity and low-income were constant.

Purpose of the Study

For women with diabetes, food insecurity, income levels, and race each contribute to the inability to adequately perform DSM activities (Fritz, 2017; Ippolito et al., 2017; Johnson et al., 2014; Kari et al., 2015; Storey & Anderson, 2014). Therefore, I conducted a quantitative study using secondary data from the 2017 BRFSS to determine how food insecurity and low income affect DSM activities in women with diabetes and determine whether there was an association with race when food insecurity and income were constant.

Research Questions and Hypotheses

RQ1: Is food insecurity associated with DSM activities in low-income women with type 2 diabetes?

$H_0 1$: There is no association between food insecurity and DSM activities in low-income women with type 2 diabetes.

$H_a 1$: There is an association between food insecurity and DSM activities in low-income women with type 2 diabetes.

RQ2: Is low income level associated with DSM activities in food insecure women with type 2 diabetes?

$H_0 2$: There is no association between low income level and DSM activities in food insecure women with type 2 diabetes.

$H_a 2$: There is an association between low income level and DSM activities in food insecure women with type 2 diabetes.

RQ3: Is there an association between race and DSM activities among low-income food insecure women with diabetes as measured by frequency of diabetes self-care activities?

$H_0$3: There are no racial differences in terms of DSM activities among low income, food insecure women with type 2 diabetes as measured by frequency of diabetes self-care activities.

H_a3: There are racial differences in terms of DSM activities among low income, food insecure women with type 2 diabetes as measured by frequency of diabetes self-care activities.

Theoretical Foundation for the Study

Theory-based DSM interventions are more effective and have longer term benefits in patients with diabetes than those that do not have a theoretical base (Zhao, Suhonen, Koskinen, & Leino-Kilpi, 2016). With a theoretical base, investigators are better equipped to understand processes and accumulate evidence regarding what is driving health behaviors and determine best ways to motivate patients to make changes. In their systematic review, Zhao et al. (2016) found that the interventions based on one or more theories led to improvements in outcomes such as A1C, self-efficacy, diabetes knowledge, and DSM activities. They did not specify which theory led to the most improvement; however, they acknowledged that the health belief model (HBM), theory of self-efficacy, theory of empowerment, and theory of planned behavior, were used most often among the studies reviewed (Zhao et al., 2016).

The framework for this study was based on the HBM, which addresses health-related behaviors and is often used as a guide for interventions. It is especially useful when there is a need to better understand cultural beliefs and perceptions in order to develop interventions which are culturally appropriate (McElfish et al., 2016). The primary constructs of the HBM can be used to determine whether people will take action to improve their health and why they are likely to act or not (Glanz, Rimer, & Viswanath, 2015). These constructs include perceived susceptibility, how likely a person perceives their chances of being diagnosed with a disease, perceived severity, or the belief regarding how severe a disease could become if left untreated, perceived benefits and barriers, which are the advantages or obstacles to taking action, cues to action, or internal or external cues which can lead to action, and self-efficacy, or the belief or confidence that one can actually perform the recommended action (Glanz et al., 2015; McElfish et al., 2016). In other words, if an individual believes they are at an increased risk for a disease or its complications, they are more likely to take action to change behavior; however, they are less likely to do either of these until this belief is actually recognized (Peek, Ferguson, Roberson, & Chin, 2014).

The HBM has been used to understand what motivates people to take action that will improve their health instead of doing nothing. In the context of this study, the HBM was used to understand the association between each of the independent variables of low income, food insecurity, and race, and the dependent variable, level of DSM activity. While there are six constructs of the HBM, this study had a more narrow focus and

applied only four: perceived susceptibility, perceived barriers, perceived severity, and self-efficacy.

For RQ1, I applied the constructs of perceived severity, self-efficacy, and perceived barriers. People who suffer from food insecurity have limited access to healthy nutritious food (Heerman et al., 2015; Lombe, Nebbitt, Sinha, & Reynolds, 2016; Lyles et al., 2013; Strings et al., 2016); however, their perception of the severity of their situation may not be motivating enough to entice them to comply with the prescribed DSM activities. According to Lyles et al. (2013), food insecure individuals may use their food insecurity as a perceived barrier for healthy eating and may lack the confidence that they can perform DSM activities effectively. They also may have lower self-efficacy (Lyles et al., 2013). For RQ2*?*, income level also aligns with the constructs perceived barriers and perceived susceptibility. Vest et al. (2013) suggested that low-income individuals have numerous perceived barriers to effective DSM activities, including lack of health insurance and lack of trust in their healthcare provider, as well as social barriers such as lack of social support. RQ3 is aligned with the construct self-efficacy. Cultural differences, beliefs, and levels of social support may influence one's level of self-efficacy and has been shown to facilitate or hinder self-management activities. From a cultural perspective, certain cultures have a greater respect for advice given by the treating physician and are more likely to follow recommendations for self-management activities. For others, this doctor-patient relationship is less trustful, which could hinder prescribed treatment. Additionally, strong family and social support could facilitate self-

management activities through encouragement, assistance with daily care, or through motivation to do well (Vest et al., 2013).

The application of the HBM to this study was appropriate as it has been shown to be effective for tailoring health education interventions focused on prevention of diabetes and its progression. According to Jalilian, Motlagh, Solhi, and Gharibnavaz (2014), for an individual with diabetes, a critical component of diabetes care is their ability to carry out self-management activities, such as self-glucose monitoring, foot checks, physical activity, adherence to medication, and good nutrition intake. When these activities are performed adequately they can mitigate the diabetes-related risk of morbidity and mortality (Jalilian et al., 2014). Among the different constructs of the HBM, self-efficacy showed a strong predictive association with engagement in DSM activity. Walker, Smalls, Hernandez-Tejeda, Campbell, and Egede (2014) measured self-efficacy using the Perceived Diabetes Self-Management Scale (PDSMS), which is an 8-item scale asking questions about finding solutions to problems with managing diabetes, challenges to change, managing one's disease, accomplishing goals of managing diabetes, and planning. They assessed the association of self-efficacy scores, where the higher the score the higher the self-efficacy, to DSM activities using linear regression models. Each of the components of DSM activities, including diet, exercise, blood glucose monitoring, and foot care had a significant association with self-efficacy. Improving self-efficacy can lead to an improvement in DSM activities like diet, exercise, and blood glucose monitoring (Walker et al., 2014). Understanding what motivates someone to take action or remain

complicit in their disease management can contribute to a more tailored and potentially successful approach to DSME (Jalilian et al., 2014; McElfish et al., 2016).

Hallgren, McElfish, and Rubon-Chutaro (2015) posited that gaining a better understanding of the motivation behind the actions or inactions taken by people with diabetes can help to improve the engagement levels of DSM activities through the development of more tailored interventions. Hallgren et al. used the constructs of the HBM to determine the attitudes, barriers, and potential areas of opportunity to effective DSM within a population of Marshallese migrants living with type 2 diabetes in an Arkansas community. While Hallgren et al. focused on all of the constructs of the HBM in their study, including perceived susceptibility, perceived severity, perceived barriers, perceived benefits, self-efficacy, and cues to action, the participants responded to the study questions focusing primarily on their perceived barriers. Several barriers to DSM activities were discovered such as lack of health insurance and stigmatization. Hallgren et al. also identified areas of opportunity including family and peer reinforcement, in which family members or peers are reminding each other of the proper behaviors. Another area of opportunity involved working with community members to help lift the stigma of having diabetes. These opportunities were felt to be a way to improve DSM practices like improvements in nutrition intake and complying with prescribed exercise and medication (Hallgren et al., 2015).

The project team for the South Side Diabetes Project used the HBM as one of their theoretical frameworks to guide the implementation and design of this project. The South Side Diabetes Project works with working class African American communities on

Chicago's South Side to promote behavior change. The goal of the project was to improve individual behaviors, such as eating habits, physical activity, and adherence to medication, which could positively impact diabetes-related outcomes. In this community, these individual behaviors are strongly influenced by beliefs and attitudes. Surprisingly, they found that many of the participants from the community had an exaggerated perception of their risk for complications they might experience because of their diabetes. This perception led to many using denial to cope with this unsubstantiated reality. The program turned to using positive testimonials from other patients and encouraged sharing success stories in an effort to change behaviors and attitudes. Additionally, the program was able to address the perceived barriers to change by having skills building programs to improve the ability of community members participating in the program to self-test glucose levels (Peek et al., 2014).

Nature of the Study

This was a cross-sectional quantitative study using the 2017 BRFSS survey. The BRFSS is one of the largest telephone surveys, which includes statewide data on health-related risk behaviors. Each year, over 400,000 interviews are conducted with adults in all 50 states, the District of Columbia, and three U.S. territories. The surveys collect data at the state and county level to target health-related behaviors and develop activities geared towards improving health. At the state level, the survey results have been used to address relevant health issues such as the flu and fallout from natural disasters (CDC, 2014).

For RQ1, food insecurity was the independent variable and DSM activity was the dependent variable. These were measured using the five BRFSS diabetes self-care activities: blood glucose monitoring, abstaining from smoking, home foot checks, physical activity, and following a healthy diet. For RQ2, the independent variable was income level and the dependent variable was DSM activity. An individual whose taxable income was less than 150% of the poverty level was considered a low-income individual (U.S Department of Education [DOE], 2018). In January of 2018, the income level for a family of four living within the contiguous United States, Alaska, and Hawaii was between $37,650 and $47,070 (DOE, 2018). Therefore, this study included women with diabetes with an income level less than $50,000.

For RQ3, race was the independent variable and DSM activity was the dependent variable. Income level and food insecurity status were the control variables. Race categories were Hispanic, which included those who identified as Hispanic, Latino/a, or of Spanish origin, White, Black or African American, American Indian or Alaskan Native, Asian, and Native Hawaiian or other Pacific Islander. Diabetes status was determined by those who responded yes to the survey question have you ever been told you have diabetes. Those who were told they had gestational diabetes were excluded as this is a transient condition occurring during pregnancy and resolving once the baby is born. Those who indicated they were on insulin were also excluded. Insulin users tend to engage more in DSM activities such as glucose monitoring and eating healthy than non-insulin users (Johnson et al., 2014). By eliminating insulin users, this also excluded those with type 1 diabetes as insulin is a mandatory treatment for people with type 1 diabetes.

Descriptive statistics were used to describe the demographics of the sample population. A binary yes or no variable was created for each of the BRFSS activities and food insecurity status. Chi-square statistics (χ^2) and Cramer's *V* statistics were used to determine association and strength of any association between the dependent and independent variables. I also used the binary logistic regression model to confirm the statically significant association between food insecurity and DSM activities.

Literature Search Strategy

The purpose of this study was to determine how food insecurity, income level, and race influence DSM practices among women with type 2 diabetes. For this literature search, several search engines were used. In the Walden Library database, I accessed the ProQuest Nursing & Allied Health database, Health and Medical collection, and EBSCOHost. I also used Google Scholar and Google as part of my search and relied on textbooks when indicated for information on the theoretical framework.

Key search terms were *diabetes, type 2 diabetes, diabetes and income, diabetes and food insecurity, diabetes and gender differences, racial differences among diabetes, diabetes self-management, diabetes self-management activities, diabetes self-management and income, diabetes self-management and food insecurity, diabetes self-management and women, diabetes self-management and age, diabetes self-management and elderly, racial differences in diabetes self-management, diabetes self-management and ethnicity, diabetes self-management and the health belief model, health belief model, food insecurity, food insecurity and diabetes self-management activities, food insecurity and income, food insecurity and ethnicity, food insecurity and racial differences, BRFSS,*

and *reliability of BRFSS*. Additional search parameters required English-only articles that appeared in full-text peer-reviewed journals and textbook searches for information on the theoretical foundation. The timeframe for my search was between 2013 and the present day. The exception to this was the 2009 American Association of Diabetes Educators (AADE) guidelines for the practice of diabetes self-management education/training (DSME/T) as there has been no update to these guidelines.

During the search, studies were excluded if the population had gestational diabetes or the population of interest was based in a country outside the US. While diabetes is certainly a global issue, the 2017 BRFSS database only included a US population. Gestational diabetes was excluded as this is typically a transient condition which resolves once the baby is born.

Literature Review Related to Key Variables

When diabetes is managed effectively, its complications may be minimized (Fan & Sidani, 2018; Kamradt et al., 2014; Schmitt et al., 2016). DSM activities are a combination of activities which contribute to improved glycemic control and have the potential to mitigate diabetes-related complications (Fan & Sidani, 2018; Fritz, 2017; Haw, Narayan, & Ali, 2015; Nguyen, Green, & Enguidanos, 2015). The activities range from changes to diet and exercise to medication adherence and monitoring of blood glucose levels (Fan & Sidani, 2018). The AADE (2009) identified seven self-care behaviors which are required for DSM to be effective: healthy eating, having an active lifestyle, glucose monitoring, adhering to medication, learning how to cope with your disease, problem solving, and minimizing risks. The AADE7, as the seven self-care

behaviors are called, are based upon the underlying theory that DSME/T should be culturally appropriate and empower patients with the tools needed to improve quality of life and their own health status (Parkin et al., 2009). The AADE7 also acts as the framework for which topics should be discussed during DSME/T at any given time following diagnosis (Powers et al., 2015).

To help clinicians assess whether patients have the skills required to adequately perform DSM activities, an appropriate and reliable tool is required. Access to an appropriate tool can help identify underlying problems and challenges faced by individuals with diabetes and assess whether additional training or education is needed. One tool used often is the Summary of Diabetes Self-Care Activities Measure (SDSCA). There are 11 different items within the SDSCA, which look at how often DSM activities were performed during the previous 7 days. The items are questions, which focus on five key areas; diet, exercise, blood glucose testing, foot care, and smoking habits. Each of the areas have survey questions focused on DSM activities. The DSM activities include diet, exercise, monitoring blood glucose, use of tobacco products, and foot care (Kamradt et al., 2014). While this is one of the most popular and most widely used tools, it has failed to show an association with A1C levels. Reducing A1C levels is one of the goals of DSM activity engagement. Not being able to show an association with A1C levels was a limitation of this tool because there is an assumption that the better the engagement in DSM activities, the better the glucose control would be. Additionally, the weak association puts into question the reliability of the SDSCA as a practical tool (Schmitt et al., 2013; Schmitt et al., 2016). The Diabetes Self-Management Questionnaire (DSMQ)

was developed in an effort to improve upon the SDSCA and to have a tool to assess DSM activities, which could be related to A1C. The five domains used in this assessment tool included activities which directly impact glycemic control such as diet, medication, glucose monitoring, and physician interactions. While similar to the SDSCA, the DSMQ tracks activities over an 8-week period, which may be more representative of usual activities as well as physician contact and medication intake, which could be stronger predictors of glycemic control, making the DSMQ a more useful and predictive tool than the SDSCA (Schmitt et al., 2016). When diabetes is managed effectively, its complications may be minimized (Fan & Sidani, 2018; Kamradt et al., 2014; Schmitt et al., 2016).

Food Insecurity and Diabetes Self-Management

Food insecurity refers to households with limited or no access to nutritious food (Berkowitz, Baggett, Wexler, Huskey, Wee, 2013; Burke, Martini, Çayır, Hartline-Grafton, & Meade, 2016; Heerman et al., 2015). In 2016, the Economic Research Service (ERS), the primary source of economic and policy issues such as food, agriculture and the environment for the U.S. Department of Agriculture (USDA), reported that more than 15 million (12.3%) households in the US were food insecure due to limited or lack of resources (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2017). While this number improved in 2017 to 11.8%, it is still above the 2007 prerecession level of 11.1% (Coleman-Jensen et al., 2018). These statistics are based on responses from the Food Security Supplement to the Current Population Survey (CPS) conducted by the USDA. The CPS surveys were sent to over 50,000 households across the country,

with just over 35,000 household responses to the Food Security Supplement. The statistics in the report were calculated based on responses to a series of 18 questions, which address the food conditions for adults and children in the household (Coleman-Jensen et al., 2018).

Some of the questions required a yes or no response, while others determined frequency of the occurrence with of the following responses: often, sometimes or never true for you in the last 12 months and almost every month, some months but not every month, or in only 1 or 2 months (Coleman-Jensen et al., 2017; Coleman-Jensen et al., 2018). Food insecurity was classified if there were three or more food insecurity conditions, which were identified when a respondent selected often, sometimes, almost every month, or some months but not every month, or yes. When a respondent identified with six or more food insecure conditions or when households with children identified eight or more conditions, the household was further classified as very low food security (Coleman-Jensen et al., 2017; Coleman-Jensen et al., 2018).

To be effective, diabetes self-management requires several key components, one of which is proper nutrition (Chan et al., 2015; Gucciardi, Vahabi, Norris, Del Monte, & Farnum, 2014). The technical term medical nutrition therapy involving the act of eating healthy food items and regulating insulin dose of carbohydrate consumption to avoid developing hypoglycemia (Chan et al., 2015). For people with diabetes, food insecurity can increase the risk of poor glycemic control and health outcomes. It can also make it difficult to perform necessary diabetes self-management activities (Gucciardi et al., 2014; Ippolito et al., 2016; Lyles et al., 2013). Individuals who are food insecure must make a

choice about what foods to purchase as they typically have limited options. Rather than choosing the more expensive and wholesome fruits and vegetables, they opt for less costly food choices, which tend to have higher quantities of calories, fat, and sugar (Gucciardi et al., 2014; Lyles et al., 2013; Seligman et al., 2015). People with food insecurity may also have a lower self-efficacy and lack the confidence to be able to manage their own diabetes successfully (Lyles et al., 2013).

Gundersen et al. (2014) said that food insecure individuals were not necessarily very poor, but were individuals with income well below the poverty line. At the same time, very poor individuals were not necessarily food insecure. In fact, 61.7% of households with incomes below the poverty line in 2014 were actually food secure. Gundersen et al. (2014) attributed this to the use of food assistance programs such as Supplemental Nutrition Assistance Program (SNAP) and school lunch programs. They also gave credit to two-parent households and having a better ability to manage finances than those below the poverty line who were food insecure (Gundersen et al., 2014). For those who were food insecure, they tended to have more challenges in managing their finances such as struggling to pay off other expenses, which they would choose to pay off rather than buy food (Gundersen et al., 2014). By contrast, Heerman et al. (2016) found in their cross sectional study, that among the racially diverse, low-income participants who had diabetes and were food insecure, they were more likely to have lower income levels than those classified as food secure. There was a significant relationship between food insecurity and poor DSM activities. Food insecure individuals were significantly more likely to eat poorly and skip meals, going against dietary recommendations. They

were also more likely to be sedentary and have poor adherence to medication (Heerman et al., 2016).

While the rate of food insecurity among adults in the US in 2014 was 9%, there was a higher prevalence among women and low-income individuals (Hernandez et al., 2017). Challenges related to managing family intake seemed to be a reason why adult women with food insecurity were more vulnerable to poor DSM (Holben & Marshall, 2017). Unhealthy foods such as fast food and other high fat foods took the place of fresh fruits and vegetables when there was a threat of food insecurity. Women often manage their family's diets at the expense of their own and make cuts to their intake so their dependent family members do not have to be deprived of food (Holben & Marshall, 2017).

Low Income and Diabetes Self-Management

Income levels tend to increase the burden of chronic diseases such as heart disease and diabetes (Mayberry, Berg, Harper, & Osborn, 2016; Spencer et al., 2018). Low-income communities bear the brunt of the disease burden and its complications (Nelson et al., 2014; Nelson et al., 2017; Page-Reeves et al., 2017; Vissenberg et al., 2016). According to Mayberry et al. (2016), low-income individuals with diabetes have lower health literacy, more stressors, and are more susceptible to the harmful actions of those around them in terms of their DSM activities. These harmful actions include sabotaging efforts to maintain a healthy diet, which have a direct impact on adherence to diet and exercise recommendations (Heerman et al., 2016; Mayberry et al., 2016). Low-income communities are also less likely to effectively engage in appropriate DSM

activities, further contributing to the problem (Page-Reeves et al., 2017; Vissenberg et al., 2016; Willard-Grace et al., 2015). One of the challenges to engagement may be due to their physical environment, where they do not have a safe place for physical activity or nutritious food that is readily available (Nelson et al., 2014; Peek et al., 2014).

Interventions geared towards improving self-management behaviors have positive health outcomes; however, in low-income populations, the interventions are not always successful (Hofer et al., 2017; Vissenberg et al., 2017). Vissenberg et al. (2017) posited that low participation rates in self-management interventions and poor retention are to blame for the lack of success and suggest that interventions be tailored specifically to enhance retention. Hofer et al. (2017) suggested that interventions be culturally appropriate and include a one-on-one counseling session with a community health worker (CHW). CHWs are often individuals who live within the community and are trusted by community members. They are chosen as CHWs because of their own personal experience with a chronic illness, such as diabetes, making them a more relatable counselor (Hofer et al., 2017; Spencer et al., 2018; Verhagen, Steunenberg, de Wit, & Ros, 2014). CHWs also tend to share the same culture and beliefs as those they are supporting and are better able to educate their peers on effective ways to manage their disease, which are culturally appropriate (Nelson et al., 2014; Verhagen et al., 2014).

Public health interventions using CHWs have been successful in providing education to low-income groups with diabetes on how to effectively manage their diabetes despite multiple barriers (Spencer et al., 2018; Verhagen et al., 2014). Hofer et al. (2017) said two different CHW-led diabetes interventions showed that there was

improved satisfaction with diabetes medication information among low-income adults with type 2 diabetes. The first intervention consisted of a home visit by a CHW and two follow up calls using an iPad application, which was an interactive e-health tool. The other intervention also consisted of a home visit by a CHW; however, the follow up information was received as print material. Both interventions shared the same information on diabetes and medications used to treat diabetes except that the information within the e-health tool was animated to accommodate those with low health literacy. The goal of both interventions was to provide information on medication in an effort to improve both the satisfaction in the delivery of medication information and improve medication adherence. Hofer et al. associated improved medication information satisfaction with improved medication adherence, which is one of the essential DSM activities. At times, low-income populations experience discrimination and poor treatment from their healthcare providers or health systems, leading to distrust regarding the information they are provided. CHWs are trusted by community members and are able to provide information and education, which are more likely to be believed by the low-income communities they serve (Hofer et al., 2017).

CHW interventions have shown success in facilitating life style changes, improving blood glucose control, and improving self-monitoring over a six-month period. Nelson et al. (2014) investigated the effectiveness of a CHW intervention to improve outcomes in individuals with poorly controlled diabetes in a low-income community. The CHWs provided support to help participants set goals and adopt their own self-management behaviors. There was an emphasis placed on improving self-efficacy and

helping motivate individuals to make behavioral changes. The program was culturally sensitive and conducted in both English and Spanish to address the needs of the participants. Despite the extra attention compared to control patients, who received usual care, the intervention group did not see a significantly greater reduction in their A1C levels. There was; however, a significant difference in A1C for a sub group of participants with poorly controlled diabetes, defined as an A1C > 10% at baseline, at the six-month follow up (Nelson et al., 2017).

For longer term success, defined as success between 12-18 months, peer leaders (PLs), who are members of the community with similar characteristics to the participants, such as having diabetes, may be used in addition to CHWs to provide cost effective support longer term. Spencer et al. (2018) evaluated an intervention using CHWs compared to CHWs plus PLs to determine their effectiveness on A1C levels in a Latino population. Participants all had poor glycemic control and received either a CHW-led DSME program or enhanced usual care (EUC), which consisted of a two hour DSME class conducted by a research assistant. The CHW-led education group received DSME classes, two 60-minute home visits per month, and one clinic visit with the participant and their physician. These groups were followed for six months, after which, the CHW group was randomized to either continue in a CHW only group or a CHW plus PL group and followed for an additional 12 months. The CHW plus PL group provided the participants with education as well as emotional support through access to weekly group sessions and regular telephone contacts. For the primary outcome of change in A1C, the CHW only group had a greater decrease in A1C from baseline to 6 months of follow up

compared to the EUC group. For those randomized to the CHW plus PL group at the 6-month follow up, the improvement in A1C was maintained at 12 and 18 months compared to the CHW only and EUC groups, whose A1C levels slowly increased. In the CHW only group, A1C levels went back to where they were at baseline and the EUC group exceeded baseline values. Spencer et al. (2018) concluded that the addition of PLs in a CHW intervention was an economical way to maintain success over a longer period of time. These data confirmed the results from an earlier study by Tang et al. (2014), which compared an intervention using CHWs vs PLs for 12 months following a 6-month CHW intervention. The results of this study indicated that utilizing PLs maintained achieved goals reached within the first 6-month period (Tang et al., 2014).

In low-income women who have type 2 diabetes, there are challenges specific to their current life circumstances (Fritz, 2017). These challenges, which include limited disposable income, lack of health insurance, and their role as caregiver, make it more difficult to focus their time and energy on the necessary self-care behaviors (Fritz, 2017).

Racial Differences and Diabetes Self-Management

While diabetes affects over 30 million adults nationwide (CDC, 2017a), racial disparities exist where American Indians, non-Hispanic Blacks, Hispanics, and Asian Americans have a higher rate of diabetes than their non-Hispanic White counterparts (Chen et al., 2014; Hawkins et al., 2018; Ricci-Cabello et al., 2014; Vaccaro, Anderson, & Huffman, 2015). A 2012 disparities report by the Agency for Healthcare Research and Quality (AHRQ) revealed that there were disparities between whites and other racial groups and between high income and lower income groups based on recommended

services such as testing for A1C, flu vaccinations, and eye and foot exams, which are among the important DSM activities (Chen et al., 2014). In an effort to examine whether AHRQ disparities were a reflection of differences in DSM activities, Chen et al. (2014) investigated population trends for DSM activities and the extent of racial disparities over a 10-year period. Results of the analysis showed that there were racial differences in the clinical care received, self-care activities, and outcomes between white non-Hispanics, Hispanics, and black non-Hispanics over time. Black non-Hispanics increased blood glucose monitoring over the 10-year period; however, their diabetes-related health outcomes compared to white non-Hispanics were worse potentiating the need for more tailored interventions (Chen et al., 2014). While the reason for racial differences in care received, self-care activities, and outcomes is unclear, social determinants, such as socioeconomic circumstances, psychosocial factors, neighborhood environment, and cultural drivers may play a role in this disparity (Walker, Strom Williams, & Egede, 2016).

Disparities can stem from poor treatment received by certain ethnic groups by healthcare professionals and limited access to more specialized physicians (Vaccaro et al., 2015). These disparities may also stem from differences in the level of engagement in DSM activity, which can lead to poor outcomes such as heart disease, stroke, or kidney failure (Hawkins, Mitchell, Piatt, & Ellis, 2018). Hawkins et al. (2018) posited that African American men were found to partake in more unhealthy behaviors such as smoking and drinking than their White peers. They were also less likely to monitor blood glucose levels, a behavior which is considered a critical component of DSM. Hawkins et

al. further pointed out that in African American men, participation in DSM activities is generally lower as they do not fit into the “tough guy” persona, and they are less likely to engage. As described by Ricci-Cabello et al. (2014), minority groups are less likely to partake in DSM activities due to lower health literacy and health beliefs. The acculturation level of Hispanic men and women as described by Manysur et al (2014) contributed to DSM activities whereby women who were less acculturated prioritized their family’s health over their own needs. Additionally, cultural food preferences such as fried and breaded meats attribute to the challenges of adhering to good DSM practices (Cunningham et al., 2018).

Diabetes Self-Management and Gender

According to Bhaloo et al. (2017), gender plays a role in motivation and adherence to treatment recommendations for diabetes as well as outcomes. Bhaloo et al. explored the motivational factors behind DSM activities and noted differences between the men and women participants. For men, having the motivation to adhere to DSM activities, such as increasing physical activity and adhering to the prescribed diet, and other recommendations were easier to accomplish when they had support of their spouse, mother, or daughter. For women, on the other hand, support did not come as readily from their spouses. In fact, some women indicated that their spouses actually hindered their adherence by either tempting them with unhealthy foods or by not showing any interest in their care at all (Bhaloo et al., 2017). For low-income women with diabetes, they were met with substantial barriers to DSM activities more so than women with high incomes. Some of the barriers to engagement in DSM activities included lack of insurance or poor

access to medical care, putting them at increased risk of poor outcomes (Fritz, 2017). For Mexican American women, the rate of adherence to DSM activities was lower than that of women of other Hispanic descent and they had a higher rate of poor glycemic control. It is speculated that the lower rate of adherence to DSM activities is due to poor support, a stressful environment, and unhealthy behaviors. Acculturation is also to blame as those who have acculturated are more sedentary and have poor nutrition habits (Mansyur et al., 2016)

Definitions

Acculturation: The process by which immigrants adapt to the culture of their host nation. A higher level of acculturation has been associated with worse eating habits with a higher intake of fast foods and fatty, caloric meals (Becerra, Mshigeni, & Becerra, 2018).

Diabetes Mellitus: Diabetes Mellitus (diabetes) is a chronic condition, in which the body is unable to process food into energy, leading to an excess amount of glucose circulating in the blood stream (Centers for Disease Control and Prevention (CDC), 2017a).

Diabetes Self-Management activities: A combination of activities, which contribute to improved glycemic control and the potential mitigation of diabetes-related complications (Fan & Sidani, 2018; Schmitt et al., 2016, Schmitt et al., 2013; Lu, Xu, Zhao, & Han, 2016). Activities include healthy eating, having an active lifestyle, glucose monitoring, adhering to medication, learning how to cope with your disease, problem solving, and minimizing risks (Parkin et al., 2009; Yang et al., 2015; Lu et al., 2016).

Food Insecurity: Food insecurity refers to households with limited or no access to nutritious food (Ippolito et al., 2016; Burke, Martini, Çayır, Hartline-Grafton, & Meade, 2016; Lyles, C. et al., 2013; Seligman et al., 2015).

Gestational Diabetes: Diabetes that occurs during pregnancy. While this typically resolves once the baby is born, it may predispose some women of developing type 2 diabetes later in life (HHS, n.d.).

Low income: Taxable incomes, which do not exceed 150% of the poverty level. For a family of four, the low-income rate for an individual living in the 48 contiguous states, DC, outlying jurisdictions, Alaska, and Hawaii was between $37,000 and $47,000 (DOE, 2018).

Type 1 Diabetes: In type 1 diabetes, the immune system attacks the pancreatic cells making them unable to produce insulin. This form of diabetes is far less common and is seen in less than 5% of the diagnosed cases of diabetes. It is most commonly diagnosed in children and young adults (U.S. Department of Health and Human Services (HHS), n.d.).

Type 2 Diabetes: This is the most common form of diabetes occurring in 95% of patients who are diagnosed with diabetes. In type 2 diabetes, the body is able to manufacture insulin but is unable to use it efficiently. Type 2 diabetes typically occurs later in life and can be treated with diet modifications, exercise, and medication (ADA, 2015). *Throughout this paper, when I refer to diabetes I am referring to type 2 diabetes, unless otherwise stated.*

Assumptions

The study was based on several assumptions. One assumption was that the majority of the study population had type 2 diabetes. The BRFSS does not differentiate between type 1 and type 2 diabetes in their survey questions. Since type 1 diabetes accounts for only about five percent of all cases of diabetes, we can assume the majority of this study population had type 2 diabetes. Additionally, by excluding insulin users from the study, those with type 1 diabetes were also excluded as insulin is a mandatory treatment (ADA, n.d.). As of 2011, the BRFSS survey uses both landlines and cellular phones to conduct their interviews (CDC, 2016; Iachan et al., 2016), which brings about the possibility of duplicate data. Another assumption was that the strict weighting process employed by the BRFSS accounts for this phenomenon so that each respondent was counted only once (CDC, 2016).

As this study was conducted with secondary data, a third assumption was that the data were collected and processed responsibly according to good clinical practice guidelines. The assumption was also made that respondents answered truthfully as the responses were all self-reported. Lastly, there was an assumption that all races were well represented in the sample population.

Scope and Delimitations

The study population included adult women aged $\geq$18 years who participated in the 2017 BRFSS dataset and were told they had diabetes, identified that they lived in a food insecure household, and had an income level less than $50,000. According to the HHS poverty guidelines, individuals with income less than 150 percent of the poverty

line were considered “low-income individuals” (DOE, 2018). As of January 2018, the low-income level for a family of four living within the contiguous United States, Alaska, and Hawaii was between $37,650 and $47,070 (DOE, 2018). This study excluded patients with gestational diabetes, as this is a transient condition. Those on insulin were also excluded as previous research suggests that insulin users practice higher levels of DSM activities (Chen et al., 2014; Johnson et al., 2014), which could bias the results. Men were excluded from the study population as women tend to have a higher burden when it comes to food insecurity and their ability to manage their own DSM activities. Women, as caregivers, tend to manage family members’ needs prior to their own leaving them more vulnerable to the complications of poor DSM activities (Holben & Marshall, 2017). The generalizability of this study is limited to women and those whose diabetes is not severe enough to advance to using insulin. Additionally, the use of the BRFSS dataset may further limit the generalizability of results to the general population as evidence suggests a lower participation rate for areas where there is a greater African American and Hispanic population and results may not be truly reflective of the overall population (Chen et al., 2014).

Significance

The purpose of this study was to determine whether risk factors of income status and food insecurity influenced DSM practices and whether there was any association with race when food insecurity and low-income were constant in women with diabetes. While there are studies, which highlight the disparities in DSM activities across gender, race, and income, none focus on race as the sole predictor of a low level of compliance to

self-management when gender, income, and food security status are equal. In 2014, Johnson et al. used the 2011 BRFSS survey data to investigate racial differences and the impact of using insulin on DSM activities. Their study did not take into account the impact of income or food security status. The current study was the first to investigate whether there were racial differences in DSM activities when food insecurity and income level were held constant. This was also the first study to use the latest BRFSS data from 2017, where both food insecurity and DSM activities were assessed in the US population. Building upon the existing data, the results of this study will contribute to the literature in three specific ways. First, the results may help provide a better understanding of the differences in DSM practices and aid in the development of more tailored interventions. Second, the significance extends to providing additional data, which allows other researchers to determine which ethnic groups may require additional support and further education. Lastly, the results of this study could lead to positive social change and has the potential to lead to improved diabetes-related outcomes in this study population, such as improved glycemic control and reduced risk of morbidity and mortality.

Summary and Conclusions

In this Section, I reviewed some of the key variables, which influence DSM activities. DSM activities have been shown to improve outcomes for patients with diabetes (Beck et al., 2017; Katula et al., 2017; Haw, Narayan, & Ali, 2015; Fan & Sidani, 2018; Schmitt et al., 2016, Schmitt et al., 2013; Kamradt et al., 2014; Lu, Xu, Zhao, & Han, 2016). I also conducted an extensive review of the literature and provided the reader with important background information on why these variables, such as

gender, income, food security status, and race, may influence the level of DSM activities. Among these data, many investigators described effective ways to address existing disparities but also brought awareness to some of the gaps, which still exist in the literature. This study addresses these gaps, which included investigating whether there were racial differences among women with diabetes who were food insecure with low-income. The next section will go into more detail on the research design and methodology as well as the rationale for design choice. The data analysis plan will be addressed and I will discuss some of the potential threats to the validity of the data. Finally, in Section 2, I will summarize the design and methodology before presenting results in Section 3.

Section 2: Research Design and Data Collection

Introduction

The purpose of this study was to determine whether income and food insecurity influenced DSM practices and whether there was an association with race when food insecurity and low-income were constant among women diagnosed with diabetes. In Section 1, I provided an overview of the latest literature, which supports the need for public health professionals to further explore this subject. I also provided my research questions, theoretical foundation for the study, nature of the study, assumptions, scope and delimitations, the significance of the study, and its potential contributions. In this section, I will go into detail regarding the design and rationale for the study, methodology (inclusive of the target population), approximate size of the population, sampling strategy, inclusion/exclusion criteria, and power analysis. This section will also include instrumentation, operational definitions of each variable, and an explanation regarding how the data analysis plan was conducted. Lastly, I will describe any internal or external threats to the validity of the data and explain the ethical procedures to secure the dataset and how the secondary data were collected.

Research Design and Rationale

The independent variables for this study were food insecurity, low income, and race. I determined if any of these variables had an impact on the dependent variable, DSM activities. The specific DSM activities included the five BRFSS diabetes self-care activities: blood glucose monitoring, smoking status, home foot checks, physical activity, and nutrition intake as assessed using the 2017 BRFSS dataset. For RQ1, I investigated

how food insecurity as the independent variable influenced DSM activities in low-income women with diabetes. RQ2 investigated how low income influenced DSM activities in food insecure women with diabetes. Because both food insecurity and low income may be confounding variables, RQ3 investigated whether race influenced DSM activities in food insecure low income women with diabetes. According to Aschengrau and Seage (2014), one way to control for confounders is to match them within the study population and have an equal distribution in each group.

This was a cross-sectional study using secondary data from the 2017 BRFSS. In addition to the core set of questions found in each state's survey, the 2017 dataset was the most recent survey to include questions on both food insecurity and diabetes self-management activities in the optional modules. Each state has the option to include questions in a separate modules, which pertain to specific health-related issues, such as high prevalence of diabetes, food insecurity, or flu outbreak. The approach I used to determine which data source I would employ involved both research-driven and data-driven methods. Having research questions in mind, I searched for appropriate datasets. I also reviewed the variables within the dataset to determine other research questions I could pose. According to Cheng and Phillips (2014), research-driven and data-driven approaches are often used together allowing for adjustments to the initial research question or questions as indicated. The use of secondary data offers the advantage of being an efficient and low-cost way to conduct research. The data collection and data cleaning processes of the secondary dataset are already detailed, allowing for ready-to-use information. To the contrary, secondary data may be a challenge to use as the data

was collected to address different research questions and variables selected in the secondary dataset may not be suitable for your specific question or questions (Cheng & Phillips, 2014). The BRFSS dataset was appropriate to use with this study as the data were collected to assess chronic conditions such as diabetes, and look at different health risk behaviors in an effort to target health related activities and develop activities geared towards improving health. Additionally, the BRFSS survey has been recognized as a reliable and valid source of information when looking at health related issues (Pierannunzi, Hu, & Balluz, 2013).

Methodology

This study employed a cross-sectional quantitative analysis of secondary data using the 2017 BRFSS dataset. This was the most recent dataset to include survey questions on food insecurity status and DSM activities. The BRFSS is a state-wide telephone survey which uses both landline and cellular phones of adults across the US (Chowdhury et al., 2016; Iachan et al., 2016; Johnson, Richards, & Churilla, 2015; Santorelli, Ekanayake, & Wilderson-Leconte, 2017).

Population

The targeted study population included adult women aged 18 and older living in households within Florida, Georgia, Iowa, Kentucky, New Hampshire, Pennsylvania, Wisconsin, and Wyoming. Those states included modules with questions on diabetes status as well as food insecurity status. These individuals also had self-reported diabetes and indicated they were food insecure. Food insecurity status was determined by selecting individuals who answered either often true or sometimes true to the questions

"The food that I bought just didn't last, and I didn't have money to get more" or "I couldn't afford to eat balanced meals". I also targeted low-income individuals with a reported income of less than $50,000 and those who identified in the survey as being one of the following races: Hispanic, which included those who identified as Hispanic, Latino/a, or of Spanish origin, White, Black or African American, American Indian or Alaskan Native, Asian, and Native Hawaiian or other Pacific Islander. Men, those who were on insulin, and those who reported they had gestational diabetes were excluded from the study population. The final study sample was 1,842 low income women with diabetes and food insecurity.

Sampling and Sampling Procedures

As of 2011, the BRFSS started to collect data not only by landline, but by cellular telephone as well. With the landline telephone, survey questions were asked to a randomly selected adult living in each household called. For cellular telephones, survey questions were asked to the adult answering the cellular telephone provided they lived in a private residence or college housing, and they were noninstitutionalized and 18 years of age or older. Random digit dialing was used for both types of phone.

For landline sampling, a disproportionate stratified sample (DSS) design was used in all states excepting Puerto Rico and Guam where a simple stratified sample (SSS) design was used. Telephone numbers were divided into two groups, high-density or medium density, which were then sampled separately. Density is determined by how many listed numbers are in the same area code. A probability sample was obtained then, each telephone number was randomly selected and all responses were self-reported.

Each state conducts its own interviews through its health department directly or an external contractor. For the 2017 survey, only eight of the state's health departments collected the data while the remaining states employed external data collectors. It is important that each interviewer is properly trained and complies with BRFSS interview process guidelines. The CDC has the option to evaluate them for their performance. The surveys collect data at the state and county level to target health-related activities and develop activities geared towards improving health. At the state level, the survey results have been used to address relevant health issues such as the flu and fallout from natural disasters (CDC, 2014). Interviews are conducted 7 days a week each month throughout the calendar year (CDC, 2018b).

To maintain consistency throughout the interview and data collection process, there are certain standards each state must adhere to. The BRFSS survey contains nine steps, which must be followed throughout the process. These steps in the protocol include that the core questions must be asked without modification, all interviewers must partake in electronic monitoring and may ensure the quality of the data by using a callback verification process. Each state must use the stated definition of an eligible household, which is either a housing unit with a separate entrance, occupants eat separately from others on the property, it is a principle or secondary place of residence, or it may not be a vacation home, group home, or institution. Additionally, the steps include that all related or unrelated adults 18 or older are considered eligible if they consider the household their home and there are no proxy interviews conducted. For landline telephones, respondents are randomly selected from the adults aged 18 or older who live in the house and for

cellular telephones, the interviews are conducted with the respondent who answers the call. A completed interview must have data for age, race, and sex and if these values were not collected, the data are imputed and used to assign weights. Lastly, verification of responses in a 5% random sample is required for quality assurance in the event electronic monitoring of interviewers is not conducted regularly, eligible persons are given at least one additional opportunity to respond to be interviewed in the event they initially refuse, and a final disposition is required for each state for each number in the sample.

In order to ensure the sample data are more representative of the population of adults in the US living in different states, the data are weighted. The weighting takes into account design factors and adjustment of the population demographics (CDC, 2018b). Up until 2011, the CDC used the post stratification method to weight the BRFSS survey data; however, this method changed in 2011 once they started using both landline and cellular telephones. Since then the weighting method used is iterative proportional fitting, or raking (CDC, 2018b; Iachan et al., 2016). This new process offers the advantage of introducing more demographic variables into the weighting process reducing bias and increasing representation. This process allows for the type of telephone used; landline or cellular, into the weighting process and allows for a more representative sample and minimizes the nonresponse bias (CDC, n.d.).

Power Analysis

Calculating statistical power is important to determine the probability of rejecting a false null hypothesis (Mayr, Buchner, Erdfelder, & Faul, 2007). Mayr et al. (2007) posited that interpreting nonsignificant results can be a challenge. When a power analysis

is done prior to the start of the study (a priori), there is better control for both type-1 and type-2 errors (Mayr et al., 2007). A type 1 error is when the null hypothesis is rejected when it is actually true. A type 2 error occurs when an association is missed and the null hypothesis is actually false (Aschengrau & Seage, 2014). According to Bausell and Li (2002), the effect size is a way to measure how likely the study's relationship truly is. In other words, how likely are the results of the study to have a significant difference. When seeking to determine the effect size of an association between two variables, Bausell and Li (2002) suggested using the Pearson *r*, which is used to measure associations between two variables. Based on power analysis using G*Power calculator version 3.1.9.2, I estimated the required sample size to be at a minimum of 145 with a medium effect size (ES) of .30, α error probability of 0.05, 95% Power (1-β error probability), and Degrees of Freedom = 1. Conducting a pilot study was not an option to determine effect size and there was limited detailed information on effect size from the available literature; therefore, effect size for this study was determined using Jacob Cohen's effect size recommendations, which stated that barring any specific insights, the recommended effect size should be medium (0.50 SD units) (Bausell & Li, 2002).

Instrumentation and Operationalization of Constructs

The BRFSS collects data from each of the 50 states, the District of Columbia, Guam, and Puerto Rico. The objective is to collect data that are uniform, so that information on factors including health status, chronic health conditions, seat belt use, exercise, and cancer screenings, to name a few, may be provided (CDC, 2018b; Chowdhury et al., 2016). The data are collected by each state's health department or a

contractor and processed, edited, weighted, and analyzed by the CDC. The processed data and summaries for each year are then provided back to the state departments and used to design public health programs, identify disparities in health behaviors, and address emerging health issues (CDC, 2018b).

As one of the largest telephone surveys to collect data on health-related behavior, the BRFSS consists of three different components, which are agreed upon by the BRFSS coordinators and the CDC. These components include the core component, optional modules, and specific questions. The questions within the core component are common to all states and cannot be altered. The optional modules have different topics and may vary from state to state and by year. The specific questions are added by individual states to gather more state specific information, such as questions about getting the flu vaccine (CDC, 2018b). Some of the questions are common among other national surveys, which allow states to compare their data to data from other surveys. Questions from the National Health Interview Survey and The National Health and Nutrition Examination Survey are just two of the established surveys from which BRFSS gets its questions, offering the advantage of using questions, which have already been validated (CDC, 2018b). When new questions are proposed, they must be tested and pass a state vote before becoming part of the BRFSS survey (CDC, 2018b). The data from the survey provide information on health risk factors, which incorporate a large geographical area and a diverse population; making the BRFSS an appropriate dataset for this study. The 2017 BRFSS survey is also the most recent survey to contain optional modules with

questions on diabetes status and food insecurity in eight states. These two modules are not part of the core component of the survey and are not available for each year surveyed.

The reliability of the BRFSS survey has been evaluated in numerous studies. The new weighting system incorporating cell phone data and new variables of education, marital status, and home ownership prompted a systematic review by Pierannunzi, Hu, and Balluz (2013). Pierannunzi et al documented examples of the reliability and validity of the BRFSS data among 10 different categories including health care access, immunization and preventive testing, physical activity, chronic conditions, mental health measures, obesity, tobacco use, alcohol/substance abuse, health risk and sexual behavior, and injury and violence. Of the 32 reliability and validity tests they reviewed from the literature, the BRFSS had an overall assessment of high reliability and validity among the topics of access to health care, immunization and preventive testing, physical activity, and chronic conditions. Other topics such as mental health measures, obesity, tobacco use, alcohol/substance abuse, health risk and sexual behavior, and injury and violence were moderate. Higher reliability scores were reflective of the quantity of published research, where the authors used repeated test/retest measures, where multiple samples were used, and where the data was collected at multiple time periods. The use of statistical tests rather than a simple comparison of prevalence estimates also garnered a higher score. The bar for higher scores on validity was when BRFSS data was compared to physical measures rather than to just self-reported measures (Pierannunzi et al., 2013).

Operationalization of Variables

The independent variables that were analyzed in this study included low income, food insecurity status, and racial identity. The dependent variable that was analyzed was DSM activities, which included blood glucose monitoring (BGM), smoking status, home foot checks, physical activity, and three components of nutrition intake; fruit, vegetable, and fried food intake. The variable of low income was based on the 2017 BRFSS survey question "Is your annual household income for all sources". Categories of Less than $10,000, Less than $15,000 ($10,000 to less than $15,000), Less than $20,000 ($15,000 to less than $20,000), Less than $25,000 ($20,000 to less than $25,000), Less than $35,000 ($25,000 to less than $35,000), and Less than $50,000 ($35,000 to less than $50,000) (CDC, 2018b) were combined into a new variable of Low Income. For food insecurity status, I used the survey questions The food that I bought just didn't last, and I didn't have money to get more and I couldn't afford to eat balanced meals. The responses to these questions were Often true, given a value of 1, Sometimes true, given a value of 2, or Never true for you in the last 12 months, given a value of 3. These were computed to form a new variable Food Secure Status and dichotomized to either Food Insecure (1), which included scores of one through five, or Food Secure (2), which included a score of six. The only way to be deemed food secure was to have answered *never* to both questions, giving a total score of six when computed. Those who responded with Don't know/Not sure and Refused were considered missing data.

The activities used to determine level of DSM activity were dichotomized and then computed to indicate *good* versus *poor* level of DSM activity (LevelDSMact). For

BGM, if respondents indicated they were checking their blood glucose daily, they were given a score of 1. Those who checked their blood glucose xx Times per week, xx Times per month, xx Times per year, and Never were combined into one variable of Not daily BGM and given a score of 2. Don't know/Not Sure/Never/Refused were excluded as missing data. For smoking status, the calculated variable Current Smoking Calculated Variable was used and renamed as SmokeStatus with the dichotomous values of Not Current Smoker (1) and Current Smoker (2). Don't know/refused/missing were excluded as missing data. For home foot checks, the variable was renamed as FeetCheck and the categories were recoded. Daily and Weekly feet checks were combined and renamed as Meet feet check and given the value 1; Monthly, Yearly, No Feet, Never were combined and renamed as Not meet feet check and given the value 2; and those with Don't know or Refused were treated as missing data and excluded from analysis. For physical activity, I used the calculated variable for Physical Activity Index, which determined whether participants Meet aerobic recommendations (1) or Did not meet aerobic recommendations (2). Those with responses Don't know or Refused were excluded as missing data.

There were three components used for nutrition intake; fried food intake (FriedFood); vegetable intake (GreenVeggies), and fruit intake (EatFruit). Participants with either daily or weekly fried food intake were combined into a new category Regular fried (2) and those with fried food intake of less than once a month, months per year, or never eat were combined to form a new category Limit fried (1). Vegetable intake was combined and recoded, whereby participants with daily or weekly intake were given a

code of 1 and renamed Meet veg req. Participants with intake less than once a month, months per year, or never eat were combined to form a new variable Not meet veg req and given the code 2. Fruit intake was combined and recoded in the same way as Meet fruit req (1) and Not meet fruit req (2). Responses Don't know or Refused were excluded as missing data.

Each of the activities was dichotomized and coded to determine positive (1) or negative (2) activities. A positive activity was reflective of engaging in the recommended DSM activity or avoiding an unhealthy activity such as smoking or eating fried foods. The dichotomized activities were then computed under the new variable LevelDSMact and a median value was obtained. Scores that were equal to or less than the median score, 9, were considered Good level DSMact *(1)* and scores greater than the median value were considered Poor level DSMact *(2).* Race was defined as *Hispanic*, which included those who identified as Hispanic, Latino/a, or of Spanish origin; *White, Black or African American, American Indian or Alaskan Native, Asian,* and *Native Hawaiian or other Pacific Islander*.

Research Questions

RQ1: Is food insecurity associated with DSM activities in low-income women with type 2 diabetes?

$H_0 1$*:* There is no association between food insecurity and DSM activities in low-income women with type 2 diabetes.

$H_a 1$*:* There is an association between food insecurity and DSM activities in low income women with type 2 diabetes.

RQ2: Is low income level associated with DSM activities in food insecure women with type 2 diabetes?

$H_0$2: There is no association between low income level and DSM activities in food insecure women with type 2 diabetes.

H_a2: There is an association between low income level and DSM activities in food insecure women with type 2 diabetes.

RQ3: Is there an association between race and DSM activities among low income food insecure women with diabetes as measured by frequency of diabetes self-care activities?

$H_0$3: There are no racial differences in terms of DSM activities among low income food insecure women with type 2 diabetes.

H_a3: There are racial differences in terms of DSM activities among low income food insecure women with type 2 diabetes.

Data Analysis Plan

All data analyses were carried out using IBM SPSS Statistics version 25. I used descriptive statistics calculated as frequencies and percentages and chi-square statistics (χ^2) to determine the association between food insecurity and DSM activities, controlling for low income for RQ 1. For RQ2, the association between low income and DSM activities was tested using the χ^2 statistic, controlling for food insecurity. Lastly, RQ3 employed the χ^2 statistic to determine the association between race and DSM activities, controlling for both food insecurity and low income. For RQ1, which was the only RQ to show a statistically significant association, a binary logistic regression model was used to

confirm the association. Age, food security, and race were used as covariates in the model.

Food insecurity, low income, and race were all treated as control variables as each could be considered plausible contributors or *rival hypotheses*. A rival hypothesis is another possible explanation for potential findings (Berman & Wang, 2018). For RQ1, the samples were divided into two groups, those with food insecurity and low income and those with food insecurity and not low income. RQ2 and RQ3 followed that same logic. If in RQ1 low income determines the level of DSM activity, rather than food insecurity, there will be no difference in the level of DSM activity when income stays the same. The chi-square test was appropriate to determine whether a significant relationship exists between two variables, which can be either nominal or ordinal (Frankfort-Nachmias & Leon-Guerrero, 2015). For this study, the following assumptions were made to determine that the chi-square test was appropriate: a random sample was selected; low income, food insecurity, and racial identity were all nominal variables; each DSM activity was a nominal variable; and level of DSM activity was recoded as a binary ordinal variable *good* or *poor* level of DSM activity.

While the chi-square test can determine whether an association exists, it cannot show the strength of the association (Frankfort-Nachmias & Leon-Guerrero, 2015; Gertsman, 2015). Since the results only showed a significant association between the variables food insecurity and DSM activities in RQ1, the Cramer's *V* statistic was used only with that RQ to show the strength of the association. A strong association would be

indicated by a value of, or close to, one and a weak association would be indicated by a value of zero or close to zero (Frankfort-Nachmias & Leon-Guerrero, 2015).

Threats to Validity

Aschengrau and Seage (2014) posited that even if you have calculated and determined a measure of association, you still need to validate that your observed results are true and that they can be generalized outside of the study population. For the results to have internal validation, you must have already eliminated any bias, confounding, and random error. In the event none of these contributes to the outcome, a true association may be assumed (Aschengrau & Seage, 2014). Threats to the internal validity of a study are centered on the ability of the researcher to draw appropriate conclusions about the population. Some internal validity threats include the occurrence of historical events, maturation of study subjects, and selection process in general, which could bias the results (Creswell, 2009). Creswell (2009) also defined threats to external validity as those, which erroneously apply to the generalizability of the results to other settings when they should not be. Examples of threats to external validity include the assumption that the setting and participants in one study are similar to the setting and participants in another (Creswell, 2009).

Pierannunzi et al. (2016) investigated the internal and external validity of the BRFSS small area estimation method (SAE), which was a new way to model prevalence estimates that were reliable. In their study, they measured internal validity by the reproducibility of the point estimates for BRFSS prevalence. For external validity, they

wanted to ensure the prevalence estimates were similar to those from different datasets (Pierannunzi et al., 2016).

Some potential threats to internal validity in this study included the nature of the method for collecting data. All data were collected via telephone survey and were not cross referenced with the respondent's medical records. Respondents were asked if they had ever been told they had diabetes, to which they were to respond with *yes, no,* or *I don't know*. Other variables of interest, such as smoking status, physical activity, BGM, home foot checks, and nutrition intake all relied on the respondent's recall of their behavior and their penchant for being truthful in their response.

External validity could be threatened by the simple nature of the inclusion and exclusion criteria. The study was limited to women with diabetes who lived in the eight states, which included the modules with both diabetes and food insecurity questions. These results may not be generalizable to the entire population. To account for these threats, the BRFSS survey started to employ a new weighting method called raking to adjust for nonresponse bias and allow for additional demographic variables to be included. This new method also increased the representativeness of the estimates (CDC, n.d.; CDC, 2018b).

Ethical Procedures

Before gaining access to the BRFSS dataset, I obtained Institutional Review Board (IRB) approval through Walden University's Ethics review process with an IRB approval number 01-16-19-0627914. According to the Walden review process, all research was in compliance with the ethical standards of Walden University and U.S.

federal regulations. No data was collected prior to obtaining IRB approval through Walden University's office of Research Ethics and Compliance (OREC). I determined the appropriate forms, approvals, and IRB steps in order to be in compliance with all regulations and policies through the OREC. The data in the BRFSS survey are in the public domain and did not require IRB approval from the CDC. The data may be reproduced without permission and will be acknowledged that the CDC's BRFSS was the original data source (CDC, 2018a). Additionally, the Data User Agreement (DUA) for the CDC's National Center for Health Statistics (NCHS) warns that any data collected by the NCHS may only be used for the purpose of statistical reporting and analysis. The DUA also warns of the protection of the identity of the data subjects. The identity may not be disclosed and any identifier must be omitted from the dataset. If any identifiable features are discovered inadvertently, the DUA instructs that the user of the data advise the Director of the NCHS (CDC, 2015). In the process of analyzing the data, I complied with the DUA and did not intentionally or unintentionally use data, which may have been compromised. I also ensured that the data was held only by me on a private thumb drive and was not shared with anyone aside from the IRB and my committee.

Summary

In this section I described the methodology for this cross-sectional study and the rationale for choosing the 2017 BRFSS survey data to investigate how food insecurity, income level, and race are associated with DSM activities in women with diabetes. I described the study population, sampling procedures, research design, data analysis, and the method for determining the approximate sample size. I also discussed the

operationalization of the variables and the data analysis plan, including statistical tests and methodology for data cleaning. Lastly, I reviewed the potential threats to internal and external validity and discussed the ethical procedures I followed before extracting the data. In my next section, I will provide a presentation of the results and my findings.

Section 3: Presentation of the Results and Findings

Introduction

The purpose of this study was to determine whether income status, food insecurity, or race influence DSM practices in women with diabetes. In this section, I will present the results and findings of my data analyses. I will describe the characteristics of the sample population and the data collection process. The results of each analysis performed will be presented in table and text formats, and I will conclude the section with whether I accept or reject my null hypotheses.

Data Collection of Secondary Data Set

The data were collected from the BRFSS 2017 survey. Since the study was focused on low-income women aged 18 and older with diabetes and food insecurity, I first reviewed the codebook to determine which variables would be appropriate to analyze. The full dataset included a total of 450,016 survey participants. After selecting for only women with reported diabetes, the number of participants was reduced to 32,944. To ensure that only participants with type 2 diabetes were selected, I excluded those who reported taking insulin, as that is a mandatory treatment for those with type 1 diabetes. Taking insulin also has been shown to improve DSM activities and had the potential to bias the sample. I then selected participants who reported an income of less than $50,000 and those who resided within the eight states who used modules with both diabetes and food insecurity questions. The final sample size was 1,842 participants, of which 505 had both food insecurity and low income.

Discrepancies in the Data Set

Population Sample Size

The sample size of 5,020 participants reported in Section 2 was derived from a cursory calculation using the 2017 BRFSS Codebook. This number was loosely based on the percentage of women aged 18 and older with reported diabetes who were not taking insulin, had an income of less than $50,000, and lived in one of the eight designated states. This number did not take into account those who were also considered food insecure based on their response to two of the survey questions. The true sample size could only be measured once access to the dataset was achieved. The a priori sample size was estimated at 145 with a medium effect size (ES) of .30; however, a post-hoc power analysis using G*Power calculator version 3.1.9.2 indicated that the obtained sample size of 1,842 using an ES of .618 (see Table 6) and an error probability of 0.05 achieved a satisfactory statistical power of 98.5%.

Descriptive Characteristics of the Sample Population

The sample population consisted of 1,842 low-income women, defined as women with a reported income of less than $50,000 who reported a diagnosis of diabetes. The sample was pulled from the states of Florida, Georgia, Iowa, Kentucky, New Hampshire, Pennsylvania, Wisconsin, and Wyoming, as these were the only states to include modules with questions on diabetes and food insecurity status. The majority of the women, 58% (*n* = 1,069), were 65 or older, and 764, or 41.5%, were between the ages of 18 and 64. The sample also consisted of 74% White non-Hispanic women, 15.5% Black, non-Hispanic women, 6% Asian women, 1.7% American Indian/Alaskan native women, 5.8% Hispanic

women, and 2.7% other non-Hispanic women. Categorical variables were recorded as frequencies and percentages and are shown in Table 1.

Table 1

Demographic Characteristics (N=1,842)

Variable	Category	*N*	%
Race	White, Non-Hispanic	1363	74.0
	Black, Non-Hispanic	286	15.5
	Asian, Non-Hispanic	6	.3
	American Indian/Alaskan Native	31	1.7
	Hispanic	107	5.8
	Other, Non-Hispanic	49	2.7
Age	Age 18 to 64	764	41.5
	Age 65 or older	1069	58.0
	Missing/Don't Know/Refused	9	.5
State of Residence	Florida	682	37.0
	Georgia	208	11.3
	Iowa	172	9.3
	Kentucky	252	13.7
	New Hampshire	125	6.8
	Pennsylvania	164	8.9
	Wisconsin	127	6.9
	Wyoming	112	6.1

Representativeness of the Sample

The sample may not be representative of the overall U.S population. First, the sample consists only of low-income women and does not account for low-income men, moderate or high-income women, or men who have diabetes. Second, according to the U.S Census (2017), the percentage of Hispanics, which was 18.1%, exceeded the

percentage of Black non-Hispanics (13.4%) by 5%. In the study sample, the prevalence of the Black non-Hispanic population was 10% greater than the Hispanic population. This could be due to the demographics within the eight states not being representative of the overall population. Lastly, this study only included states that had modules on diabetes and food insecurity. Each state may choose to ask survey questions in modules outside of the core modules to obtain additional information about its population. It is possible these eight states were predisposed to a higher prevalence of diabetes and food insecurity than the rest of the country, which could have biased the sample.

Bivariate Characteristics of the Sample

Bivariate analyses were performed using cross tabulations in SPSS for each of the three research questions. For each analysis, 505 low-income, food insecure women with diabetes were analyzed to determine whether there was an association with DSM activities. RQ1 addressed whether there was an association between food insecurity and DSM activities in low-income women with type 2 diabetes. RQ2 assessed the association between low income and DSM activities among food insecure women with type 2 diabetes. For RQ3, cross tabulation was used to assess whether there was any association between race and DSM activities among low-income food insecure women with diabetes (see Table 2).

Table 2

Characteristics of Level of DSM Activity (N=1,842)

	Poor Level DSMact		Good Level DSMact			
Characteristic	N	%	N	%	χ^2	*P*
Food	226	44.8%	279	55.2%	48.99[a]	.000

insecure							
Low income		249	49.3%	256	50.7%	.220[b]	.639
Racial identity	White, non-Hispanic	173	51.0%	166	49.0%	4.98[c]	.418
	Black, non-Hispanic	35	39.3%	54	60.7%		
	Asian, non-Hispanic	1	50.0%	1	50.0%		
	American Indian/Alaskan Native	5	62.5%	3	37.5%		
	Hispanic	27	54.0%	23	46.0%		
	Other, non-Hispanic	8	47.1%	9	52.9%		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 146.39.
b. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 14.23.
c. 4 cells (33.3%) have expected count less than 5. The minimum expected count is .99.

Study Results

RQ1

RQ1 asked how food insecurity was associated with DSM activities in low-income women with type 2 diabetes. The null hypothesis was there is no association between food insecurity and DSM activities. The alternate hypothesis was there is an association between food insecurity and DSM activities in low-income women with type 2 diabetes.

Statistical Assumptions and Findings

The chi-square test is a test for independence and is appropriate to determine whether a relationship exists between two nominal or ordinal variables (Frankfort-Nachmias & Leon-Guerrero, 2015). I conducted a Pearson's Chi-Square test to examine

whether the observed count of food insecure individuals with good or poor DSM activities was significantly different from the expected count. An observed difference would determine whether the association was dependent. The results of the test showed there was a difference between the observed and expected counts with a p value < 0.0001 (Table 3). In other words, the results of the Chi-Square test showed there is very strong evidence of a relationship between food insecurity and level of DSM activities (Chi-Square = 48.99, df – 2, $p < 0.0001$). Therefore, I can reject the null hypothesis that there was no association between food insecurity and DSM activities. The strength of the association as measured by Cramer's V (Table 4) was small to moderate.

Table 3

Cross Tabulation for Food Insecurity and DSM Activity

		Level DSMact		
		Poor level DSMact	Good Level DSMact	Total
Food Insecure	Count	226	279	505
	Expect count	197.7	307.3	505

Note. $\chi^2(2) = 48.99$, $p < 0.0001$

Table 4

Symmetric Measures

Low_Income			Value	Approximate Significance
< 50,000	Nominal by Nominal	Phi	.163	.000
		Cramer's V	.163	.000
	N of Valid Cases		1842	

The results of the Chi-Square model revealed there is significant evidence that an association between food insecurity and DSM activities exists. To determine what the drivers of the association were and account for potential confounders, such as age, I conducted additional testing with binomial logistic regression analysis. For the analysis, DSM activities was the dependent variable and food insecure status, race, and age were covariates. Food insecure status was used as the reference value. The Nagelkerke R^2 value was 0.49, suggesting that 49% of the variation in the dependent variable of DSM activities can be explained by this model. The regression coefficient for both reported age and food secure status were significant (Table 5), Wald=21.479, $p < 0.001$, OR=.584 and Wald=16.422, $p < 0.001$, OR=1.618; respectively. This indicated that low-income women who were between the ages of 18-64 had .584 times the odds of having a good level of DSM activities than low-income women of ≥65 years. Low-income women who were food secure had 1.618 times the odds of having a good level of DSM activities than those who were food insecure. The regression coefficient for race/ethnicity did not reveal significant results as shown in Table 5.

Table 5

Binary Logistic Regression for Food Insecurity Predicting DSM Activities

Predictor	*B*	*SE*	Wald	*P*	OR	95% CI for OR
Food Secure (reference: Food insecurity)	.481	.119	16.422	< .001	1.618	[1.282 to 2.041]
Race/Ethnicity	.073	.044	2.838	.092	1.076	[.099 to 1.172]
Age: 18-64 y (reference: ≥ 65 y)	-.538	.116	21.479	< .001	.584	[.465 to .733]

RQ2

RQ2 asked how income level was associated with DSM activities in food insecure women with type 2 diabetes. The null hypothesis was that there was no association between income level and DSM activities and the alternate hypothesis states that there is an association between income level and DSM activities. In order to determine if the null hypothesis could be accepted, a Peason's Chi-Square statistical test was conducted. The results of the analysis, shown in Table 3, did not yield a significant result ($p > 0.05$) indicating there was no association between income level and DSM activities in food insecure women with type 2 diabetes, failing to reject the null hypothesis. No further statistical analyses were performed.

Research Question 3

In the third research question, cross tabulation and Pearson's chi-square test were used to determine if there was an association between race and DSM activities among low income, food insecure women with diabetes. The null hypothesis states that there are no racial differences in DSM activities among low income, food insecure women with type 2 diabetes and the alternate hypothesis states there are racial differences in DSM activities among low income, food insecure women with type 2 diabetes. The results of the analysis indicated a non-significant *p*-value ($p > 0.05$) shown in Table 3; ensuing in a failure to reject the null hypothesis. No additional statistical tests were warranted.

Table 6

*G*Power Analysis for X^2 Test for Independent Samples*

Analysis:	Post hoc	
Input:	Effect Size w	= 0.618
	α err prob	= 0.05
	Total sample size	= 1842
	Df	= 2
Output:	Noncentrality parameter λ	= 703.504
	Critical χ^2	= 5.9914645
	Power (1-β err prob)	= 1.00000

Summary

In this section, I described the sample population and my efforts to collect the data, making note of any discrepancies from the plan described in Section 2. I also described how the sample population might deviate from the overall population. The purpose of this study was to determine whether income status, food insecurity, and race influence level of DSM activities in women with diabetes. In this section, I reported the results of the statistical analyses, which included the Pearson's chi-square test, Cramer's *V*, and binary logistic regression analysis.

For RQ1, which assessed whether there was an association between food insecurity and DSM activities in low-income women, chi-square test revealed a significant result with a p value < 0.001. Additional statistical testing using logistic regression analysis confirmed this result and I was able to reject the null hypothesis that there was no association between food insecurity and DSM activities. The results of the chi-square analyses for the second and third research questions, on the other hand, did not show a significant association ($p > 0.05$), leading to a failure to reject the null hypotheses

for those two research questions. No further statistical testing was indicated for RQ2 and RQ3.

In Section 4, I will interpret the findings in the context of the literature and the theoretical framework and will discuss the limitations of the study. I will also describe recommendations for future research and discuss implications for professional practice. Lastly, I will describe the potential impact for positive social change at the individual, family, organizational, and social levels.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

Diabetes affects more than 30 million people living in the US (CDC, 2017a). Prevalence varies by race, education, age, and income level, with disparities favoring poor and food insecure ethnic minorities (CDC, 2017b). Of all of the treatment options, DSM activities have been shown to prevent or delay complications and improve clinical outcomes for people with diabetes (Beck et al., 2017; Fan & Sidani, 2018; Haw, Narayan, & Ali, 2015; Kamradt et al., 2014; Katula et al., 2017; Lu, Xu, Zhao, & Han, 2016); however, not everyone can perform these activities to an adequate level and thus do not reap the benefits. The purpose of this study was to determine whether income status, food insecurity, and race influence DSM practices among women with diabetes.

A quantitative cross-sectional study using secondary data from the 2017 BRFSS survey was used to determine whether there were any associations between the independent variables of race, low income, and food insecurity and the dependent variable level of DSM activities in women with diabetes. The study was conducted to add to the current literature in three important ways. The first way was to provide a better understanding of differences in terms of DSM practices and aid in the development of more tailored interventions. The second way was to offer additional insights into potential unmet needs and third, to lead to positive social change, potentiating improved outcomes in this study population.

In this section, I will interpret my findings in the context of the current literature and theoretical framework. I will also discuss limitations and outline recommendations

for future research. Lastly, I will address implications for professional practice and the potential for social change.

Key Findings of the Study

While there are numerous studies which identify food insecurity, income level, gender, and race as contributors to level of DSM activity, this was the first study to explore these variables in the selected study population. The key findings of this study revealed that there was a significant association between food insecurity and level of DSM activities [$\chi^2(2) = 48.99$, $p < 0.001$] in low income women with diabetes, but not between low income, race, and level of DSM activities. Additional testing using binary logistic regression analysis confirmed the earlier statistical results indicating that low-income food secure women had 1.618 times the odds of having a good level of DSM activities than those who were food insecure (OR=1.618, 95% *CI*=1.282 - 2.041, $p <$ 0.001). There was also a significant association between the age of the participant and level of DSM activity whereby younger participants had .584 times the odds of having a good level of DSM activities compared to older participants (OR=.584, 95% *CI*=.465 - .733, $p < 0.001$).

Interpretation of the Findings

The independent variable of food insecurity was the only main variable to show evidence of a significant association with DSM activities. This finding is consistent with the literature that being food insecure can negate one's ability to adequately perform DSM activities (Gucciardi et al., 2014; Ippolito et al., 2016; Lyles et al., 2013). Heerman et al. (2016) suggested that there was a significant relationship between food insecurity

and some of the prescribed DSM activities in low-income individuals. This was driven by the inability of low-income individuals to follow diet and exercise recommendations, two components of DSM activities, and proper medication adherence (Heerman et al., 2016). Further, Holben and Marshall (2017) described the impact of food insecurity on adhering to prescribed DSM activities among women, especially as it relates to their dietary intake. Women, compared to men, were more vulnerable to inadequate intake of nutritious food. They were more likely to forego healthy foods, such as fruits and vegetables, when these items were scarce, so their children or other family members were not deprived.

When age was used as a covariate in the binary logistic regression model for food insecurity and DSM activities, it also showed significant predictive behavior. Women with diabetes who were 18-64 years of age had .584 times the odds of having a good level of DSM activities than those who were age 65 and older ($p < 0.001$). This is contrary to the notion that DSM activities are more challenging and more burdensome as people age. Older age can make DSM activities difficult to manage. Physical activity, handling medication, and monitoring blood glucose levels require a higher level of health literacy, which is potentially lacking in older individuals (McCaskill et al., 2016). Cognitive function, which tends to decline with age, also influences DSM activities, such as medication adherence, glucose monitoring, and the ability to respond appropriately to the results. Impaired cognitive function threatens to impair DSM activities by making it difficult to remember to take medication and to check blood glucose daily as prescribed (Tomlin & Sinclair, 2016).

Boakye et al. (2018) assessed DSM education and its association with sociodemographic and patient characteristics. They also selected three diabetes self-management behaviors: self-glucose monitoring, foot examinations, and physical activity, to determine if there was an association between them and DSM education. They noted that older age respondents were more likely to partake in DSM education than 18 to 54 year olds, and DSM education had a significant association with the DSM activities. Those who engaged in DSM education had 1.46 times the odds of being more physically active (95% CI, 1.37-1.56), 1.37 times the odds of conducting home foot checks (95% CI, 1.28-1.45), and 1.59 times the odds of monitoring their blood glucose (95% CI, 1.48-1.70) than respondents who did not engage in DSM education (Boakye et al., 2018). While the current study did not explore DSM education as a predictive independent variable for DSM activities, it is plausible to consider that the older aged participants in this study may have engaged in DSM education more than their younger aged counterparts, leading to the contrary results.

Regarding the independent variable low-income, there was no significant association with DSM activities. Not only do low income levels contribute to the increased burden of chronic disease and its complications (Mayberry, Berg, Harper, & Osborn, 2016; Nelson et al., 2014; Nelson et al., 2017; Page-Reeves et al., 2017; Spencer et al., 2018; Vissenberg et al., 2016; Willard-Grace et al., 2015), but low-income individuals and communities tend to have lower health literacy and greater stressors, which make them more susceptible to negative influences, such as family members undermining their self-care activities or sabotaging their prescribed diet by bringing

unhealthy, tempting food into the home (Heerman et al., 2016; Mayberry et al., 2016). The inability of low-income communities to effectively engage in appropriate DSM activities contributes to their poor health outcomes (Page-Reeves et al., 2017, Vissenberg et al., 2016; Willard-Grace et al, 2015).

In low-income women with diabetes, the challenges to appropriate DSM activities seem to be magnified due to life circumstances which limit their ability to focus on their own self-care behaviors (Fritz, 2017). This is contrary to what I found in the current study. In food insecure women with diabetes, I found no evidence of a significant association between low income and DSM activities. It is possible that by including only those women with food insecurity, the role of low income in DSM activities may be limited.

RQ3, indicated there was no evidence to support a significant association between race and level of DSM activities in this study population. Racial disparities exist in the level of engagement in DSM activities and how effectively they are performed (Chen et al., 2014; Johnson et al., 2014; Ricci-Cabello et al., 2014). Chen et al. (2014) said trends for DSM activities over a 10-year period showed that differences in self-care activities were present between white non-Hispanics, Hispanics, and black non-Hispanics, which contributed to differences in health-related outcomes. In particular, Hispanics were less likely than non-Hispanic Whites to monitor their blood glucose levels and get any exercise. This was evident from baseline through the end of the 10-year period (Chen et al., 2014). According to Hawkins et al. (2018), these disparities were often driven by the higher propensity of ethnic minorities to engage in unhealthy behaviors. Ricci-Cabello et

al. (2014) attributed the disparities to the lower health literacy often seen with ethnic minorities. For less acculturated Hispanic women, suboptimal engagement in DSM activities, like following a healthy diet or getting enough exercise, was attributed to putting their focus on the needs of their family rather than on themselves (Manysur et al., 2014). Health beliefs and food preferences among ethnic minorities made adhering to the prescribed diet challenging, yet the results of this study did not show any evidence of an association between race and DSM activities.

One possible explanation for the non-significant results in this study could be that the sample population was made up of more than 70% white non-Hispanic women. In the current literature, I found the study populations to be either a homogenous pool of one racial identity or a heterogeneous mix with between group comparisons using the white, non-Hispanic group as the reference. Additionally, by including women with both food insecurity and low income, the role of race in level of DSM activities may have been limited.

Theoretical Framework: HBM

The HBM was used as the theoretical framework for this study. The primary constructs of the HBM can be used to decipher why people take action to improve their health or decide to do nothing (Gatwood et al., 2016; Glanz, Rimer, & Viswanath, 2015; Hallgren et al., 2015). While there are six constructs of the HBM, only four of them were considered in this study in an effort to have a more narrowed focus. The constructs of perceived susceptibility, perceived barriers, perceived severity, and self-efficacy were applied to each of the research questions.

The HBM can be applied in the context of the first research question exploring why food insecure women would be less likely to have a good level of DSM activities, as per the results. Given that access to healthy, nutritious food is limited among food insecure individuals, it is possible these women use this as their excuse or perceived barrier to comply with expected DSM activities, such as good nutrition intake. These women also may not be receiving the education necessary to improve their self-efficacy so they can be better equipped to take control of their own self-management. Additionally, with the added stress of taking care of others, food insecure women may not recognize the risks to their own health, causing their perceived susceptibility and perceived severity to be low.

Peek et al. (2014) were able to address some of the constructs of the HBM through different components of their program, the South Side Diabetes Project. Based out of the South side of Chicago, the program works with working class African American communities to promote behavior change with a goal to improve the health outcomes and reduce the disparities. To address the construct of perceived barriers, the project team provided inspirational text messages, problem solving skills, and hands on workshops in an effort to remove the perceived barriers and improve the community's ability to manage their own diabetes (Peek et al., 2014). The program also addressed the importance of self-efficacy through experiential learning where participants took classes on how to read food labels. They put this new skill into practice by going on guided shopping trips to the grocery store (Peek et al., 2014).

For younger aged women with diabetes, it is possible that one of the perceived barriers could be cost of medicine, cost of healthy food, or lack of insurance. Hallgren, McElfish, and Rubon-Chutaro (2015) explored the beliefs and perceptions that influenced DSM behaviors using HBM as the theoretical framework. Cost and lack of insurance bubbled up as perceived barriers to effective DSM behavior. For younger women, who are not yet qualified for Medicare, it is conceivable that the potential lack of health insurance and elevated costs associated with healthy foods may be used as a perceived barrier to DSM education, medication adherence, and good nutrition practices.

Limitations of the Study

One of the limitations of this study is the use of a cross-sectional, secondary dataset. While the benefits to secondary data include access to large amounts of data providing time and cost savings, secondary data are limited (Ellram & Tate, 2016). The data are collected for another purpose and therefore may not be fully appropriate to address the needs of your study (Babbie, 2017). Additionally, a cross-sectional study limits the ability to establish causal relationships (Lombe et al., 2016). Many of the survey questions for the BRFSS dataset required answers, which were self-reported. This can open the responses up to certain bias. The participant's diabetes status, frequency of healthy and unhealthy food intake, and frequency of physical activity were just a few of the questions reliant upon recall. Any of these answers could have been under or over reported to skew the results. Althubaiti (2016) posited that recall bias and social desirability bias are often seen when researchers use survey questions to collect data.

Additionally, using data from the eight states whose survey included modules with diabetes and food insecurity precluded the majority of the participant population from evaluation. The dataset used in this study may not have been a true representation of the overall population. As one of the components of the dependent variable DSM activities, good nutrition was determined by the operationalization of the variables GreenVeggies, EatFruit, and FriedFood. The operationalized variable good nutrition may have included a more lenient definition of what was considered *good.* For example, I considered it to be good nutrition if the participant consumed GreenVeggies or EatFruit either weekly or daily. According to the latest dietary guidelines, there is a recommendation to consume fruits daily. Vegetables are also recommended daily; however, different categories, such as dark green leafy vegetables, red and orange vegetables, legumes, or starchy vegetables have recommendations for a certain amount per week (HHS, 2015). My interpretation of good nutrition based on daily or weekly may have been more forgiving. Using a broader definition in this study could have inflated the number of sample participants with *good* intake and therefore, could have skewed the results. This study also did not take into account whether any of the respondents participated in a DSM education program (DSME). Current literature supports DSME as a way to improve engagement in DSM activities and improve health-related outcomes in low income and minority populations with diabetes (Beck et al., 2017; Johnson et al., 2015; Testerman & chase, 2018); however, it was not the focus of this study.

Recommendations

This study evaluated data from the 2017 BRFSS survey dataset to determine whether there was an association between food insecurity, low income, race, and level of DSM activity in women with diabetes. The results indicated that the only significant association was found with food insecurity, younger age, and DSM activities, and not with race or low income. I did not investigate whether there were any health related outcomes associated with a poor level of DSM activities in this population; therefore, one recommendation for future research would be to explore whether a poor level of DSM activities in this population puts them at a greater risk for poor outcomes such as elevated A1C, presence of heart disease, or presence of microvascular injury such as renal disease. I would also explore whether DSME was associated with level of engagement in DSM activities and determine the population characteristics of those who engaged in DSME. Additionally, I would recommend a prospective study evaluating the benefits of using a DSME program in this study population on improvements in A1C levels. Improvements in outcomes, such as A1C and improved food stability are achievable according to the results of a study by Seligman, Smith, Rosenmoss, Marshall, and Waxman (2018). Seligman et al. evaluated the benefits of combining DSME with food bank assistance in a food insecure population. The food bank provided diabetes appropriate foods coupled with education over a 12-month period. Significant A1C improvements were found in 40 of the 203 participants in the intervention group who met the criteria for full engagement, which meant they picked up 80% or more of the diabetes-appropriate boxes of food, they saw their primary care physician one or more times over the 6-month follow up period,

and they attended two or more diabetes education classes. For the intervention group overall, there were significant improvements in food stability and healthy food intake compared to the control group (Seligman et al., 2018).

Based on the significant associations found with food insecurity, age, and DSM activities, I would recommend public health professionals assess potential contributing factors, such as access to health care or lack of comprehensive medical insurance, to the poor level of DSM activities within this population, This would allow for more tailored interventions or policy implementation, which could lead to improvements in critical self-management activities, potentiating better health outcomes.

Implications for Professional Practice and Social Change

The prevalence of food insecurity in the US in 2017 was 11.8% (Coleman-Jensen et al., 2018). The prevalence was greater when considering ethnic minorities and those with income levels below the poverty line. Compared to the national average, the prevalence of food insecurity among Black, non-Hispanics and Hispanics was 21.8% and 18%, respectively. Households with incomes below the poverty threshold were almost three times as high as the national average, at 30.8% (Coleman-Jensen et al., 2018), thus showing how vulnerable these populations are. Food insecure individuals are more likely to have challenges complying with prescribed DSM activities (Seligman et al., 2018). The results of this study showed a significant association between food insecurity and the inability to effectively perform DSM activities in low income women. This may have positive implications for professional practice and social change on several levels.

On an individual level, the professional practice implications could be to develop targeted interventions using mobile technology and text messaging. Russell, Vess, Durham, and Johnson (2017) employed a strategy for using text messaging to deliver DSME to low income diabetics to augment face-to-face visits with clinicians. Low-income populations were shown to use their mobile devices to send and receive text messages more frequently than higher income households. In their study, the use of text messages to augment DSME showed significant improvement in blood glucose levels over a 12-week period (Russell et al., 2017). Nundy et al. (2014) also showed improvements in glycemic control when using mobile technology and text messaging as complementary self-care management support.

On the community level, the professional practice implications include the development of a targeted DSME program for individuals with diabetes who are food insecure. Seligman et al. (2018) made an attempt to leverage a community based food bank with the delivery of diabetes appropriate foods and DSME. Although only a small portion of the intervention group who were fully engaged realized a benefit in A1C levels, there was an overall improvement in food stability and understanding of healthy food selection (Seligman et al., 2018).

At the organizational level, more needs to be done about improving the communication of nutrition education among supplemental food programs, such as SNAP (Supplemental Nutrition Assistance Program), and other community based food programs. While food programs are intended to reduce food insecurity in those who participate, there is limited education available at most food programs on how to apply

food budgets to healthy, nutritious foods rather than low quality, calorically dense foods. The findings from Lombe et al. (2016) posited that much of the food budget in low-income households enrolled in SNAP and other programs, is spent on low cost meat, sugary soft drinks, and low quality foods, which contribute to chronic conditions such as diabetes (Lombe et al., 2016). Perhaps the implementation of an education program, which could help guide SNAP food purchasers towards purchasing healthier, more nutritious foods and provide a better understanding of why healthier foods are better for them, could lead to improvements in A1C and other diabetes-related outcomes.

Positive Social Change

The intent of this study was to provide a better understanding of the differences in DSM practices in the hopes it would aid in the development of more tailored interventions. Based on the findings indicating a significant association between food insecurity, younger age, and DSM practices among low income women with diabetes, I would say that positive social change is possible in this population. At an individual level, technology driven DSME programs could increase personal confidence and self-efficacy in the management of diabetes leading to improvements in glucose control. Dinesen et al. (2016) posited that there is no uniformity in how patients with diabetes use technology to get information. Younger aged populations have had more exposure to the technological advances and are more dexterous than the elderly. They also may not have succumbed to more advanced adverse effects of diabetes, such as limb loss, neuropathies, or visual problems, at their less advanced age. The option of a technology driven DSME program could be more appealing to a younger population (Dinesen et al., 2016). At the

community level, implementing diabetes specific food options and DSME at community food programs could improve both food security and nutrition knowledge, potentiating an improvement in diabetes related outcomes. Lastly, at the societal level, positive social change could be spurred by implementing policy, which can establish guidelines for DSME within large supplemental nutrition programs, such as SNAP, and increasing reimbursement for local DSME programs geared towards food insecure individuals who are living with diabetes. The positive social change stemming from more targeted programs, could lead to improved outcomes, such as a reduction in A1C, increase in food stability, and an enhanced understanding of the benefits of choosing diabetes appropriate foods. Improving the current state of reimbursement for education programs could lead to more robust, widely available programs, potentially increasing access to the underserved. Additionally, by improving DSM activities in this population, there is the potential to improve both clinical outcomes and improve the economic burden to society.

Conclusion

This was the first study to explore the association of food insecurity, low income, and race with DSM activities in a sample of low-income women with diabetes from the 2017 BRFSS survey. The results of this study showed mixed results whereby, there was significant evidence to support an association between food insecurity and young age and level of DSM activities; however, not between race and low income. This is in stark contrast to the literature, which posits that in addition to food insecurity, ethnic minorities, the elderly, and low income individuals face numerous challenges to complying with their prescribed DSM activities (Fritz, 2017; Ippolito et al., 2017;

McCaskill et al., 2016; Ricci-Cabello et al., 2014; Saunders, 2019; Tomlin & Sinclair, 2016).

Regardless, the results of this study add to the current literature by providing evidence to support the need for a more targeted approach to DSME in younger individuals with food insecurity and chronic conditions, such as diabetes. Over 30 million Americans have diabetes and that number will continue to grow over the next three decades (CDC, 2017a). These results can have significant implications in helping to manage the challenges faced by this population. Additional research is recommended to determine whether diabetes-related outcomes improve with more targeted supplemental food programs or if there are other variables, which should also be addressed. In the meantime, public health professionals should begin to take a more targeted approach to treating the challenges of food insecurity in younger age, especially with concomitant diabetes.

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