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Social Determinants of Type 2 Diabetes and Health in Caribbean Women

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2020

Abstract

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Abstract

Type 2 diabetes is a pressing public health issue for women in the Caribbean. The purpose of this study was to examine the prevalence of prediabetes, overweight/obesity, and Type 2 diabetes and the predictive relationship of social determinants, weight status, physical activity, and race/ethnicity on Type 2 diabetes diagnosis of women in Puerto Rico and the U.S. Virgin Islands. Further research was needed to understand why Caribbean women are at such high risk for Type 2 diabetes and obesity. A quantitative, nonexperimental design, involving the analysis of secondary data published by the Behavioral Risk Factor Surveillance System at the Centers for Disease Control and Prevention, was used. The theoretical framework was the social-ecological model. Using descriptive statistics and binary logistic regression in IBM SPSS 25, the prevalence of Type 2 diabetes was 11.2%, overweight/obesity 79%, and prediabetes 12.6% in the sample of 2,237 women. Women who had more than a high school attainment were less likely to have Type 2 diabetes than those who did not graduate high school (OR = 0.61; p = 0.035). Participants who were unemployed (OR = 1.81; p = .004), were homemakers (OR = 1.70; p = .011) or were retired (OR = 4.13; p = .001) were more likely to have Type 2 diabetes in comparison to those who were employed. Those who were overweight (OR = 2.02; p = .002) or obese (OR = 4.38; p = .001) were more likely to have Type 2 diabetes in comparison to those who were underweight or normal weight. Based on the findings in this study, the departments of health need to take action and address the modifiable risk factors of prediabetes, overweight, and obesity. To help prevent Type 2 diabetes gender specific interventions should be implemented to effect social change.

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Dedication

I dedicate this study to my 93-year-old mother, Ann Frances Tuitt, my hero and role model. She worked tirelessly to ensure that my siblings and I received an education. She felt it was essential to do so since she thought she missed her chance to have the same opportunities. She would tell all the neighbors in our village, “I would never keep my daughter from school to pick cotton. She must get an education. I do not want her to have to work as hard as I do. I would like her to hold a pen!”

I would also like to dedicate this work to family members who have gone on to be with the Lord. These individuals are my father, David Locker; maternal grandfather, Edmond Tuitt; maternal grandmother, Penelope Weekes; Aunts Margaret Weekes and Mary Daley; godmother, Katherine (Maude) Tuitt; second mother, Margaret Allen; and two brothers, Conrad Duberry and John Thomas Williams. My brothers passed away in 2018 within two months of each other while I was on this PhD journey. Without the love, foresight, and support of these persons, I would not be the person I am today.

It would be remiss to leave out my oncologist and good friend, Dr. Mary Jo Villar, who saved my life in 2007. I am also grateful to Baptist Health South Florida's management and staff, where I received all the surgeries and medical treatments related to a breast cancer diagnosis. My illness led me on a journey to learn more about health and wellness and saved my life. I learned a lot of health information, and I found my purpose to help others who would like to enjoy good health.

Finally, I would also like to dedicate this dissertation to my family members (James Tuitt, Clifford Ryan, Daniel Tuitt, David Tuitt, Ann E. Tuitt, and Ethlyn Tuitt-

Mills). I would like to let the nieces and nephews know that if I can do this, they can do it as well. I led the way by being the first girl to go to grammar school and go to college. Since then, many have followed in my footsteps and achieved their educational dreams. If you can dream it, you can do it. Thank you for your service for those family members who served in the military and for the nieces, who are nurses and essential workers during the COVID-19 pandemic; you also have my admiration and support.

Acknowledgments

I would like to take this opportunity to thank my chair, Dr. Beverly Neville; committee member, Dr. Carol Spaulding; and URR, Dr. John Saindon, for their guidance and support throughout this journey. I would not have been able to complete this dissertation without you. Thank you very much. Every instructor who taught me the coursework also taught me something vital, whether it had to do with APA, women's health, research, or applied statistics. I would also like to say a big thank you to those fantastic persons in the Walden Library, Writing Center, Academic Advising, Academic Residencies, and the Center for Research Quality. The tutors who conducted the weekly sessions were also exceptional. You will be forever in my thoughts and prayers.

I would like to thank all those teachers who taught me earlier in life. An extra thank you to those who saw something in me and gave me that extra push to excel. Some of these exceptional teachers were my cousin Jeanelda Howson, Joy Bramble, Eudora Fergus, Edith Allen, and Blondina Howes, to name a few.

I am also appreciative of the knowledge that several doctors shared with me about disease prevention, and as a result, I developed an interest in chronic noncommunicable diseases. For many years I have interested many regional cancer societies and women's' groups to host lectures on breast cancer, hypertension, diabetes, cervical cancer, women's health, prostate cancer, cardiovascular disease, and how heart diseases negatively impact women's health. Physicians such as Diedre Marshall, Jorge Rabaza, Marcus St. John, Troy Gatcliffe, Darren Bruck, Charan Donkor, Yvonne Johnson, Arthur Agatston, Tomas Villanueva, Theodore Feldman, Hrachaian Hakop, Khurram Nasir, and many others were

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My mother was correct. It did take a village.

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Chapter 1: Introduction to the Study

The purpose of this study was to examine the association between the social determinants of health and a diagnosis or nondiagnosis of Type 2 diabetes in Caribbean women. I focused on the following social determinants of health: income, educational attainment, employment status, health insurance status, and race/ethnicity. Like other regions globally, the Caribbean is going through an epidemiological shift regarding the burden of diseases (Dagogo-Jack, 2017). Chronic noncommunicable diseases (NCDs) such as Type 2 diabetes, cancers, hypertension, and cardiovascular diseases are responsible for most deaths and disability in the region and are estimated to be as high as 80% (Pan American Health Organization [PAHO], 2019a). The prevalence of these diseases and the complications due to them are currently a pressing health issue.

In a recent systematic review and meta-analysis conducted in the Caribbean, Sobers-Grannum et al. (2015) concluded that women were three times more obese than men and were 1.5 times more likely to have Type 2 diabetes. An observation by Sobers-Grannum et al. was that the only other place in the world to have similar statistics for women was Southern Africa (Sobers-Grannum et al., 2015). This situation needs immediate attention because the economic burden due to diabetes complications has become prohibitive and unsustainable for many health departments in the region (Legetic et al., 2016). Health departments require appropriate interventions and policies specifically directed at women to address the high rates of diabetes and obesity. (PAHO, 2019b). By adopting and implementing policies and interventions for women in society, health stakeholders may be able to effect positive social change by addressing the

modifiable social determinants of health associated with the high rate of Type 2 diabetes in women. As a result, Caribbean women may have a better understanding of how to prevent Type 2 diabetes, which may allow them to have a better quality of life, contribute more to their communities, and transfer this health information to future generations.

In Chapter 1, I explore the background of the study and state the problem and purpose of the study. Other sections include the research questions (RQs), the hypotheses, the theoretical framework, and the nature of the study. I also discuss the assumptions, scope and delimitations, limitations, and significance of this study.

Background of the Study

Diabetes is an NCD with serious personal, social, and economic consequences for many persons around the world. In 2017, Saeedi et al. (2019) stated that the disease was responsible for approximately four million deaths globally, making it among the top 10 causes of mortality in persons over 18. Further, the health economic burden was U.S. $77 billion (Saeedi et al., 2019). Saeedi et al. outlined that the prevalence of diabetes (Type 1 and Type 2) was steadily increasing. The worldwide estimates in 2009 were 285 million (Saeedi et al., 2019). In 2011, that figure rose to 366 million; in 2013 it was 282 million, in 2015 it was 415 million, and in 2017 the estimate was 425 million (Saeedi et al., 2019). Type 2 diabetes made up approximately 90% of these estimates (Saeedi et al., 2019). Eighty percent of these cases are in low-and-middle-income countries who do not have the resources to adequately deal with this epidemic (Bennett et al., 2015). In the Caribbean region, Bennett et al. (2015) stated that the average prevalence of Type 2 diabetes was approximately 4% in 1995 and was estimated to increase to 9.9% in 2030.

Between 2010 to 2011, the prevalence was 9% and was accountable for about 13.8 % of deaths in adults (Bennett et al., 2015). These statistics demonstrate how severe diabetes is as a public health issue for the world and the Caribbean region.

More research was needed to determine which social determinants of health are responsible for the increasing prevalence in Type 2 diabetes in Caribbean nations. Obesity, urbanization, and aging populations are some of the leading causes of these statistics (Bennett et al., 2015). However, Saeedi et al. (2019) argued that the reasons for these rising numbers are not all known but did point to earlier diagnoses of individuals, extended life expectancy in some populations, and the rising number of young adults developing diabetes as possible factors. Currently, approximately 500 million persons around the world have diabetes, and governments have felt the urgent call from their communities and the World Health Organization (WHO) to assist with strategies to tackle this epidemic. If not addressed, the estimates are that by 2030 the number will be 578 million and will increase to 700 million by 2045 (Saaedi et al., 2019). According to Bennett et al. (2015), Caribbean nations need to be concerned because past research showed that, although the prevalence of diabetes is less than 2% in those younger than age 35 years, the average is between 10 to 16% in those age 65 and older. Public health officials in the region with the evidence from this study will have an opportunity to address diabetes in younger persons and prevent the rise of the disease in the population as it ages. As such, the prevalence of Type 2 diabetes is a public health issue that needs solutions right now.

However, the rapid rise in the prevalence of Type 2 diabetes in Caribbean nations is a challenging health issue to address. The rapid assimilation of Western culture, customs, practices, and values and the aging of the population are also some of the reasons given by Dagogo-Jack (2017) for the rising tide of diabetes in the Caribbean region. Type 2 diabetes was the second leading cause of death and disability in 2016 (Richardson, Kelly, Kumodzi, Liburd, & Laws, 2019). Women in this region are disproportionately affected by Type 2 diabetes and obesity (Dagogo-Jack, 2017). Furthermore, Legetic et al. (2016) identified poor nutrition, gestational diabetes, and lack of physical activity as some of the risk factors associated with this trend. Lifestyle modification and interventions for individuals are necessary as are appropriate policies and regulations at the governmental level (Legetic et al. 2016). The rising trends in the prevalence of Type 2 diabetes are not sustainable for health departments. More studies are needed to identify the reasons for the excess of obesity and Type 2 diabetes in women to design the appropriate interventions to address the issue.

Social determinants of health have a documented impact on health outcomes. In the early 2000s, Marmot (2004) identified that the social determinants of health (i.e., socioeconomic status, educational attainment, gender, access to healthcare, and ethnicity) were important to understand when looking at health outcomes and the rise of NCDs in communities. These social determinants of Type 2 diabetes are associated with individual, socioeconomic, environmental resource, and behavioral cultural lifestyle factors (Kilanowski, 2017). Some of the many reasons are that they impact how individuals with diabetes manage the disease, which influences health outcomes (Salihu

et al., 2015). According to Zainal et al. (2018), individual and sociodemographic factors include variables such as age, sex, marital status, ethnicity, adherence to medications, health insurance status, glycemic control, and family history. Some of these variables were predictors for Type 2 diabetes in past studies (Zainal et al., 2018). Additionally, environmental factors such as access to nutritious food, where one lives, housing, safe areas to walk, and exercise are associated with better diabetes self-management, according to Kolb and Martin (2016).

Most of the fast-food companies from the United States are in the countries in the region. The Food and Agriculture Organization of the United Nations (FAO, 2015) noted that nutritional intake and lifestyles have been changing for several years in the Caribbean region. There is now a high intake of foods made from refined carbohydrates low in fiber, especially from fast food companies (FAO, 2015). Many persons find these foods low in cost, satisfying because they are high in fat and sugar, and convenient to procure (FAO, 2015). These factors have led to an increase in Type 2 diabetes and other NCDs in the region. Past studies in the Caribbean have provided evidence of an association between obesity, a sedentary lifestyle, and Type 2 diabetes (Guariguata et al., 2018). In this study, I explored the role of social determinants, such as socioeconomic status, health insurance status, and race/ethnicity (Sobers-Grannum et al., 2015). The RQs were crafted to understand the role of modifiable and nonmodifiable social determinants of health regarding this public health issue. Statistically significant, modifiable risk factors can be identified and changed with appropriate interventions and can yield positive social change for women, families, and societies in the region.

Problem Statement

The Caribbean is undergoing public health challenges with chronic NCDs such as cancers, cardiovascular diseases, hypertension, and a high prevalence of Type 2 diabetes (Bennett et al., 2015; Caribbean Public Health Agency [CARPHA], 2018). The Caribbean is comprised of a group of islands such as Jamaica, Trinidad & Tobago, the U.S. Virgin Islands, and Puerto Rico located in the Caribbean Sea. However, due to a long history of political, economic, and social cooperation in the English-speaking Caribbean, it includes countries such as Guyana in South America, the Bahamas, the Turks & Caicos, Bermuda, and Barbados located in the Atlantic, and Belize in Central America (Bennett et al., 2015). According to Sobers-Grannum et al. (2015), in the Caribbean nations, the prevalence of diabetes is 10 to 15% in adults. Type 2 diabetes accounts for 90 to 95% of the overall cases. Sobers-Grannum et al. also noted that Caribbean women have a one and a half times higher risk for diabetes than men and the prevalence of obesity in women is three times higher than in Caribbean men. Similarly, according to Bennett et al. (2015), the prevalence of diabetes among women was 9.3 to 14% versus 6.4 to 9.8% in men. Sobers-Grannum et al. also stated that these health statistics are similar to those in Southern Africa. The findings of these studies reinforced that further research was needed to understand why Caribbean women are at such high risk for Type 2 diabetes and obesity.

Further, Sobers-Grannum et al. (2015) stated that the higher likelihood of diabetes in Caribbean women compared to men was not the norm. Globally, women and men usually have the same risk of Type 2 diabetes, with men having a higher incidence, even

when women are more obese (Sober-Grannum, 2015). Also, Howitt et al. (2015) stated that past studies have shown that globally diabetes prevalence among the sexes was either comparable or more prevalent in males. Additionally, Sobers-Grannum et al. identified obesity and physical inactivity in past research as major risk factors for diabetes in Caribbean women. However, there was a dearth of information on the role of educational attainment, employment status, income, and ethnicity to explain the high prevalence of Type 2 diabetes (Sobers-Grannum et al., 2015). I addressed this gap in the research by conducting this study.

Many complex factors influence the development of Type 2 diabetes in communities. According to Walker, Williams, and Egede (2016), there is an association between the social determinants of health, disease development, and health outcomes. Walker et al. noted that in past research, the contribution of these determinants was not always taken into consideration when assessing the unequal burden of disease in populations. The WHO (2019) described social determinants of health as the circumstances in which one was born and raised extending to across the lifespan. Many factors influence this dynamic continuum. These include individual, sociodemographic factors, socioeconomic conditions, behavioral/biologic factors, environmental resources, cultural and social norms, and public/political input (WHO, 2019). These factors subsequently influence health status, health outcomes, and well-being (WHO, 2019). Also, Walker et al. stated that evidence from research conducted in Canada, the United States, and the United Kingdom had shown relationships between the variables outlined in the social determinants of health and Type 2 diabetes development. However, the

authors stated that previous researchers did not fully describe the role of the determinants of health on diabetes outcomes (Walker et al., 2016). In this study, I analyzed some of the social determinants of health that are associated with Type 2 diabetes in women of the Caribbean region.

There are several modifiable and nonmodifiable risk factors associated with the diabetes epidemic in the Caribbean. According to Legetic et al. (2016), the presence of these factors has contributed the development of insulin resistance leading to Type 2 diabetes. Some of these factors, such as physical inactivity and poor diets, are powerful contributors (Legetic et al., 2016). Further, the PAHO (2019b) described obesity and overweight as serious issues among women and children of the region. For example, the Caribbean countries of Puerto Rico (30 to 35%), Barbados (36%), and the U.S. Virgin Islands (32.5%) had among some of the highest rates of obesity in the region. The PAHO described that women were most affected and had obesity rates 10% higher than men. The PAHO and FAO recommendations were that the region's governments urgently needed to implement policies in collaboration with the ministries of agriculture to provide nutritious, healthy food; tackle food insecurity; and ensure that this supply was sustainable (PAHO, 2019b).

Type 2 diabetes is a preventable disease. Some Caribbean studies have already shown an association between physical inactivity and the prevalence of Type 2 diabetes (Sobers-Grannum et al., 2015). The U.S. Centers for Disease Control and Prevention (CDC, 2019a) explained that exercising for at least 30 minutes a day/5 days a week and if overweight losing at least 5 to 7% of body weight can prevent or lower an individual's

risk for this disease. Implementing interventions to take such actions can lower a person's risk as much as 58 % and up to 71 % if over 60 (CDC, 2019a). Also, Alleyne (2019) recommended that prevention be promoted, especially to the younger population before the disease developed. Moreover, Alleyne cautioned against stopping or reducing exercise programs in schools, while advertisements for unhealthy foods continue to be targeted to children (Alleyne, 2019). The health departments need to provide clearer health messages and enact policies to address overweight and obesity because they are associated with Type 2 diabetes development.

I focused on addressing the gap identified in the literature showing that in the Caribbean, there was a lack of information on the role of income, occupation, educational attainment, and ethnicity in the high prevalence of obesity and Type 2 diabetes in women. Therefore, policy makers need more knowledge of how these social determinants are associated with Type 2 diabetes status in women. This information may enable health departments to develop more specific health policies and interventions for women in the region to prevent Type 2 diabetes. According to Legetic et al. (2016), departments of health need to take immediate action because diabetes is a preventable disease and some of its risk factors are modifiable. Having a diabetes diagnosis can decrease an individual's life expectancy by approximately 10 years and raise health care costs more than for those who do not have the disease (Legetic et al., 2016). Furthermore, persons living with diabetes are at higher risk of developing other dangerous complications such as diabetic retinopathy, kidney disease, heart diseases, and diabetic foot diseases, leading to amputations (Legetic et al., 2016). Data are scarce; however, Legetic et al. reported

that in the Latin America Caribbean region, even as early as 2000, the associated treatment cost for diabetes was approximately U.S.$65 billion (Legetic et al., 2016). Public health agencies in the region, such as the PAHO (2015) and the CARPHA (2018), are aware of the importance of tackling this public health crisis. Understanding how these social determinants are associated with the problem of obesity may help health leaders write effective public health policies, design gender-specific interventions, allocate resources, prioritize decisions, and base health education programs on this study's evidence.

Purpose

The purpose of this study was to examine the association of social determinants of health and Type 2 diabetes prevalence in Caribbean women. These determinants of health included socioeconomic factors (income, educational attainment, and employment status, health insurance status), individual and sociodemographic variables (sex and age), and other risk factors, which I studied among a convenience sample of participants living in the Caribbean territories of Puerto Rico and the U.S. Virgin Islands. The gap identified in the literature was a lack of information on the possible role of income, occupation, educational attainment, and ethnicity in contributing to the high prevalence of Type 2 diabetes in Caribbean women. I used a quantitative approach to understand how these variables are associated with Type 2 diabetes. For the analysis, I used secondary data collected in 2016 for Puerto Rico and the U.S. Virgin Islands for the Behavioral Risk Factor Survey (BRFSS) by the CDC. For this study, the independent variables were income, employment status, educational attainment, country of residence, health

insurance status, overweight/obesity, physical activity, and race/ethnicity. The dependent variable was Type 2 diabetes status (a diagnosis of diabetes, nondiagnosis of diabetes). The covariates were gender and age.

Research Questions and Hypotheses

The RQs and hypotheses were as follows:

RQ1: What is the prevalence of Type 2 diabetes, overweight/obesity, and prediabetes among Caribbean women of the different nationalities in the study sample?

RQ2: What is the predictive relationship between the social determinants (income, education level, employment status, country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women?

$H_0$2: There was no statistically significant association between the social determinants of health (income, education level, employment status, country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women.

H_A2: There was a statistically significant association between the social determinants of health (income, education level, employment status, country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women.

I used binary logistic regression to analyze RQ2. The independent variables (IVs) were measured as follows:

- income (actual number 1–5),

- educational level (actual number 1–3),
- employment status (actual number 1–4),
- country of residence (actual number 1-2),
- health Insurance status (actual number 0-1),
- overweight/obesity (actual number 1–3),
- physical activity (actual number 0–1),
- race/ethnicity (actual number 1–4), and
- prediabetes (actual number 0–1).

The dependent variable (DV) was Type 2 diabetes status, which was measured using an actual number 0-1. There was one covariate (CV), age, which was measured using an actual number 1-2.

Theoretical Foundation

The framework selected as the theoretical foundation of this study is the social-ecological model (SEM). Tehrani, Majlessi, Shojaeizadeh, Sadeghi, and Kabootarkhani (2016) explained that this ecological model was introduced by the psychologist Urie Bronfenbrenner in 1970, who posits that the health of individuals could be affected negatively or positively due to the influences surrounding the individual. The model places the individual in the center of several overlapping circles of influence, including the social environment, the physical environment, and a public health policy level. Tehrani et al. described that the individual's health behaviors are shaped by every layer (Tehrani et al., 2016). Explaining health behavior with a multilevel model approach can help develop interventions and policies to tackle obesity and Type 2 diabetes prevention.

This theory's layers are the individual, social environments, physical environment, and public health policy. According to Tehrani et al. (2016), a researcher can look at factors such as knowledge, attitudes, beliefs, age, and gender at the individual level. Interventions at this level should target the individual's abilities to engage in behavior change by raising awareness and enhancing personal skills. On the other hand, Tehrani et al. stated that the social environment includes the individual's cultural and social norms and interpersonal relationships that can influence the individual. These positive or negative influences could come from family members, co-workers, or friends. If family members and peers support healthy behaviors, that can positively affect the individual's health behavior (Tehrani et al., 2016).

Further, Dendup et al. (2018) stated that the many aspects of the physical environment in which an individual resides could impact a diagnosis of type 2 diabetes. Dendup et al., described that the physical environment could be protective or increase the risks for Type 2 diabetes. The physical environment can reinforce healthy behaviors or lead to unhealthy choices. Also, Dendup et al. stated that the ease of using resources to engage in physical activity such as open spaces, sidewalks, gyms, and recreational areas could be beneficial for exercise and social activity. Additionally, Dendup et al. described that the safety and physical characteristics of a woman's neighborhood can influence the health choices that are made and, as a result, positively or negatively impact the risks for Type 2 diabetes (Dendup et al., 2018). All these factors have an impact on the individual's health status.

The last level of the ecological framework is the public policy level of influence. According to Albright (2015), addressing all levels of the SEM would prevent Type 2 diabetes. The individual cannot manage alone; supporting all levels of this multi-level model would provide the balance where persons with diabetes can manage the disease, and those without diabetes can practice preventative measures. Albright stated that to support the individual, social environments, the physical environment, and the policy environment need to provide health education and health promotion for prevention. Health policies will be needed to impact behaviors associated with obesity, personal behaviors, and the environment. Albright recommended that these policies include strategies to impact obesity, consumption of healthy foods, energy consumption, and physical activity (Albright, 2015). The health communities in the Caribbean have a lot to consider.

Glanz, Rimer, and Viswanath (2015) explained the rationale for using the SEM. The authors mentioned that this model lends strength to a framework since it allows the study to be inclusive of other ideas and theories. The multi-level feature of the SEM allows for the inclusion of several concepts, and make for improved interventions to address the health problem (Glanz et al., 2015). The model also easily incorporates the social determinants of health into the framework described by the CDC (CDC, 2018). In a recent study conducted by McElfish et al. (2020), the SEM was chosen for diabetes prevention intervention. The SEM's constructs consider that the individuals in the study are surrounded by an ever-changing system that aids an individual to have a good quality of life across the lifespan. McElfish et al. posited that single-level models might not give

an individual enough support to prevent a diabetic diagnosis and those with diabetes to effectively manage the disease (McElfish et al., 2020). Choosing the SEM as a theoretical framework provided several advantages for this study.

Nature of the Study

I used a quantitative, retrospective, and non-experimental research design utilizing secondary data to investigate the relationships between social determinants of health and Type 2 diabetes diagnosis in Caribbean women. The selected cross-sectional datasets were sourced from the CDC's BRFSS database for the territories of Puerto Rico and the U.S. Virgin Islands. The data was publicly available on the CDC's website. According to the CDC (2019a), the BFRSS datasets are collected in the United States and its territories. The data were collected using telephone surveys. These datasets have many of the same variables regarding Type 2 diabetes and other chronic diseases needed for the RQs (CDC, 2019a). I obtained Institutional Review Board (IRB) approval from Walden University to conduct the study. Because the CDC data sets are publicly available, an application to use the data was not necessary.

The IBM SPSS, Version 25 software, provided descriptive statistics, frequencies, and cross tab tables. Analysis using binary logistic regression investigated the association between the independent and dependent variables after coding for the diagnosis or nondiagnosis of Type 2 diabetes. The participants for this study were women with and without a diagnosis of diabetes, aged 18 to 64 years. Comparing the two groups of women determined what factors distinguish women who develop Type 2 diabetes from those who do not. Zainal et al. (2018) stated that binary logistic regression was one of the

best tools to determine the best fit model to determine the association between dichotomous dependent variables and several independent variables (2018). The analysis determined a Caribbean woman's likelihood of being diagnosed with Type 2 diabetes. The analysis provided information regarding which modifiable and non-modifiable risk factors are associated with a diagnosis or nondiagnosis of Type 2 diabetes in women living in Puerto Rico and the U.S Virgin Islands.

Definition of Terms

This section includes definitions of the terms used in this study. The variables were compiled based on the inclusion choices that were available in the CDC (2019a) BRFSS data sets for Puerto Rico and the U.S. Virgin Islands.

Type 2 diabetes: This disease is a chronic NCD. When it is present in an individual, the body cannot properly control blood sugar levels. This type of diabetes occurs mainly in adults and make-up about 90 percent of diabetes found in the population. Some individuals can control their blood sugars with diet and exercise, and some may need medications (American Diabetes Association, 2019).

Food security: The status "when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meet their dietary needs and food preferences for an active and healthy life" (FAO, 2020).

Health insurance status: Individuals had health insurance if they had any type of health insurance or health coverage, such as a prepaid health plan, HMO, or government plan (CDC, 2019a).

Income: The study defined income as the total household income from all sources (CDC, 2019a)

Employment status: For this study, employment status was sorted into employed, not employed or unable to work, homemaker, and retired (CDC, 2019a).

Educational status: Educational attainment was assessed as: did not graduate high school, graduate high school, attended/graduate high school or technical college (CDC, 2019a)

Prediabetes: Prediabetes is the health status of having high blood sugar readings between the clinical definition of a diagnosis of Type 2 diabetes and normal levels (Bansal, 2015).

Body Mass Index (BMI): Body mass index is a term used to refer to the result of dividing an individual's weight (kg) by their height (meters), and this measure is used to screen for obesity. To be considered underweight, a person's BMI should be less than 18.5, and for normal weight, it should fall between 18.5 to 24.9. To be classified as overweight, the BMI should be between 25.0 to 29.9, and for obese, it would be in the category of 30.0 and more (Fan et al., 2015).

Race/ethnicity: The Office of Management and Budget in 1997 decided on five categories for race. They are American Indian or Alaska Native, Black or African American, Asian, White, Native Hawaiian, or Other Pacific Islander. Only two categories for ethnicity were published. They are Hispanic or Latino and Not Hispanic or Latino (National Institutes of Health [NIH], 2015).

Country of residence: The Caribbean countries that are part of this study are Puerto Rico, the U.S. Virgin Islands (CDC, 2019a)

Sociodemographic factors: Variables such as age, BMI, sex, and race/ethnicity are in this category (Zainal et al., 2018).

Socioeconomic factors: Several factors, such as educational attainment, income, and employment status, are in this category (Howitt et al., 2015).

Social determinants of health: The environment "where people live, learn, work, and play" (CDC, 2018).

Assumptions

Since this is secondary data sourced from the CDC, the assumptions are that the participants who answered the phone and took part in the surveys are over 18 years of age and capable of answering the survey questions. Further, assumptions are that the collected information was true and correct to the best of the participants' abilities. Lastly, several researchers have assessed the CDC data sets' internal and external validity threats. The results were that other national studies provided similar data. The above limitations were also discussed in Tran et al. (2019). The authors mentioned that several researchers who used the BRFSS data found a good correlation among studies that used actual measurements taken from participants and those found in the BRFSS data sets with R squared values of 89 to 92 % (Tran et al., 2019).

Scope and Delimitations

This study used a quantitative research design to find how several social determinants of health variables are associated with the excess of Type 2 diabetes in

Caribbean women. The independent variables are income, educational attainment, employment status, health insurance status, overweight/obesity, physical activity, and race/ethnicity. There was an interest in two other variables: access to access to nutritious food and food security. However, these variables were not in the data sets. The participants are from the Caribbean countries of Puerto Rico and the U.S. Virgin Islands. Only women who were 18 to 64 years with and without a diagnosis of Type 2 diabetes are included in the study. Women 65 years and over were excluded since advanced age is a known predictor of Type 2 diabetes (Dagogo-Jack, 2017).

Limitations

The data used for this study was secondary data; therefore, I needed to depend on the reliability and validity of the instruments and methods used by the researchers who collected the data. According to the CDC (2019a) the BFRSS data for the U.S. Virgin Islands was last collected in 2016. Therefore, the data set for 2016 was also chosen for Puerto Rico. The information collected from participants was self-reported through telephone interviews (CDC, 2019a). This was a limitation. I will need to depend on the fact that the CDC and the health departments used a sample that was representative of the populations, and it was reliable, valid, and accurate.

Significance

Like in other areas of the world, chronic diseases are responsible for the most deaths and disabilities in the Caribbean (Howitt et al., 2015). However, there was limited published data on how chronic diseases are distributed among social and ethnic groups (Howitt et al., 2015). Also, Bennett et al. (2015), in a recent review of 43 studies, from 17

papers examined ethnicity and diabetes, and 11 looked at gender differences. The authors found that in six of the studies, women had a higher prevalence (9.3 to 14 %) than among men (6.4 to 9.8 %), four found no differences, and one showed that gender was not significant (Bennett et al., 2015; Sobers-Grannum et al., 2015). In the Caribbean, the role of social determinants needs further research to understand how they are associated with Type 2 diabetes to positively impact social change.

This study may yield positive social change for women in the Caribbean. According to Dr. Iris Yob in Laureate Education (2015g), after a dissertation is finished, it will provide evidence-based research for health practitioners, ministries of health, and civic organizations that promote policies, and health educators who implement interventions for persons living with diabetes. Dr. Yob explained that instead of just hoping or believing, the information that resulted from a study will be based on evidence and can provide valuable information to stakeholders in the region (Laureate Education, 2015g). The knowledge that results from the dissertation will be practical since it is based on data from that population. Therefore, those involved in working with women with Type 2 diabetes will have practical information that could be beneficial for better outcomes.

Another result of the dissertation is that health workers can use the results to start positive social change among the organizations that work with women to manage or prevent Type 2 diabetes (Laureate Education, 2015g). Dr. Yob explained that collaboration across the social-ecological framework was vital for best practices. This collaboration can start the ripple effect that makes for social change to start, and it can

eventually grow into a wave. Going forward, the evidence from this dissertation can allow healthcare workers to lobby and advocate for changes in the way women are cared for so that current health outcomes regarding diabetes are changed. This advocacy can be legislative or through the media to encourage political and community engagement (Laureate Education, 2015g). As a result, future policies can incorporate the evidenced-based information found in the dissertation.

Women from all walks of life must be made aware that the rise in Type 2 diabetes prevalence is an urgent health issue for all women, especially Caribbean women (Bennett et al., 2015). Sobers-Grannum et al. (2015) and several other studies identified a lack of knowledge regarding socioeconomic status and other sociodemographic variables (2015). According to Brathwaite and Lemonde (2017), behavioral and cultural practices and beliefs are associated with the prevention, treatment, and self-care of Type 2 diabetes. The authors noted a lack of information about how Caribbean individuals think about preventing Type 2 diabetes. It was important to consider these factors to provide appropriate interventions for this community (Brathwaite & Lemonde, 2017). As a result, information about factors such as standards of beauty related to body size, lifestyle patterns such as physical activity, and food when recommending policies and interventions to assist the culturally diverse populations of the Caribbean.

In the region, many risk factors go hand in hand with poor health outcomes. According to Walker et al. (2016), some of the non-modifiable risk factors and social determinants of health such as race/ethnicity, aging of the population, the physical conditions of neighborhoods, food insecurity, and urbanization may be responsible for

some of the increasing prevalence of Type 2 diabetes in many communities. Walker et al. discussed that additional research should look at how these factors affect access to care and its quality. Past studies have shown an association between risk factors for Type 2 diabetes, health outcomes, and social determinants of health. In this dissertation, the explanations provided will show how health determinants are related to Type 2 diabetes development and its negative health outcomes (Walker et al., 2016). For example, the English-speaking Caribbean governments are taking steps to address diabetes and other NCDs. However, according to Alleyne (2019), although these governments took a global leadership role in tackling NCDs, the momentum has slowed, and many of these countries will not be able to meet the Sustainable Goal of reducing premature deaths due to NCDs by 30 % by 2030 (Alleyne, 2019). In Caribbean nations like Puerto Rico and others in the English-speaking Caribbean, the health departments have published chronic disease action or obesity prevention plans (PAHO, 2015). Recommendations suggested by Alleyne (2019) are for governments of the region to tackle these problems by providing more resources from all sectors such as finance, agriculture, urban planning, and trade (2019). The findings from this dissertation research will provide evidence-based information to help policymakers and health educators develop effective interventions in their communities for diabetes prevention for Caribbean women.

The implications for social change are central to the Walden University mission. As a result, Dr. Yob recommended that the dissertation's results should empower women of all ethnicities and socioeconomic statuses. Taking this action would ensure social change. Health education specialists should teach the knowledge, awareness, and

outcomes from this study to health workers, civic organizations, non-governmental organizations, community health workers, diabetes organizations, and women of the region (Laureate Education, 2015g). This dissertation will look at the big picture to see how the findings fit within the social-ecological network. As a result, this evidence-based information will be valuable for entire communities to turn the tide of these negative statistics regarding women with Type 2 diabetes in the Caribbean region (Laureate Education, 2015g). The aim was to impact social change at all levels of society. These actions would help ensure that women's quality of life and their families change in real and positive ways.

Summary

There has been a shift in the Caribbean and worldwide from communicable diseases being the major cause of death to chronic NCDs such as Type 2 diabetes being the main cause of mortality and disability (Dagago-Jack, 2017). According to Sobers-Grannum et al. (2015), women of the Caribbean region are three times more obese than men and one and a half times more likely to have Type 2 diabetes (2015). Some of the known risk factors for developing Type 2 diabetes are overweight/obesity and a sedentary lifestyle present in Caribbean women (Legetic et al., 2016). Along with these modifiable risk factors, researchers such as Walker et al. (2016) and Artiga and Hinton (2019) also posited that social determinants of health such as income, occupation, ethnicity, and educational attainment play a role in individual health and the development of NCDs along the life course (Artiga & Hinton, 2019; Walker et al., 2016). Researchers such as Sobers-Grannum et al. (2015) and Guariguata et al. (2018) found that the results of past

research in the Caribbean found an association between obesity, physical activity, and Type 2 diabetes in women. However, there was a shortage of information on income, education status, ethnicity, occupation, and their role in women's health outcomes (Guariguata et al., 2018; Sobers-Grannum et al., 2015). This study analyzed how income, education level, employment status, country of residence, health insurance status, overweight/obesity, physical activity, and race/ethnicity are associated with the Type 2 diabetes status of women in Puerto Rico and the U.S. Virgin Islands. The results of this study will impact social change and add valuable data to the field. This study will continue next with Chapter 2, which will describe the literature review.

Chapter 2: Literature Review

Introduction

I investigated the association between income, educational attainment, employment status, country of residence, health insurance status, overweight/obesity, race/ethnicity, and Type 2 diabetes status of women living in Puerto Rico and the U.S. Virgin Islands. In this chapter's literature review, I examine how these social determinants of health play a role in a Caribbean women's health status. Although many past studies indicated high rates of Type 2 diabetes around the world (Saeedi et al., 2019), there was still a need for research specific to the Caribbean region. Specifically, there was need for information on the role of income, occupation, educational attainment, and ethnicity accounting for the high prevalence of Type 2 diabetes. The focus of the RQs therefore was on ascertaining the prevalence of Type 2 diabetes, overweight/obesity, and prediabetes and how social determinants of health predict Type diabetes status among women living in the territories.

I begin this chapter by discussing the search strategy I used to find literature for the review. I then provide an overview of the theoretical foundation. The literature review includes topics such as Type 2 diabetes as a public health issue in the Caribbean, gender and Type 2 diabetes, and Type 2 diabetes risk factors. The review also includes discussion of the known effects of the role of the social determinants of health (income, educational attainment, country of residence, employment status, health insurance status), overweight/obesity, prediabetes, and race/ethnicity. The review concludes with a summarizing paragraph.

Literature Search Strategy

I searched for information in several scholarly databases. ProQuest Central, Google Scholar, PubMed, EMBASE, NIH, Thoreau, ERIC, and SAGE were some of the main databases for the search. The websites of the *West Indian Journal* and institutions working with the Caribbean governments to address NCDs were also sources of information. These organizations are the WHO, the CDC, the CARPHA, the PAHO, and the Caribbean Common Market (CARICOM). Keyword terms such as *women*, *risk factors*, *prediabetes*, *obesity*, *gender*, *Type 2 diabetes*, *Caribbean*, *ethnicity*, *social determinants of health*, *socioeconomic factors*, *Puerto Rico*, and *the U.S. Virgin Islands* were used to obtain peer-reviewed articles published within the last 5 years. No information came from sources such as Wikipedia and newspaper articles.

Theoretical Foundation

I selected the constructs of the SEM as the theoretical framework. Urie Bronfenbrenner, a psychologist, introduced this model in 1970 that posits that the health outcomes of individuals are affected negatively or positively due to the influences surrounding the individual (Tehrani et al., 2016). The model places the individual in the center of several overlapping circles of influence, including the social environment, the physical environment, and a public health policy level. Tehrani et al. (2016) explained that every layer shape individual health behavior. Explaining health behavior with a multilevel model approach can help health leaders to develop interventions and policies to tackle obesity and Type 2 diabetes prevention.

The conceptual framework shown in Figure 1 came from the CDC (2017). Its constructs incorporate five overlapping circles of the SEM to show how many risk factors and the social determinants of health influence obesity and Type 2 diabetes. Figure 1 illustrates the dynamics of this model. According to Kilanowski (2017), use of the SEM allows a researcher to look at how the social determinants of health influence the development of Type 2 diabetes and other health behaviors (2017). All five areas should be a priority to successfully address Type 2 diabetes prevention in communities (Albright, 2015; Dendup et al., 2018).

The first circle of influence is the individual level. According to Albright (2015), at the individual level, it is important for persons to have the knowledge and self-efficacy to engage in healthy lifestyle actions such as physical activity, eating healthy foods, maintaining a healthy weight, and controlling blood sugar values. These skills and knowledge about Type 2 diabetes are vital for individuals to make the right decisions about their health (Albright, 2015). However, the FAO (2015) reported that obesity rates in the Caribbean are rising, which was one of the main reasons for the high rates of NCDs such as Type 2 diabetes. Dietary practices in the region have changed from eating local fresh fruits and vegetables to consuming processed and fast food, high in fat and calories (FAO, 2015). Individual responsibility is essential to preventing and treating Type 2

diabetes, its economic burden, and its complications.

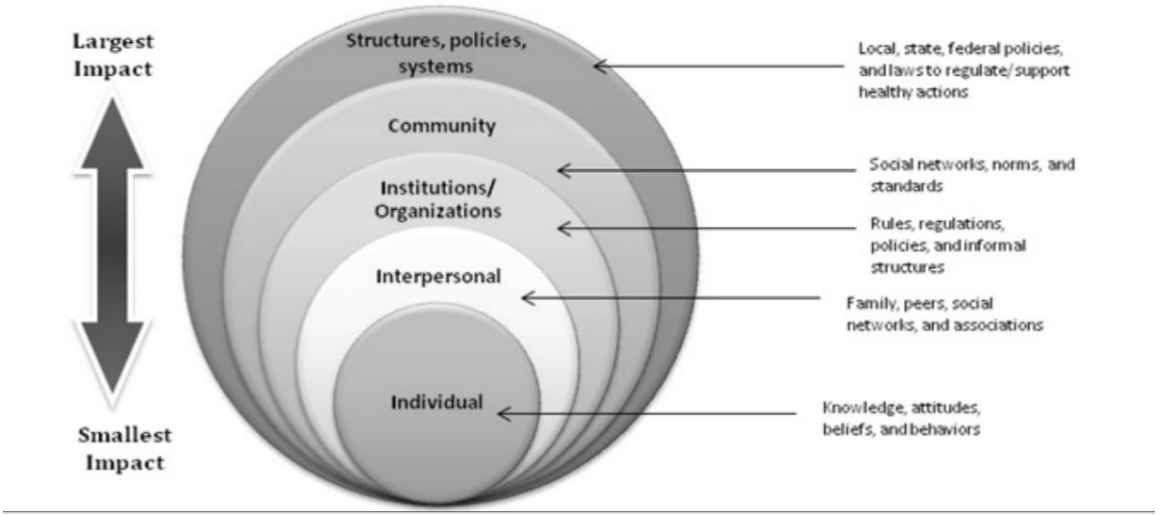

Figure 1. Social-ecological model. This illustration shows the different interlapping levels of this model. Adapted from "Health Equity Resource Toolkit for State Practitioners Addressing Obesity Disparities," by the Centers for Disease Control and Prevention, 2017. Retrieved from https://www.cdc.gov/nccdphp/dnpao/state-local-programs/health-equity/. In the public domain.

The next level of this dynamic network is the interpersonal level. According to Salihu et al. (2015), this level includes relationships with family and friends who can lend social support. Trust in health care providers is also an essential construct at this level (Salihu et al., 2015). Further, Harvey et al. (2016) found that previous researchers had established the protective role of supportive social relationships in managing Type 2 diabetes. Family and friends can influence someone with a chronic illness positively or negatively. Harvey et al. found that women had more success at managing a chronic illness like diabetes if a family member was diagnosed earlier. The influence of family and peers is thus an important factor at the interpersonal level of the framework.

The third level of the model addresses the institutional/organizational setting. According to Salihu et al. (2015), it includes access to health care institutions, laboratories, health workers, and their resources to treat and manage the disease. These health care providers need to have the requisite skill to assist the individual in managing the symptoms of diabetes (Salihu et al., 2015). Further, Khurana et al. (2019) stressed the importance of effective communication between patients and healthcare workers who impart knowledge and education to manage the disease. Communication between physicians and their patients is one of the main factors that can impact taking medications as prescribed and impressing the individual to adhere to the regimen to control the disease and avoid complications (Khurana et al., 2019). However, one of health workers' most important roles is to work with their communities to encourage individuals to engage in healthy lifestyle practices to help prevent the disease, according to Andermann (2016). Health institutions and healthcare providers are essential resources for good health and well-being.

The fourth level of the framework is the community level, which includes the physical and the built environment. According to Salihu et al. (2015), this level considers access to restaurants and supermarkets with healthy foods, transportation, health organizations, sidewalks, and parks to safely engage in physical activity. Salihu et al. also included social and cultural norms/attitudes about the disease in this level. Also, Habte, Kebede, Fenta, and Boon (2016) observed that to effectively manage diabetes, persons with diabetes need to be compliant with a certain regimen. The regimen includes having access to hospitals, clinics, sources of healthy foods, and exercise facilities (Habte et al.,

2016). As a result, the model's overlapping nature is critical in understanding this disease's dynamics in communities.

The last construct of the SEM includes public policy's role in treating and preventing Type 2 diabetes. According to Salihu et al. (2015), public policy can provide regulations for food labels, healthy food programs in schools, taxation on unhealthy foods and beverages, and the building of sidewalks, parks, jogging trails, and convenient/accessible places to exercise (Salihu et al., 2015). Further, Sobers-Grannum et al. (2015) also stated a need for specific policies to prevent obesity and Type 2 diabetes in women. To understand the dynamics of why women are at such risk, this issue needs further research (Sobers-Grannum et al., 2015). The SEM was effective in many settings. However, different communities need different interventions based on sociodemographic factors (Albright, 2015).

Literature Review Related to Key Variables and/or Concepts

Type 2 Diabetes: A Public Health Issue

Type 2 Diabetes is a public health issue in the Caribbean (CARPHA, 2020). According to the (ADA, 2019), this chronic disease occurs in adults when the pancreas is compromised, and it does not provide enough insulin to control blood sugar levels. Another name for this condition is insulin resistance (American Diabetes Association [ADA], 2019). Dagogo-Jack (2017) described that the prevalence of diabetes was very low in the Caribbean in the 1950s and 1960s. The rate was less than 3 %. Dagogo-Jack cited Wright and Taylor (1958), whose study found a Type 2 Diabetes prevalence of 1.4 % in Trinidad. Similarly, the author cited Tulloch and Johnson (1958), whose study

found a rate of 0.73 % in Jamaica (Dagogo-Jack, 2017; Tulloch & Johnson, 1958; Wright & Taylor, 1958). Of interest was that even in 1962 and 1968, Pyke and Wattley (1962) and Poon-King, Henry, and Rampersad (1968) found that more women than men had diabetes. Poon-King et al. also found that in persons under 20 years of age, the prevalence of diabetes was very low, and in those over 20 years, the rate was 3.45 %. However, the authors did not conclude if the variables of ethnicity or diet played a role in the prevalence of the disease (Poon King et al., 1968; Pyke & Wattley, 1962). These studies set the stage so that researchers can analyze the current situation more fully.

Today, the prevalence of diabetes in the Caribbean is at epidemic proportions (Guariguata et al., 2016). According to Guariguata et al., this disease was causing and has caused serious social, economic, and public health issues in the region, such as increased deaths and disability from amputations (Guariguata et al., 2016). A recent systematic review and meta-analysis estimated that the prevalence of Type 2 diabetes in adults was approximately 10 to 15 % (Sobers-Grannum et al., 2015). The prevalence of diabetes was higher in women than in men, with estimates of 6.4 to 9.8 % in men versus 9.3 to 14.0 % in women (Bennett et al., 2015). Additionally, women were three times more overweight and obese than men and had a more sedentary lifestyle. Obesity and lack of physical activity are two of the largest contributors to a high prevalence of Type 2 diabetes (Sobers-Grannum et al., 2015). Although these studies consistently mentioned a shortage of information regarding social determinants and health and Type 2 diabetes, the information available provided a less than ideal background regarding a Caribbean woman’s health status.

Gender and Type 2 Diabetes

The results of several studies in the Caribbean showed that women are more at risk for Type 2 diabetes than men (Guariguata et al., 2018). A meta-analysis and systematic review of Sobers Grannum et al. (2015) examined 50 peer-reviewed studies published in the Caribbean region from 2007 to 2013. The research papers selected for the meta-analysis provided information on Type 2 diabetes, gender, prevalence, complications, and risk factors. Seven studies covered diabetes prevalence and gender, eight studies looked at gender and obesity, and six examined gender and tobacco use. The papers covered several countries such as Barbados, Cuba, Grenada, Guadeloupe, Jamaica, Puerto Rico, Saba, Suriname, Trinidad & Tobago, and the U.S. Virgin Islands (Sobers-Grannum et al., 2015). This paper was one of the first reviews of its kind in the region.

Gender is a risk factor in many of the studies under review. According to Sobers-Grannum et al. (2015), most of the studies used in the analysis were population-based studies. In analyzing gender and diabetes prevalence, women are more likely to be diabetic than their male counterparts. Females also have higher BMI than men and more likelihood of abdominal obesity. When it came to physical activity, there are similar results. Women are less physically active than men. However, men engaged in tobacco use more than women. Sobers-Grannum et al. concluded that the likelihood of having diabetes as a woman was one and a half more times more likely than in men, and women are also three times more likely to be obese than men. Women are more obese than men and had a higher diabetes prevalence across different regions. To follow up on Sobers-

Grannum et al., Guariguata et al. (2018) looked at data from the WHO Stepwise surveys conducted in the region and studies published after 2013. The findings were like Sobers-Grannum et al. (2015). These findings are important for the development of health policies to address Type 2 diabetes in women specifically.

Risk Factors of Type 2 Diabetes

Researchers in past studies published the risk factors of Type 2 diabetes over the years. According to Zainal et al. (2018), there are several known predictors for Type 2 diabetes. They are family history, age, educational status, marital status, sleep duration, stress at work, physical inactivity, gender, fish consumption, BMI, eating salty food, and coffee consumption (Zainal et al., 2018). There are also other non-modifiable risk factors, such as family history, the aging of the Caribbean population, and race/ethnicity (Walker et al., 2016). In the Caribbean and Latin American regions, Legetic et al. (2016) have also identified the four main modifiable risk factors responsible for over 60 % of NCDs' prevalence, including Type 2 diabetes. The four risk factors are smoking, alcohol misuse, physical inactivity, and a poor diet made up of processed foods loaded with sugar, trans fats, salt, and saturated fats. Legetic et al. explained that engaging in these lifestyle factors caused changes to the body and resulted in overweight/obesity, hypertension, insulin resistance, and raised cholesterol (Legetic et al., 2016). However, recent studies from Walker et al. (2016) and Tehrani et al. (2016) have identified other social determinants of health, such as the environment specific to the individual that played a role in developing Type 2 diabetes and other NCDs.

Caribbean governments must address the known social determinants for equitable health in populations. Legetic et al. (2016) also discussed the role of the social and economic conditions present in communities. Some important factors are the environment where one lives and work, government policies, availability of nutritious foods, and food security in neighborhoods. A person's race/ethnicity, social status, culture, and gender also play vital roles (Legetic et al., 2016). In Sobers-Grannum et al. (2015), the discussion of risk factors related to Type 2 diabetes and women focused mainly on a lack of physical activity, overweight and obesity, tobacco use, access to nutritious food, and metabolic syndrome (2015). This dissertation will not focus on metabolic syndrome and tobacco use.

Social Determinants of Type 2 Diabetes

Researchers are increasingly becoming aware that a community's health was not just about providing more access to healthcare (Artiga & Hinton, 2019). Many factors influence populations' health, such as the health behaviors of binge drinking, tobacco use, a sedentary lifestyle, and unhealthy diets. The socioeconomic, environmental, government policies, and support systems surrounding an individual are associated with one's health outcomes (Artiga & Hinton, 2019). The WHO recognized the need for health organizations to address the social determinants of health worldwide several years ago. According to the WHO (2020), "social determinants of health are the conditions in which people are born, grow, live, work, and age" (2020). These determinants include income, educational attainment, employment status; the neighborhood and environment in which one lives; access to healthy foods and food security; community and social

support, and access to effective, convenient, and affordable healthcare (Artiga & Hinton, 2019). Although these areas are not fully understood, the linkages between social determinants of health and health outcomes are worth exploring.

As previously stated, Caribbean women are adversely affected by being at greater risks for Type 2 diabetes and obesity. According to Guariguata et al. (2018), the statistics for women being obese are (OR: 3.10; 95% CI = 2.43-3.94) and for diabetes (OR:1.65. 95% CI = 1.43-1.9) versus men. The authors cited in the meta-analysis performed by Sobers-Grannum et al. (2015) that information regarding social determinants of health are scarce even though social determinants of health data are collected in censuses. One of the reasons may be that the Caribbean encompasses a diverse area. Although some countries may have data, organizations such as the ministries of health, the WHO Stepwise Surveys, and the PAHO were responsible for its collection. However, they have not been analyzed, peer-reviewed, and published. Guariguata et al. concluded with the same findings as Sobers-Grannum et al. that the prevalence of Type 2 diabetes and its risk factors such as obesity, physical inactivity, and fruit and vegetable intake are hurting the health outcomes of Caribbean women (Guariguata et al., 2018). The Caribbean governments are working with organizations such as the CDC, the PAHO, and the WHO to address NCDs because it is vital to adopt policies and interventions to target the rise of Type 2 diabetes.

Socioeconomic Status and Type 2 Diabetes

In the Caribbean, the relationship between socioeconomic status and Type 2 diabetes is unknown (Bennett et al., 2015). According to Cheng and Goodman (2015),

socioeconomic status placed persons into different social groups or social classes. The concept of social-economic status can be complicated and mean different things in different situations. Cheng and Goodman cited Marmot and Wilkinson (1999) that described linkages between socioeconomic status (SES) and health. SES can mean constructs, such as income, education, occupation, and wealth. Also, SES can refer to status in society. Cheng and Goodman suggested that either way, SES can impact one's health status at different points in the life cycle, individually, in a household, in a community, or a population (Cheng & Goodman, 2015). Therefore, it was important to consider SES since it provided valuable information in health research.

For this study, some of the variables of interest are income, educational attainment, and employment status. Haire-Joshu and Hill-Briggs (2019) described that occupation and income could denote social status in a community, infer economic standing, and access resources such as health insurance and food security. This study assessed educational attainment on whether a woman did not graduate high school, graduated high school, or attended/graduated college or technical school. With higher education levels, the more access to better SES, life skills, access to healthcare, access to medications, food security, and health literacy, as examples (Haire-Joshu & Hill-Briggs, 2019). Further, Walker et al. (2016) described that evidence from research conducted in developed nations showed an association between a higher likelihood of developing Type 2 diabetes and lower SES. Also, persons who live in the United States with a less than high school educational attainment were twice as likely to die from diabetes complications than someone with a college or higher educational attainment. Also,

persons who attended college were more apt to have good glycemic control of their blood sugar than someone who did not have a college or higher education (Walker et al., 2016). Therefore, SES was a modifiable risk factor that should be evaluated when suggesting interventions to tackle the high rate of Type 2 Diabetes in the region.

A recent scoping review looked at inequalities in the Caribbean region about Type 2 diabetes and health. According to Bennet et al. (2015), not many studies addressed SES and the prevalence of diabetes. In the few available studies, there was an association with low educational attainment and low incomes having a higher likelihood of a diagnosis Type 2 diabetes (Bennett et al., 2015). Further, Guariguata et al. (2018) found an association of higher diabetes prevalence in those with more education in one Puerto Rico study. The results were 6.6 % in those with no formal education, 11.4 % in grades 1 to 8, and 11.9 % in those with higher than high school education, $p = .013$ (Guarigata et al., 2018). Therefore, this dissertation will provide more valuable research for Puerto Rico and the U.S. Virgin Islands.

Description of Each Nationality/Country of Residence and Type 2 Diabetes

This dissertation's data sets will come from the Caribbean countries of Puerto Rico and the U.S. Virgin Islands. Both territories will provide diverse populations made up of Whites, Blacks, Hispanics, and other races. The following are overviews of the two nations.

Puerto Rico. Puerto Rico is a U.S. territory located in the north-eastern Caribbean. Several other islands are part of the territory and include Culebra, Mona, and Vieques (PAHO, 2015). In 2015, the population was approximately 3,474,182, and about

15 % was over 65 years. In 2013, the life expectancy at birth was 75.8 years for men and 83.1 years for women (PAHO, 2015). The U.S. Census Bureau (2019) estimated that 18.6 % of the population was under 18 years of age and 52.5 % of the total population are females. In terms of race and ethnic makeup, 98.9 % were Hispanic/Latino, and 0.8 % were Whites (U.S. Census Bureau, 2019). The annual per capita income in 2015 was US$12,476, and Puerto Rico was considered a high-income country. Since Puerto Rico is a U.S. territory, its population had the same health benefits under the Affordable Care Act. In 2010, the country's literacy rate was 92 %; in 2015, the unemployment rate was 12.9 %, and 46.1 % of the population was under the federal poverty line. The country is having severe economic problems, which affected its health sector (PAHO, 2015). All the above indicators have an impact on access to health and health status in the territory.

As it pertains to health, Puerto Rico joins its Caribbean neighbors in having similar health problems. According to the PAHO (2015), the prevalence of diabetes was on the increase. In 2014, the overall prevalence was 15.7 %. The rate in females was 16.4 % and in men 14.8 %. Also, in 2014, the prevalence of obesity and overweight was 65.6 %. The prevalence was 26.8 % in men and 29.6 % in women. Persons aged 55 to 64 years had the highest prevalence of obesity at 35.2 %. In 2014, 10.5 % of gross domestic product (GDP) was spent on health (PAHO, 2015). Although Puerto Rico was going through health and economic challenges, the country enacted a Chronic Disease Action Plan for 2014 to 2020 and an Obesity Prevention Action Plan in 2016. The PAHO and the Food and Nutrition Commission supported these plans (PAHO, 2015).

U.S. Virgin Islands. Four islands located in the Caribbean Sea comprises the territory known as the U.S. Virgin Islands. Its location is approximately 50 miles east of Puerto Rico, and it is also a U.S. territory (Michael, Valmond, Ragster, Brown, & Callwood, 2019). According to the Central Intelligence Agency (CIA, n.d.), in 2020, the population was approximately 106,235. Life expectancy at birth in this territory was 83.2 years for women and 76.6 years for men. Rum production, trade, and tourism provided the most wealth to the economy. Most of the food consumed in the territory was imported, and there was a small agricultural sector. In 2016, the GDP was estimated at $3,872 billion, with a GDP per capita of $37,000. In 2017, the unemployment rate was 10.4 %, and in 2002, an estimated 28.9 % lived below the poverty line. In 2017, two Category 5 hurricanes (Irma and Maria) severely damaged the infrastructure, society, and economy (Central Intelligence Agency [CIA], n.d.). The territory is slowly recovering.

In a recent report, Michael et al. (2019) reported that overall, the territory's population was aging, with 62 % being over 35 years of age. Over 50 % of the population were women, and single women head up 48% of households. The largest portion of the population (77 % were Black, 17 % were Hispanic/Latino (mainly from Puerto Rico and the Dominican Republic),12.4 % were of Mixed Race, and 10.5 % were White. Further, Michael et al. discussed that only half of the population (49 %) were born in the territory. Approximately 36 % were immigrants from other Caribbean islands, especially the English-speaking islands of the Eastern Caribbean. Further, the breakdown of the population explained that 9 % came from the United States. Another finding from Michael et al. was that diabetes was one of the top four health concerns identified in the

population. Some others were cardiovascular disease, hypertension, obesity, and cancers (Michael et al., 2019). The data showed that this territory's people were ethnically diverse, multi-cultural, and diabetes is a known public health issue.

As it pertained to Type 2 diabetes, in the U.S. Virgin Islands, this Caribbean country also has similar statistics to the other Caribbean nations. According to the CDC (2016a) BRFSS, the prevalence of obesity in the population was 32.5 % in 2016. The prevalence of diabetes in 2010 was 9.1 % (CDC, 2016a). However, McDonald, Nunez, and Yarandi (2017) stated that diabetes was the fifth leading cause of death in this territory. McDonald et al. described that diabetes was not well studied, and more research was needed to study chronic conditions. The authors also cited the Diabetes 2025 Forecast, which estimated that the prevalence of diabetes was as high as 31.4 % (McDonald et al., 2017). Recently, Ogilvie, Patel, Narayan, and Mehta (2018) looked at whether the standards for diabetes care as outlined in Healthy People 2020 are carried out in Guam, Puerto Rico, and the U.S. Virgin Islands. The findings were that these territories are not meeting the Health People 2020 objectives for diabetes foot care (Ogilvie et al., 2018). These facts show that more funding and research was needed in the territory to address the diabetes burden.

Neighborhood Environment and Type 2 Diabetes

The neighborhood or community in which one lives has an association with quality of life and health status. Dendup et al. (2017) described that other studies had associated Type 2 diabetes with individual risk factors that are biological and behavioral, along with environmental factors that are independent of the individual. Persons living in

areas where the physical environment had sidewalks, open spaces, and parks may be encouraged to walk more. These attributes affected tendencies towards overweight and obesity. Dendup et al. also mentioned that supermarkets and farmers' markets with fresh fruits and vegetables could encourage these foods' consumption and less intake of offerings from fast food outlets (Dendup et al., 2017).

Additionally, Walker et al. (2016) stated that when neighborhoods are considered safe with low crime, moderate traffic, and low social unrest, the community will be less likely to fear being outdoors. Persons would engage more in walking and would not take part in socially isolating behaviors. Aesthetically pleasant neighborhoods with green spaces can help the community members socialize more, form strong social networks, a sense of community that can impact hemoglobin A1c and, as a result, overall well-being (Walker et al., 2016). It was essential to investigate if these social determinants of health have an association with the prevalence of Type 2 diabetes in Caribbean women.

Access to physical activity. Low physical activity is a modifiable risk factor, and enacting policies can address this issue. As a result, Howitt et al. (2016) cited the WHO, whose recommendations are for nations to tackle physical inactivity, and by 2025, lower present rates by 10 % to address NCDs. Howitt et al. found that one of the most popular forms of physical activity is walking (Howitt et al., 2016; Legetic et al., 2016). Therefore, Legetic et al. (2016) recommended that since walking was one of the most common forms of physical activity, policies should address providing safe environments with sidewalks and secure spaces for the population. Legetic et al. also noted that there was an association between higher income and increased physical activity. Access to physical

activity in women and men in high-income countries doubled the statistics in low-income countries (Legetic et al., 2016). Between 2015-2018, the CDC, BRFSS stated that the rate of physical inactivity in Puerto Rico was approximately 30% (CDC, 2020c). On the other hand, in 2009, the data for the U.S. Virgin Islands showed that the rate was about 58 % (CDC, 2015). Health officials' significant efforts are needed to encourage higher physical activity rates by providing more opportunities for the population to be outdoors.

The results of past studies in the field have already shown the association between physical activity and Type 2 diabetes. According to Guariguata et al. (2018), Caribbean women engaged in less physical activity than men. However, the authors could not draw conclusive associations between physical activity, ethnicity, and gender (Guariguata et al., 2018). Also, Legetic et al. (2016) described that a lack of physical activity was among the top ten leading causes of death, disability, and low health outcomes worldwide. The authors stated that compared to persons who engaged in the recommended 150 minutes of weekly physical activity, those who did not were at 20 to 30% risk of dying from some disease (Legetic et al., 2016).

The Caribbean territories are taking notice. Currently, the U.S. Virgin Islands Department of Health is working with the CDC to conduct an audit of the walkability of the streets. In 2010 it was determined that one one in three persons in the territory did not engage in physical activity. The stakeholders are looking at the roadways to determine where sidewalks can be extended and crosswalks placed to encourage the population to be more active (United States Virgin Islands [USVIDOH], 2017). This is part of a program sponsored by the CDC (2020b) to encourage over 27 million persons to be more

active, whether it is biking, or walking. Providing biking lanes, sidewalks and pedestrian crossing may encourage more walking and physical activity in the territory (CDC, 2020b). Increased physical activity is vital to change the negative heath statistics for women.

Access to healthy foods and food security. Several factors, such as food insecurity and access to healthy foods, are associated with adverse health outcomes in the Caribbean region. According to a report by the FAO (2015), although several countries in the Caribbean except for Guyana and Haiti, are high or middle-income countries, the region was not exempt from the negative health outcomes of food insecurity since a large portion of food into the region was imported. The inhabitants of this region exceeded the daily allowance of recommended calories, and a significant amount of this consumption was processed foods. The FAO also reported that 20% of the population lived under the poverty line in many Caribbean nations. Factors such as unemployment and income inequality also impacted this group's ability to purchase fresh fruits and vegetables. As a result, food choices may include high fat and fried foods (FAO, 2015). Additionally, the FAO (2020) defined food security as the state “when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meet their dietary needs and food preferences for an active and healthy life” (FAO, 2020; Smith, Kassa, & Winters, 2017). These facts clarified why food security was important in the fight against the rising tide of obesity and NCDs, such as Type 2 diabetes.

Many Caribbean islands are also vulnerable to climate change and the annual tropical storms, severely damaging infrastructure, and the economy, as recently happened

in Puerto Rico and the U.S. Virgin Islands (FAO, 2015). According to Legetic et al. (2016), this had consequences for poorer women and children than men in low-income communities. They are at particular risk for obesity due to food insecurity. The authors described that the trends were that in low-income countries, women who are well off are the ones who are more obese. However, with an increase in wealth from economic development, both women in low- and high-income groups can be obese. The findings from past studies have also shown a relationship between obesity and race/ethnicity, regardless of income (Legetic et al., 2016).

The previous findings were borne out in Martinez-Brockman et al. (2018) regarding the association of food security and overweight/obesity, cardiovascular disease, hypertension, and Type 2 diabetes in the Caribbean. The findings were that 28.7% of households had some food insecurity, 17.4% were mild, 6.5% were moderate, and 4.7% were severe. Martinez-Brockman et al. described that the sample of participants was from Barbados, Puerto Rico, the U.S. Virgin Islands, and Trinidad. The sample size was (n = 2,087), and food security was measured using a previously used instrument from the Americas. Martinez-Brockman et al. reported that Trinidad had the highest prevalence of food insecurity, followed by Puerto Rico, Barbados, and then the U.S. Virgin Islands. Also, there was an association between low educational attainment and food insecurity. The authors also stated that the presence of moderate food insecurity was associated with a higher likelihood of having Type 2 diabetes and other NCDs than those who were not food insecure (Martinez-Brockman et al., 2018). These results were significant findings

for these countries' governments while designing and implementing nutrition-based interventions for women.

Some form of food insecurity is present in most countries around the world. Smith, Rabbitt, and Coleman-Jensen (2017) explained that by 2030 one of the United Nations Sustainable Development Goals aims to end hunger and attain food security for everyone across the globe. To achieve this goal, countries in the Caribbean need to define and understand food insecurity determinants by knowing where it is happening and why. Smith et al. suggested that this knowledge will help governments identify the resources, build consensus, and implement effective policies to address the issue as it relates to obesity and a diagnosis of Type 2 diabetes (Smith et al., 2017). Recommendations offered by Legetic et al. (2016) are that governments should enact inter-ministry public policies that can help tackle obesity. An example was to collaborate with the departments of agriculture to address food insecurity and the ministry of planning to help design healthy living spaces that promote walkability, safe public spaces for exercise so that adults and children can play and engage in physical activity while feeling safe (Legetic et al., 2016). Involving all government agencies, not just the ministries of health, in the fight against Type 2 diabetes and other NCDs, makes a lot of sense.

Access to Health Insurance and Type 2 Diabetes

Social determinants of health include health access to affordable health services by having access to private health insurance. Legetic et al. (2016) described that having an NCD such as diabetes can be expensive due to a need for additional and specialized health services. To afford such services, individuals needed to have health insurance or

other methods to afford healthcare. If someone does not have health insurance, health benefits and health supplies will need to be purchased separately and most often comes out of living expenses. Being poor exacerbates this situation. Legetic et al. described that this dynamic could reduce family members' opportunities and even the possibility of bankruptcy (Legetic et al., 2016). Financing chronic diseases are expensive without access to health insurance.

In a recent report, Kaiser Family Foundation (KFF, 2020) outlined that in St. Thomas, 30 % of the population was uninsured, and in Puerto Rico, the figure was much lower at 7 %. Additionally, 49 % of Puerto Ricans and 22 % of Virgin Islanders have Medicaid. The KFF report also stated that due to the two major storms in 2018, which caused significant damage in these two territories, hospitals and clinics feel the financial burden. The number of persons without health insurance has grown as some persons have lost their jobs and may not be eligible for Medicaid (Kaiser Family Foundation [KFF], 2020). These territories are undergoing severe financial and health-related stress. Policy initiatives to address climate change and health are needed in both regions as priorities.

Obesity and Type 2 Diabetes

Overweight and obesity are public health issues in the Caribbean and around the world. According to Dagogo-Jack (2017), overweight and obesity are significant contributors to the rapid rise in Type 2 diabetes and other chronic diseases in the Caribbean countries. In this region, there has been a trend towards consuming processed and fast food. Persons are moving away from traditional diets, including local seasonal fruits, vegetables, and other local produce high in fiber. Dagogo-Jack et al. explained that

these trends are some of globalization's ramifications and persons moving into urban areas from rural areas (Dagogo-Jack et al., 2017). A recent meta-analysis conducted by Sobers-Grannum et al. (2015) discovered that women in the region were, on average, three times more obese than men in research conducted in several Caribbean nations (2015). In 2017, the CDC (2020a) reported that the prevalence of obesity in Puerto Rico and the U.S. Virgin Islands ranged between 30 to 35 %. The organization warned that these high obesity rates placed affected persons at significant risk for NCDs such as Type 2 diabetes, cardiovascular problems, mental illness, and some cancers (CDC, 2020a).

Obesity interventions are needed to address this public health crisis; however, health educators will need to be aware of several factors that can impact their efforts. Firstly, Sobers-Grannum et al. (2015) described a phenomenon that may not be exclusive to the Caribbean. In this region, overweight and obesity are not seen as detrimental. Sobers-Grannum et al. explained that males prefer a larger, more full-body size in females (Sobers-Grannum et al., 2015). Further, in a recent study conducted as part of a longitudinal study in Barbados, Puerto Rico, Trinidad, and the U.S. Virgin Islands, Hassan et al. (2018) discovered that weight misperception was also an issue in the region. Weight misperception occurs when those who are overweight or obese see themselves as having a normal size. Hassan et al. found that 54 % of overweight and 23 % who were obese had weight misperception. There was no difference between men and women or those with Type 2 diabetes. However, 85 % of those with weight misperception was less likely to try to lose weight (Hassan et al., 2018). These factors will need to be taken into consideration when designing programs for women.

Prediabetes

This study analyzed the prevalence of Type 2 diabetes, prediabetes, and overweight/obesity in Puerto Rico and the U.S. Virgin Islands for RQ1. Bansal (2015) defined prediabetes as the health status of having high blood sugar readings between the clinical definition of a diagnosis of Type 2 diabetes and normal levels. Currently, the prevalence of prediabetes is rising at a high rate globally. A diagnosis of prediabetes has important health consequences. If an individual has prediabetes, it increases the risks of developing Type 2 diabetes. It also increases the risks for developing other NCDs and complications exacerbated by the presence of Type 2 diabetes. Some of these are cardiovascular disease, gestational diabetes, kidney disease, neuropathy, and diabetes retinopathy (Bansal, 2015). Also, Hostalek (2019) explained that a diagnosis of prediabetes is a severe health problem. Twenty-five percent of individuals with prediabetes will develop full-blown Type 2 diabetes in three to five years, and 75% will do so over their lifespan. However, the prerequisites for a diagnosis of prediabetes varies among different institutions, such as the WHO and the ADA. Some institutions use fasting plasma glucose (FPG), some use impaired fasting glucose (IGT), and others use the results of glycated hemoglobin (HbA1c). As a result, there is confusion on which method is better for a diagnosis of prediabetes (Hostalek, 2019). Lifestyle interventions are needed to address this known risk factor for developing Type 2 diabetes

Further, Hostalek (2019) stated that in 2017 the global prevalence of prediabetes in adults was 7.3 % (352.1 million). The estimates are that by 2045 these statistics will increase to 8.3 % (587 million) persons. The author stated that most of the individuals

with this condition are under 50 years of age, and the prevalence rates are the same among women and men. Hostalek noted that the world's region with the highest prevalence was North America and the Caribbean, with a prevalence of 15.4%, followed by Central and South America with an estimated 10% (Hostalek, 2019). The territories of Puerto Rico and the U.S. Virgin Islands are in the North America and the Caribbean region.

There are several risk factors described in previous studies that are associated with prediabetes. Hostalek (2019) explained that race/ethnicity and prediabetes have an association. In comparison with other races such as Whites, Blacks, South Asians, and Native Americans; Hispanics have an increased risk of being diagnosed with prediabetes. Other risk factors are socioeconomic status, educational attainment, knowledge, awareness, obesity, and healthcare access across the lifespan. Hostak also found that there are no differences in prevalence between men and women. The author stated that with the effects of globalization, such as more access to processed foods, increased income, and more longevity, the prevalence of prediabetes is expected to rise (Hostalek, 2019).

Data about the prevalence of prediabetes in Puerto Rico and the U.S. Virgin Islands is sparse. However, Perez et al. (2015), in a study of 857 participants aged 21 to 79 years in Puerto Rico, found that the prevalence of prediabetes in women using IFG was 25.3 % and impaired HbA1c 40.6 % (2015). On the other hand, in a convenience sample of 380 participants in primary care clinics in San Juan, Puerto Rico, Mattei et al. (2018) reported that 15.2 % of women had pre-diabetes. The participants in this study

were aged 30 to 75 years (Mattei et al., 2018). Based on the information analyzed for this review, departments of health should establish uniform criteria to determine prediabetes diagnosis.

Ethnicity and Type 2 Diabetes

Race/ethnicity is a non-modifiable risk factor for Type 2 diabetes. Walker et al. (2016) described that past studies have provided evidence that social determinants of health and race/ethnicity play a role in persons who develop diabetes. The results from past studies have provided evidence that there are differences between ethnicities in health outcomes related to diabetes and blood sugar control (Walker et al., 2016). Also, Bennet et al. (2015) described a lack of information regarding Type 2 diabetes inequities among black Caribbean populations. However, some findings were that Caribbean Blacks had a higher prevalence of Type 2 diabetes than Caucasians and West African Blacks. However, the prevalence was lower than South Asians (Bennett et al., 2015). More research was needed in the Caribbean region to understand how variables such as ethnicity, gender, and SES are associated with Type 2 diabetes.

Race/ethnicity as an independent variable in this dissertation may provide mixed information. In a current longitudinal study, Wang et al. (2019) described that when collecting data for race/ethnicity in the Caribbean, over 18 % of the sample chose two or more categories for race, 15.2 % chose two, and 2.6 % chose three or more races. As a result, the variable for race/ethnicity gave flawed results. The recommendations were that collecting data for this variable can be challenging and scientific standards for the Caribbean may be necessary for persons to distinguish their race/ethnicity (Wang et al.,

2019). A clearer definition of race/ethnicity is an area that needs attention so that this variable can be reliably collected and analyzed in future research.

Summary

During the mid-20th century, the known prevalence of Type 2 diabetes in the Caribbean was less than 3 % in countries like Jamaica and Trinidad & Tobago. (Dagogo-Jack, 2017). Seven decades later, the prevalence of Type 2 diabetes in the Caribbean region is a public health issue due to its ravages on individual health, family finances, and public health resources (CARPHA, 2020). Results from recent systemic reviews have provided information that Caribbean women are, on average, three times more obese than men and are at excess risk for Type 2 diabetes (Sobers-Grannum et al., 2015). The results from past studies have shown an association of obesity, physical inactivity, gender, and the diagnosis of Type 2 diagnosis (Guariguata et al., 2018). However, there was a lack of information on the role of income, occupation, educational attainment, and ethnicity in women (Sobers-Grannum et al., 2015). The RQs concerned how these social determinants of health are associated with the disease in women who live in Puerto Rico and the U.S. Virgin Islands.

Chapter 2 provided information regarding the literature review strategy, the theoretical model, the urgent public health issue Type 2 diabetes posed for the Caribbean, and a description of the two countries in the study. This chapter also provided information about the main risk factors for diabetes and a description of each social determinants of health in the study. In Chapter 3, which follows, additional information

will be provided regarding the research design and rationale, the methodology, the data analysis plan, threats to internal and external validity, and the ethical procedures.

Chapter 3: Research Method

Introduction

In this study, I analyzed which social determinants of health are associated with the high rate of obesity and Type 2 diabetes status in women in the Caribbean islands of Puerto Rico and the U.S. Virgin Islands. The problem statement in Chapter 1 indicated that the gap in knowledge was that Caribbean women are at excessive risk for obesity and Type 2 diabetes and information is scarce regarding the role of income, occupation, educational attainment, and ethnicity. Additionally, I discussed the significance of this problem for health and economic outcomes and the impact on social change.

In this chapter, I will explain the research design and rationale and the methodology, including the population, sampling and sampling procedures, study variables, and data analysis plan. The focus of RQ1 was on the prevalence of Type 2 diabetes overweight/obesity and prediabetes among Caribbean women of the different nationalities in the study sample. The focus of RQ2 was on the association between the social determinants of health (income, educational attainment, employment status, nationality/country of residence, health insurance status), overweight/obesity, physical activity, and race/ethnicity in Caribbean women with a diagnosis of Type 2 diabetes versus those without a diagnosis of Type 2 diabetes. If significant statistical associations ($p \leq .05$) are found between the independent variables and the dependent variable, the analysis will include a further examination of the odds ratios. If the analysis revealed odds ratios larger than 1, there was a positive relationship. Following Rastogi and Singh's

(2019) protocol, I reported the results based on an analysis of the significance levels and the corresponding odds ratios.

I begin Chapter 3 by discussing why a quantitative design was appropriate to answer the RQs. In this chapter, I also address internal and external validity threats and the ethical procedures I followed.

Research Design and Rationale

I used a retrospective, quantitative, nonexperimental, cross-sectional research design to analyze which social determinants of health variables are associated with the high rate of obesity and Type 2 diabetes in women living in Puerto Rico and the U.S. Virgin Islands. Secondary data collected in 2016 were obtained from the CDC's BRFSS and used for the analysis. As described by the CDC (2019a), the organization along with departments of health began the BRFSS in 1984 to collect data from 15 states using a cross-sectional telephone survey. The system has since been expanded to all 50 states, the District of Columbia, and the territories (CDC, 2019a). The CDC data sets were collected over the years to enable the states and territories to track the prevalence and risk factors for chronic diseases such as diabetes, cancers, asthma, and cardiovascular disease (CDC, 2019a). The data sets had enough variables to allow the two RQs in this study to be answered.

The BRFSS data sets are secondary data and were immediately available. As explained by Setia (2016), there were no time or resource limitations in using these publicly available data. I calculated the estimated prevalence of Type 2 diabetes, prediabetes, and overweight/obesity to answer RQ1. I derived the likelihood of a woman

being diagnosed with Type 2 diabetes from the information in the data sets to answer RQ2 (see Setia, 2016). The use of cross-sectional secondary data sets has several advantages. They are collected in a faster manner and are less expensive for the researcher (Setia, 2016). However, with this type of data, no causal relationships can be assumed at the end of the study; only the associations between the independent and dependent variables can be shown.

This study's independent variables were income, educational attainment, employment status, nationality/country of residence, health insurance status, overweight/obesity, physical activity, and race/ethnicity. The dependent variable was a binary dependent variable of women with and without a Type 2 diabetes diagnosis. I used binary logistic regression to answer RQ2. According to Rastogi and Singh (2019), researchers can use binary logistic regression to analyze the association of several predictor independent variables on a categorical dependent variable at a specific point in time. Further, Uba, Jiadong, Sohail, Irshad, and Yu (2019) explained that this statistical test shows the probability of diagnosis or nondiagnosis of Type 2 diabetes based on the chosen independent variables. Uba et al. also stated that this statistical procedure allows the researcher to use independent variables with different measures, whether continuous, ordinal, or categorical. Also, binary logistic regression has been used successfully by many researchers (Uba et al., 2019).

Methodology

Population

The population selected for this study was women with and without a diagnosis of Type 2 diabetes who were 18 to 64 years of age and living in Puerto Rico and the U.S. Virgin Islands. In the data set for Puerto, the sample contained 1,830 women, 209 with a diagnosis of Type 2 diabetes and 1,621 with no Type 2 diabetes diagnosis (CDC, 2016b). In the U.S. Virgin Islands, the sample size was 407 women, 41 with a diagnosis of Type 2 diabetes and 366 with no diagnosis of Type 2 diabetes (CDC, 2016b).

Sampling and Sampling Procedures

Selecting a sampling strategy is an important step in the study. The CDC (2019A) noted that, for the BRFSS telephone survey, a simple random sample design was used in which landlines in Puerto Rico and the U.S. Virgin Islands were called. To chose a cell phone to call, there is a protocol that selects which number to dial. The BRFSS sample was divided into sections of 1,000 numbers from the Telecordia telephone exchanges database based on the territories area codes and exchanges. The telephone numbers in each frame (N) were divided by the determined sample size (n) to form intervals (K). The BRFSS calling system then selected a random number to call. (CDC, 2019a).

Deciding on the sample size is a necessary process when conducting a research study. According to Schäfer and Schwarz (2019), researchers use the effect size to analyze the results and figure out the statistical power of research studies. In his seminal works in 1962, 1969, 1977, 1988, 1990, and 1992, Jacob Cohen described that a small,

medium, or large effect size can establish if the research results are meaningful. Schäfer and Schwarz recommended that to determine the sample size needed to attain a predetermined power level, the researcher should decide on an effect size that makes sense for the research type. The researcher can pick either a small, medium, or large effect size and chose one for the power analysis (Schäfer & Schwarz, 2019). I used archival data for this study. In such a study, a sample size of 100 valid records and an effect size of 0.5 was appropriate (Bujang, Sa'at, Sidik, & Joo, 2018); Schäfer & Schwarz, 2019). With that sample size, Cohen d = 0.4 would be statistically significant because 0.2 would be considered small and 0.5 would be considered a medium effect. The results from the G*Power calculator, version 3.1.9.2. are shown in Figure 2 (Faul et al., 2013). Determining the sample size was an essential step to ensure that the study yield valid results. The results from the G*Power calculator, version 3.1.9.2. are shown in Figure 2 (Faul et al., 2013). Determining the sample size was an essential step to ensure that the study yield valid results. The results from the G*Power calculator, version 3.1.9.2. are shown in Figure 2 (Faul et al., 2013). Determining the sample size was an essential step to ensure that the study yield valid results.

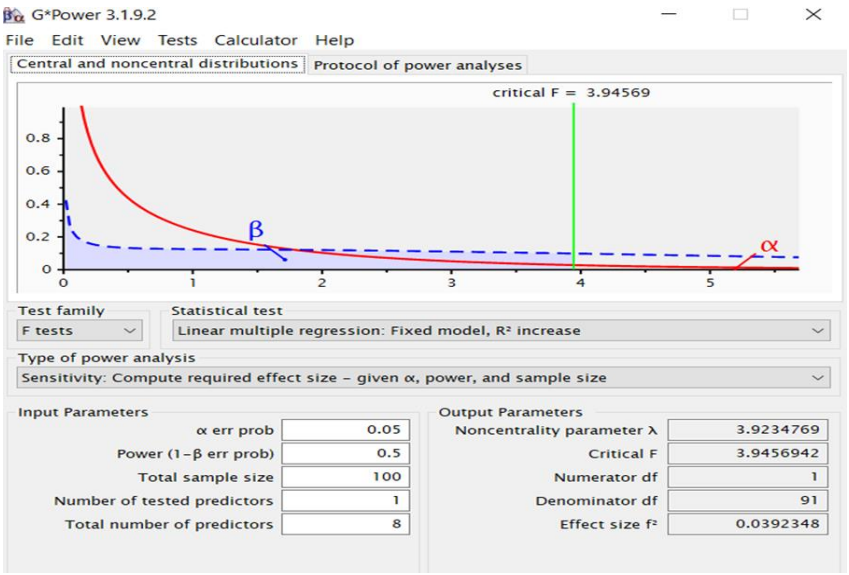

Figure 2. G*Power analysis. This figure shows the G*Power (Faul et al., 2013) calculator's output that I used to determine the adequate sample size and effect size for this study. In the public domain.

Data and Data Sources

The data used for this study was sourced from the CDC's BRFSS surveys collected in 2016 for Puerto Rico and the U.S. Virgin Islands. According to the CDC (2019a), the health departments collected this data every month by calling landlines and residents' cell phones. The questionnaire used was a standardized instrument developed by the CDC. Prevalence data were collected from residents about their health behaviors and health status and then sent to the CDC to be compiled in the same manner as all of the other states and territories (CDC, 2019a). The U.S. Virgin Islands used this data mainly for providing information to researchers about the prevalence of diabetes in those who use Medicare (CDC, 2016a). In Puerto Rico, the data was more widely used to monitor the prevalence of diabetes, provide information for those who design interventions for persons with diabetes who develop diabetes complications, provide data

for the design of campaigns for obesity, and increased physical activity. Overall, the data was used to monitor the quality of life of persons living in Puerto Rico (CDC, 2016a). As can be seen, these departments of health have diverging interests; however, the information collected allowed these institutions to carry out their mission. The data was publicly available from the CDC website; therefore, permission was not necessary to access the data sets.

Instrumentation and Operationalization of the Study Constructs

This study used data sets collected by the CDC. According to the CDC (2019a), the BRFSS data set collection started in 1984 using landlines to collect the survey responses during a telephone call. Today, the program expanded to include data collected from cell phones. This allowance increased the number of persons that can be reached and provided for more diversity in the number of interviewed persons. In 2016, the system's dialing protocol picked persons 18 years and older to call who had a cell phone and lived in a private home or college dormitory (CDC, 2019a). Permission was not be needed to use the 2016 data set since they are publicly available on the CDC site.

The BRFSS data sets have been widely used for several years. Rolle-Lake and Robbins (2020) explained that many government institutions and researchers had used the BRFSS data in important ways. As a result, government agencies can make critical decisions about health issues and enact policies when necessary. For example, Rolle-Lake and Robbins explained that the BRFSS system's data on the H1N1 pandemic enabled the U.S. government to plan for future eruptions (Rolle-Lake & Robbins, 2020).

Additionally, Iachan et al. (2016) stated that the BRFSS data sets provided national health estimates for asthma, influenza, obesity, diabetes, hypertension, and diabetes. The authors explained that the data was reliable and credible. These data sets have been used from 1984 to 2012 in approximately 1,400 articles (Iachan et al., 2016). Also, Tran et al. (2016) mentioned that several researchers who used the BRFSS data found a good correlation among studies that used actual measurements taken from participants and those found in the BRFSS data sets with R squared values of 89 to 92 % (Tran et al., 2019).

Table 1 shows how the variables were operationalized (see Appendix for the original variables from the BRFSS data sets).

Table 1

Dependent and Independent Variables

Research Question	**BRFSS Code**	**Variable Type**	**Re -Coding**
RQ1: What is the prevalence of Type 2 diabetes, overweight/obesity, and prediabetes among Caribbean women of the different nationalities in the study sample?	Diabetes Status: Question: "(Ever told) you have diabetes (If ´Yes´ and respondent was female, ask ´Was this only when you were pregnant?" 1 – Yes 2 - Yes, but female told only during pregnancy 3 - No 4 – No, prediabetes or borderline 7 – Don't know/Not sure 9 – Refused	Eligibility variables (nominal)	0 = No 1 = Yes 2 = Prediabetes 9 = Refused 999 = Don't Know, Not Sure (DIABETE3)
	Prediabetes: Question: "Have you ever been told by a doctor or other health professional that you have pre-diabetes or borderline diabetes (if "Yes" and respondent was female, ask: "Was this only when you were pregnant?" 1 – Yes 2 – Yes, during pregnancy 3 – No 7 – Don't know/not sure 9 – Refused		0 = No 1 = Yes 9 = Refused 999 = Don't know/Not sure (PREDIAB1)

Research Question	**BRFSS Code**	**Variable Type**	**Re -Coding**
RQ2: What is the predictive relationship between the social determinants (income, education level, employment status, nationality/country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis?	Diabetes Status	Dependent Variable (binary)	0 = No diagnosis of Type 2 diabetes 1 = Diagnosis of Type 2 diabetes
	Income: Question: Income categories 1 - Less than $15,000 2 - $15,000 to less than $25,000 3 - $25,000 to less than $35,000 4 - $35,000 to less than $50,000 5 - $50,000 or more 9 - Don't know/Not sure/Missing	Independent variable (ordinal)	1 = Less than $15,000 2 = $15,000 to less than $25,000 3 = $25,000 to less than $35,000 4 = $35,000 to less than $50,000 5 = $50,000 or more 9 = Don't know/Not sure/Missing (_INCOMG)

Research Question	BRFSS Code	Variable Type	Re -Coding
	Educational Attainment: Question: "Level of education completed?" 1 – Did not graduate High School 2 – Graduated High School 3 – Attended College or Technical School 4 – Graduated College or Technical School 9 – Don't Know/Not Sure	Independent Variable (categorical)	1 = Did not graduate High School 2 = Graduated High School 3 = Attended GraduateCollege/Technical School 9 = Don't Know/Not Sure 999 = Missing (_EDUCAG)
	Employment Status: Question: "Are you currently?" 1 – Employed for wages 2 – Self-employed 3 – Out of work for 1 year or more 4 – Out of work for less than 1 year 5 – A homemaker 6 – A student 7 – Retired 8 – Unable to work 9 – Refused	Independent variable (categorical)	1 = Employed 2 = Unemployed 3 = Homemaker 4 = Retired 9 - Refused 999 = Missing (EMPLOY1)
	Nationality/Country of Residence: These were: Puerto Rico U.S. Virgin Islands "State FIPS Code" 72 – Puerto Rico 78 – US Virgin Islands	Independent variable (nominal)	1 = Puerto Rico 2 = U.S. Virgin Islands (_STATE)

Research Question	BRFSS Code	Variable Type	Re -Coding
	Health Insurance Status: Question: "Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service?" 1 - Yes 2 - No 7 - Don't know/Not sure 9 - Refused	Independent variable (binary)	0 = No 1 = Yes 999 = Don't know/Not sure 9 = Refused (HLTHPLN1)
	Physical Activity: Question: During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?" 1 – Yes 2 – No 7 – Don't know/Not sure 9 - Refused	Independent variable (binary)	0 = No physical activity or exercise in the last 30 days 1 = Had physical activity or exercise in the last 30 days 9 = Refused 999= Don't know/Not sure (_EXERANY2)

Research Question	BRFSS Code	Variable Type	Re -Coding
	Body Mass Index: Question: Four categories of Body Mass Index (BMI) 1 – Underweight 2 – Normal Weight 3 – Overweight 4 - Obese 9 – Don't know/Refused/Missing	Independent Variable (categorical)	1 = Underweight/ Normal weight 2 = Overweight 3 = Obese 9 = Don't know/Refused/Missing (_BMI5CAT)
	Race/Ethnicity: Question: Five-level race/ethnicity category. 1 – White only, Non-Hispanic 2 – Black only, Non-Hispanic 3 – Other race only, Non-Hispanic 4 – Multiracial, Non-Hispanic 5 - Hispanic 9 – Don't know/Not sure/Refused	Independent variable (categorical)	1 = White only, Non-Hispanic 2 = Black only, Non=Hispanic 3 = Other race/Multiracial, Non-Hispanic 4 = Hispanic 9 = Don't know/Not sure/Refused 999 = Missing (_RACEGR3)

Research Question	BRFSS Code	Variable Type	Re -Coding
	Age: Question: Two level age category 1 - Age 18 to 64 2 – 65 or older 3 - Don't know/Refused/Missing	Independent variable (categorical)	1 = Age 18 to 64 2 = 65 or older 9 = Don't know/Refused/Missing (_AGE65YR)
	Sex Indicate sex of respondent 1 – Male 2 – Female 9 – Refused		2 = Female 9 = Refused 999 = Missing (SEX)

Note: Dependent and independent variables selected from the CDC's BRFSS Codebook 2016 and adapted from the "Behavioral Risk Factor Surveillance System," by the Centers for Disease Control and Prevention

Data Analysis Plan

The RQs and hypotheses were as follows:

RQ1: What is the prevalence of Type 2 diabetes, overweight/obesity, and prediabetes among Caribbean women of the different nationalities in the study sample?

RQ2: What is the predictive relationship between the social determinants (income, education level, employment status, country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women?

$H_0$2: There is no statistically significant association between the social determinants of health (income, education level, employment status, country of residence,

health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women.

H_A2: There is a statistically significant association between the social determinants of health (income, education level, employment status, country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women.

As previously discussed, the BRFSS data sets for 2016 were selected for Puerto Rico and the U.S. Virgin Islands. The year 2016 was selected because that was the last year the U.S. Virgin Islands had data collected for analysis. Therefore, this data should give a good idea of the state of health in these Caribbean territories. The CDC (2017) explained that these two data sets were already weighted. The weighting procedure allowed for more variables to be added to the data sets so that they more accurately portrayed the sociodemographic characteristics of the territories. The CDC also stated that the BRFSS was the largest survey conducted via telephone interviews in the world. The weighting system was introduced in 2011 and replaced the old method of post-stratification weighting used in previous years. The CDC stated that this new process added a uniform procedure and allowed for more variables to be added, such as marital status, educational status, and telephone lines ownership. This raking allowed for the data sets to more accurately portray the socio-demographic characteristics of a jurisdiction. The 2016 interviews to collect the information for the data sets in this study were collected from cell phones and landlines. As a result, the data sets provided information such as the ethnic makeup of the territories, age by gender, marital status, educational

attainment, whether the information was collected from a landline or cell phone, gender by race and ethnicity, age by race and ethnicity, and whether the respondents owned or rented where they live (CDC, 2017).

Additionally, Iachan et al. (2016) explained that the BRFSS data were collected from a combined sample of cell phones and landlines, some of which may overlap. The authors stated that the breakdown was that 65 % of data was collected from cell phones and 35 % from landlines. The data raking method was the same across the 50 states, although it may vary in a few jurisdictions. Iachan et al. added some other variables such as age, sex, race, ownership of a home, and ethnicity to the list supplied by the CDC (2017). The cleaned data sets were published for the public every year. As a result, Iachan et al. explained that the BRFSS data sets provided national health estimates for diseases such as asthma, influenza, obesity, diabetes, hypertension, and diabetes. The authors explained that the data was reliable and credible. These data sets have been used from 1984 to 2012 in approximately 1,400 articles (Iachan et al., 2016).

When retrieved from the CDC website, the data sets were already cleaned with no identifying information about the respondents. After identifying the variables needed in the codebook for the RQs, they were extracted and imported into the IBM SPSS 25 software. The variables were coded, as explained in Table 1. The focus was on all women (18 to 64) years with and without a Type 2 diabetes diagnosis. The analysis will include running frequency distribution, cross-tabulation tables, and descriptive statistics. To

answer RQ1, the prevalence of Type 2 diabetes, overweight/obesity, and pre-diabetes, the number of persons classified in those categories was divided by the total number of women in the sample and presented as a percentage. For RQ2, the analysis used binary logistic regression to investigate if the independent variables (income, educational attainment, employment status, health insurance status, overweight/obesity, physical activity, and race/ethnicity) were associated with a diagnosis or non-diagnosis of Type 2 diabetes in Caribbean women. This analysis aimed to predict the likelihood of diagnosis or non-diagnosis of Type 2 diabetes among the study participants. The analysis was conducted in the IBM SPSS 25 software

As previously mentioned, binary logistics regression was used to analyze the association of the social determinants of health variables in women diagnosed with Type 2 diabetes versus those without a diagnosis of Type 2 diabetes. Binary logistic regression analysis allowed for the prediction of the likelihood of the women in the sample being placed in one of these two groups based on the analysis of the independent variables (Shrestha, 2019). Logistic regression has been used to analyze the association of several predictor independent variables on a categorical dependent variable at a specific time (Rastogi & Singh, 2019). Binary logistic regression was a good tool to use since it was previously used in several different scenarios and provided good information for the health field (Shrestra, 2019).

There were several assumptions that needed to be satisfied and were analyzed before running the analysis in SPSS. Rastogi and Singh (2019) outlined seven important assumptions that should be met. The first four are that the dependent variable should be

dichotomous, there should be one or more independent variables, there should be independent observations, there should be mutually exclusive and exhaustive relationships between the categories of the dependent variable and the nominal independent variables, and there should be at least 15 occurrences for each independent variable. The three other assumptions are that there should be no multicollinearity and no significant outliers. If there are independent variables with scale measurements, there should be a linear relationship between the variables and the logit transformation of the dependent variable (Rastogi & Singh, 2019). These assumptions were tested in SPSS.

To test for multicollinearity (Rastogi and Singh, 2019) used Variance Inflation Factor (VIF) to analyze if there was multicollinearity among the independent variables. No multicollinearity was important to establish between the predictor variables since its presence resulted in inaccurate results, thus affecting the hypothesis. The VIF for each independent variable should be less than ten for the model's assumption to be met (Rastogi & Singh, 2019).

After the regression was analyzed in SPSS, the descriptive statistics will be presented in Chapter 4, and the data output will be analyzed. The first set of outputs were labeled as Block 0. This portion of the output was the null model. It will not have information about the predictors, only the intercept. In Block 1, there were several important tables to analyze. The first table was the Omnibus Test of Model Coefficients. This table was based on a comparison of the model with a full set of predictors against the null model. It provided a likelihood ratio Chi-Square test. If this table was statistically significant, it provided information that the full model was an improvement and fit over

the null model. Next was the Model Summary Table, which showed the Cox & Snell R Square and the Nagelkerke R Square values (pseudo R squares) to explain how much in percent the model was influenced by the independent variables. The Classification Table in the full regression will show how much in percentage each independent variable added to the model. It demonstrated how well the model classified group membership. It showed the specificity, sensitivity of the model, and the overall classification accuracy in percentages. The Hosmer Lemeshow Table provided important information regarding the goodness of fit of the binary logistic regression. It showed how well the chosen data fit in the model. If the model was statistically insignificant ($p > .05$) in the Hosmer Lemeshow Table, this was an indication of a good model fit (Rastogi & Singh, 2019). The Variables in the Equation Table provided information on Regression Coefficients, the Standard Errors, the Wald Test, the Degrees of Freedom, which independent variables are statistically significant ($p < .05$), and the Odds Ratios. The odds ratio showed the odds that women will have Type 2 diabetes or non-diabetes based on the predictors (income, education level, employment status, country of residence, health insurance status, overweight/obesity, physical activity, and race/ethnicity). If an odds ratio was greater than one, and the independent predictor was statistically significant, that means that there was a positive relationship. If an odds ratio was less than 1, that means there was a negative relationship. Based on the analysis, the results were reported with 95 % Confidence Interval (CI). The wider the CI, the less precise the odds, and the smaller the CI, the more precise the odds. The findings, along with the relevant tables, were reported as appropriate.

Threats to Validity

I used secondary data to conduct quantitative, non-experimental, retrospective analysis to answer the RQs. According to Patino and Ferreira (2018), the term validity in a research study referred to whether the findings can be generalized to others in the population. Validity in research usually referred to internal and external validity. First, looking at internal validity, the researcher would want to ensure that the findings represent the sample in the study and not due to errors and bias. Once internal validity was ensured, then the researcher can examine factors that would affect external validity (Patino & Ferreira, 2018). Also, Matthay and Glymour (2020) discussed eight threats to internal validity in studies. They are maturation, history, testing, statistical regression, mortality, interaction effects, instrumentation, and testing. If not controlled, they can negatively affect the study. None of these factors influenced the secondary data (Matthay & Glymour, 2020). Further information was provided below:

- History: The study used data only from 2016. There was no need to take into consideration what happened between a first and second measurement.
- Maturation: The data was collected over a short period every year before being processed. The study does not need to take into consideration participants improving over time.
- Testing: The data was only collected once in 2016. The data set did not include a second test.
- Instrumentation: A standardized questionnaire was used that was approved by a representative of each of the 50 states and territories. It was used for years (Rolle-

Lake & Robbins, 2020). The CDC also described that data collectors have low turnover, and the collectors are monitored and evaluated often.

- Statistical regression: There was a protocol to randomly select the phone numbers that are called, the respondent, and all the data are combined. Further, the CDC performed a weighting procedure on the data before giving it back to the states (Rolle-Lake & Robbins, 2020).
- Selection of subjects: There was an automated process to select which telephone numbers are called. It would be difficult to introduce bias into the system to choose particular participants.
- Mortality: In this type of data collection, experimental mortality would be difficult to introduce. This was a cross-sectional data collection, not a longitudinal study.
- Interaction effects: In this type of data collection, there would not be an interaction effect of comparison groups and maturation. The data was collected over several months using the same instrument, then sent to the CDC for processing (Rolle-Lake & Robbins, 2020).

Additionally, the CDC (2019a) described that the BFRSS data was self-reported and collected during telephone interviews. In 2011, to access a more diverse population, the CDC started interviewing respondents on cell phones and landlines (CDC, 2019a). Several researchers have looked at the issue of internal validity and reliability of the BRFSS data. According to Tran et al. (2019), one method to test this data's validity was to compare the prevalence rates found in the BRFSS data to other surveys from other

national studies (2019). In 2018, Hsia et al. (2020) also examined ten popularly used variables from the BRFSS, the NHANES, and the NHIS between 2011-2016. Hsai et al. found that the BRFSS variables had similar results to those from the NHANES and the NHIS. The conclusions were that although slight differences were found, they were not significant (Hsia et al., 2020). These finding adds to the data that showed that the BRFSS data sets are reliable and valid. The prevalence rates found in the data sets were compared to the results found in other studies.

External Validity

External validity addresses the issue of the extent to which a study's findings can be generalized (Patino & Ferreira, 2018). Therefore, as discussed by Setia (2016), causal relationships cannot be attributed between the independent variables and the dependent variable. Only associations were drawn from the analysis (Setia, 2016). Also, according to the CDC (2019a), before 2011, interviews were only conducted by calling landlines. In 2011, cell phone interviews were added to the survey. This feature allowed the CDC to add a new methodology of weighting (raking). The weighting or raking enabled the CDC to make the samples' characteristics like the states' population and territories in which the data sets were collected. The answers to the questions were those provided by the respondent, and the responses are assumed to be truthful and correct. Another factor to consider was that only women 18 to 64 years of age were included in the study, not the entire data set (CDC, 2019a).

Additionally, Qin, Bailey, and Zahran (2019) described that adding cell phones to the calling option provided a better quality of data, added more Hispanics, younger

persons, and included a more comprehensive and more diverse sample of the population in the states and territories. These factors increased the validity of the data collected. Also noteworthy was the fact that landlines are becoming a thing of the past. Approximately 54.9 % of households no longer have landline telephones (Qin et al., 2019). Therefore, the move to add the use of cell phones to the survey was an important decision. These previously mentioned points would further the aim of this study and provided answers for this study's RQs.

Ethical Procedures

The BRFSS data sets for Puerto Rico and the U.S. Virgin Islands were downloaded from the CDC website. An IRB application was made to Walden University for approval before starting to conduct the analysis. The CDC (2019a) outlined the ethical procedures that were taken in collecting the data. The information was collected using telephone interviews on landlines and cell phones from adults over 18 years and noninstitutionalized living in Puerto Rico and the U.S. Virgin Islands. The process was overseen by the departments of health in the territories and followed the guidelines that were agreed to with the CDC. The health departments worked with the CDC to agree on how the interviews were handled and what questions were asked. The interviewers have previous experience and are also trained to use the BRFSS questionnaire. The CDC reported that there was a high rate of retention among interviewers. According to the BRFSS protocols, the quality of the interviewer's skills was evaluated, and in 2016 all sites were able to evaluate the interviewers. For quality control, the accuracy of the data was verified through a callback feature in the process. The CDC was the institution that

cleaned up the raw data and added the weighting measures before returning the data sets to the individual territories. The data sets did not have any identifiers, such as names to protect the confidentiality of the responders. Additionally, persons over 80 years were not interviewed. These processes have been ongoing since 1984, and constant review and modifications have been made to improve the survey results (CDC, 2019a). The data sets that resulted from the surveys are publicly available therefore, permission was not needed to use the data**.**

Lastly, an application was also made to IRB at Walden University to gain permission to conduct this study. Approval was granted in July 2020. The IRB approval number is 07-22-20-0740191.

Summary

This study will use cross-sectional research, quantitative, non-experimental design to answer the RQs posed in Chapter 1. Data sets from the CDC's BRFSS for Puerto Rico and the U.S. Virgin Islands were used for the analysis. This chapter explained the research design and rationale, the study population, ethical procedures, the research design and rationale, the sampling procedures, the methodology, the data analysis plan, along with threats to internal and external validity. This chapter also described the predictor variables, the dependent variable which was the Type 2 diabetes status of the study participants. The results and findings will be discussed in Chapter 4.

Chapter 4: Results

Introduction

My goal in conducting this study was to analyze which, if any, social determinants of health have an association with the high rate of obesity and Type 2 diabetes status in women in the Caribbean islands of Puerto Rico and the U.S. Virgin Islands. In this chapter, I will further explain the data collection and report the findings of the data analysis. Frequencies and percentages will be used to explore the analysis of the nominal-level variables. Descriptive statistics will be presented to explore RQ1. A binary logistic regression will be used to address RQ2. Chapter 4 also includes the results of the study and a summary of key points. The two RQs for the study were.

RQ1: What was the prevalence of Type 2 diabetes, overweight/obesity, and prediabetes among Caribbean women of the different nationalities in the study sample?

RQ2: What was the predictive relationship between the social determinants (income, education level, employment status, country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women?

$H_0$2: There was no statistically significant association between the social determinants of health (income, education level, employment status, country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women.

H_A2: There was a statistically significant association between the social determinants of health (income, education level, employment status, country of residence,

health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women.

Data Collection

I selected the BRFSS data sets for 2016 for Puerto Rico and the U.S. Virgin Islands. Data sets from 2016 were chosen because that was the last year the BRFSS data were collected for the U.S. Virgin Islands. The CDC (2019a) indicated that in 2011, the agency changed its collecting and weighting methods and included data collected via cell phones. Previously, data were only collected using landlines. Data collected from landlines involved the use of a disproportionate stratified sampling methodology, while random sampling was used to collect data using cell phones (CDC, 2019a). After collecting the data, the CDC staff used a method referred to as *raking* for weighting the data. The two data sets used for this study included women aged 18 to 64 years; the data was raked and weighted to represent the demographic attributes of the population (CDC, 2019a).

The data sets retrieved from the CDC website contained no identifying information regarding the respondents. I extracted and imported the variables needed to answer the codebook's RQs into the IBM SPSS 25.0 software. The variables were then recoded, as outlined in Table 1, and the cases that met the inclusion criteria for the study were extracted for analysis.

This study's population of interest included all women (18 to 64 years) with and without a Type 2 diabetes diagnosis. The initial sample consisted of 4,416 female participants. After selecting women who were 18 to 64 years old, the sample size was

2,775 participants. I did not include survey responses that did not provide complete information for the variables of interest for the final analysis. The CDC (2019a) noted that survey responses with incomplete information could result from factors such as the interview terminating before all the questions were asked, the respondent refusing to answer, or the questionnaire being designed in a certain way. For example, responses to questions such as a status of prediabetes were collected based on the response from an earlier question about Type 2 diabetes status. The original question asked the respondent, "(Ever told) you have diabetes? (If ´Yes´ and respondent was female, ask ´Was this only when you were pregnant?" The choices were, "Yes", "Yes, but female told only during pregnancy", "No", "No, prediabetes or borderline", "Don't know/Not sure", "Refused". If a respondent answered yes to being told that they were told they had prediabetes or borderline, they were routed to answer further questions regarding having a status of prediabetes. (CDC, 2019a).

Descriptive Statistics

The sample consisted of 2237 participants. Table 2 shows the frequencies and percentages of the demographics. For income, approximately 822 (36.7%) women earned less than $15,000, followed by 673 (30.1%) who earned $15,000 to $24,999. Concerning educational attainment, 1,483 (66.3%) attended or graduated college or technical school, and 536 (24.0%) graduated high school. Nearly half of the sample, 1,105 (49.4%), were employed, 514 (23.0%) were homemakers, and 430 (19.2%) were unemployed or unable to work. In this sample, 2,055 (91.9%) had health insurance; only 182 (8.1%) individuals had no health coverage. More than half of the sample, 1,333 (59.6%), reported that they

had some form of physical activity or exercise in the last 30 days; 904 (40.4%) had no physical activity. Lastly, the largest portion of the sample, 1,873 (83.7%) were Hispanic, followed by 288 (12.9%) who identified as Black only, non-Hispanic.

The Puerto Rico sample's lowest income level (less than $15,000) was the predominant income group. The U.S. Virgin Islands sample's highest income level ($50,000 or more) was the predominant income group. Most of the participants in both samples attended/graduated college/technical school. Also, most of the participants in both samples were employed. Most participants had health insurance and had physical activity or exercise in the previous 30 days. A majority of the sample was from Puerto Rico and of Hispanic descent. Most of the sample from the U.S. Virgin Islands was Black.

Table 2

Frequencies and Percentages for Demographic Variables

Variable	Puerto Rico (*n* = 1830)		U.S. Virgin Islands (*n* = 407)		Total sample (*n* = 2237)	
	n	%	*n*	*%*	*n*	%
Income						
Less than $15,000	746	40.8	76	18.7	822	36.7
$15,000 to $24,999	587	32.1	86	21.1	673	30.1
$25,000-$34,999	192	10.5	49	12.0	241	10.8
$35,000-$49,999	142	7.8	63	15.5	205	9.2
$50,000 or more	163	8.9	133	32.7	296	13.2
Educational status						
Did not graduate high school	169	9.2	49	12.0	218	9.7
Graduated high school	406	22.2	130	31.9	536	24.0
Attended/Graduated college/Technical school	1255	68.6	228	56.0	1483	66.3
Employment						
Employed	817	44.6	288	70.8	1105	49.4
Unemployed or unable to work	377	20.6	53	13.0	430	19.2
Homemaker	490	26.8	24	5.9	514	23.0
Retired	146	8.0	42	10.3	188	8.4
Health insurance						
Yes	1741	95.1	314	77.1	2055	91.9
No	89	4.9	93	22.9	182	8.1
Physical activity						
Had physical activity or exercise in last 30 days	1026	56.1	307	75.4	1333	59.6
No physical activity or exercise in the last 30 days	804	43.9	100	24.6	904	40.4
Race/Ethnicity						
White only, non-Hispanic	20	1.1	33	8.1	53	2.4
Black only, non-Hispanic	5	0.3	283	69.5	288	12.9
Other race/multiracial, non-Hispanic	6	0.3	17	4.2	23	1.0
Hispanic	1799	98.3	74	18.2	1873	83.7

Note. Due to rounding errors, percentages may not equal 100%.

In Chapter 3, I described that the CDC (2019) implemented a weighting system, also referred to as raking, to make the territories' data sets representative. It was introduced in 2011 and replaced the old method of post-stratification weighting used in previous years. The CDC stated that this new process added a uniform procedure and allowed for more variables to be added, such as marital status, educational status, and telephone lines ownership. This raking allowed the data sets to portray the territories' socio-demographic characteristics more accurately (CDC, 2019a).

Further, the CDC (2019a) reported that the 2016 surveys for Puerto Rico and the U.S. Virgin Islands were collected from both cell phones and landlines. As a result, the data sets provided information such as the ethnic makeup of the territories, age by gender, marital status, educational attainment, whether the information was collected from a landline or cell phone, gender by race and ethnicity, age by race and ethnicity, and whether the respondents owned or rented where they live. Additionally, the CDC described that raking added several advantages. The new procedures allowed additional variables such as homeownership, educational attainment, and marital status. The expansion of adding cell phone lines assisted with adding more persons to the survey, which helped reach a wider population and lower the chances for bias (CDC, 2019a).

Results

RQ1 was, What is the prevalence of Type 2 diabetes, obesity, and prediabetes among Caribbean women of the different nationalities in the study sample?

To address RQ1, descriptive statistics were utilized to explore the prevalence of Type 2 diabetes, overweight/obesity, and prediabetes among Caribbean women of the

different nationalities in the study sample. Table 3 presents the frequencies and percentages for Type 2 diabetes, weight status, and prediabetes. In the total sample of participants 250 (11.2%) had Type 2 diabetes, 1,987 (88.8 %) had no Type 2 diabetes. Most of the sample 799 (35.7%) were obese, followed by 757 (33,8 %) who were overweight. As it related to prediabetes status, 1,698 (78.9 %) had no prediabetes, 282 (12.6%) had prediabetes, and 257 (11.5 %) did not respond. Further analyzed, in the Puerto Rico sample, approximately one-third of the sample was categorized into each of the BMI categories: underweight/normal weight 584 (31.9%), overweight 621 (33.9%), and obese 625 (34.2%). In the U.S. Virgin Islands sample, the obese group was the most prevalent 174 (42.8%). In Puerto Rico, 11.4 % was diagnosed with prediabetes versus 17.9 % in the U.S. Virgin Islands.

Table 3

Frequencies and Percentages for Type 2 Diabetes, BMI, and Prediabetes

Variable	Puerto Rico (n = 1830)		U.S. Virgin Islands (n = 407)		Total sample (n = 2237)	
	N	*%*	*N*	*%*	*n*	*%*
Type 2 Diabetes						
Yes	209	11.4	41	10.1	250	11.2
No	1621	88.6	366	89.9	1987	88.8
BMI						
Underweight/normal weight	584	31.9	97	23.8	681	30.4
Overweight	621	33.9	136	33.4	757	33.8
Obese	625	34.2	174	42.8	799	35.7
Prediabetes status						
Yes	209	11.4	73	17.9	282	12.6
No	1405	76.8	293	72.0	1698	78.9
No response	216	11.8	41	10.1	257	11.5

Note. Due to rounding errors, percentages may not equal 100%. No response could have resulted from several factors such as the interview terminating before that question was asked, the respondent refusing to answer, or how the questionnaire was designed. The prediabetes question was only asked based on the response from an earlier question about Type 2 diabetes status. Adapted from the "Behavioral Risk Factor Surveillance System," by the Centers for Disease Control and Prevention

Figures 3, Figure 4, and Figure 5 portrayed the results for Puerto Rico and the U.S. Virgin Islands.

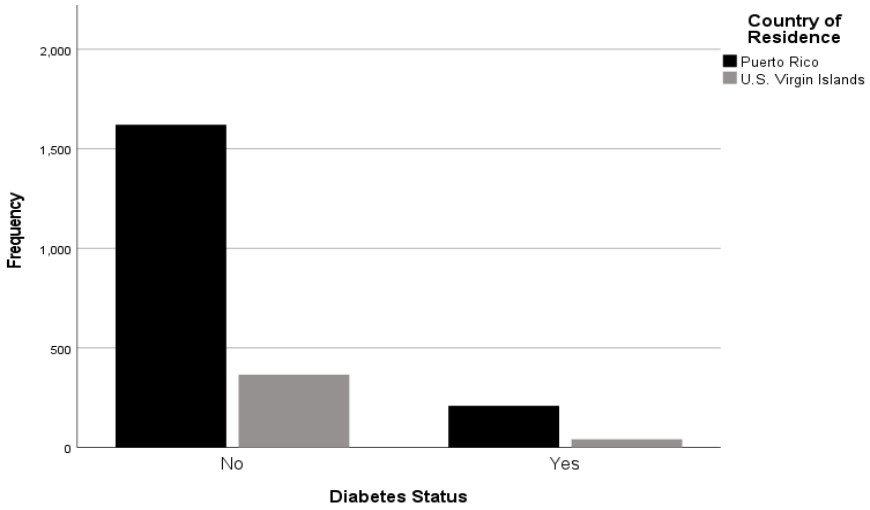

Figure 3. Bar graph showing the prevalence of Type 2 diabetes in Puerto Rico and the U.S. Virgin Islands.

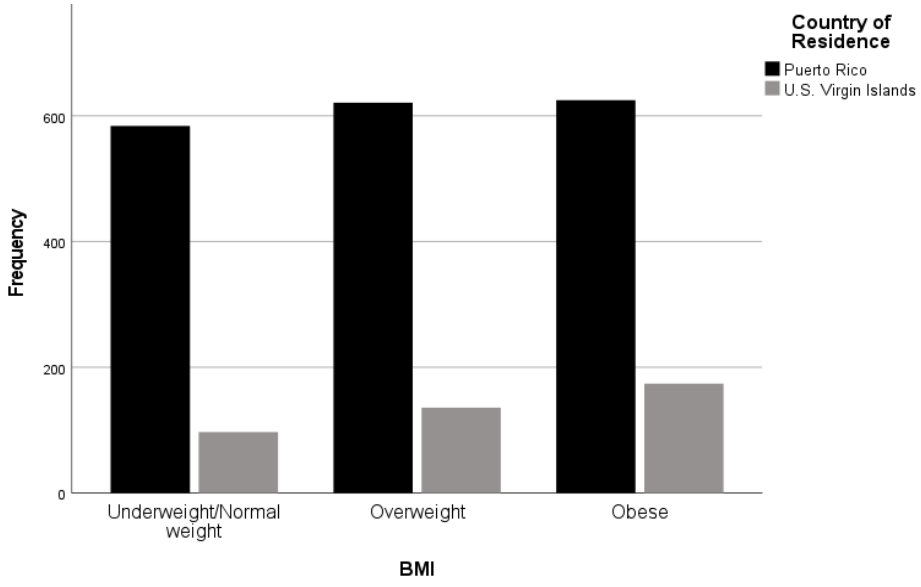

Figure 4. Bar graph showing the prevalence of BMI (Underweight, Overweight, and Obesity) in Puerto Rico and the U.S. Virgin Islands

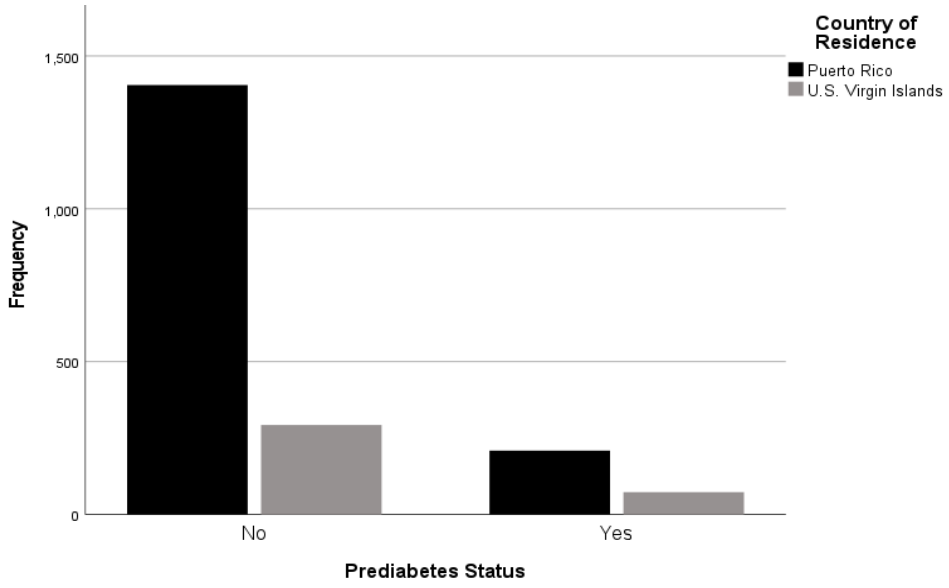

Figure 5. Bar graph showing the prevalence of Prediabetes in Puerto Rico and the U.S. Virgin Islands

RQ2 was, What is the predictive relationship between the social determinants (income, education level, employment status, country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women? The hypotheses were as follows:

$H_0$2: There is no statistically significant association between the social determinants of health (income, education level, employment status, country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women.

H_A2: There is a statistically significant association between the social determinants of health (income, education level, employment status, country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women.

To address RQ2, a binary logistic regression was conducted to examine the predictive relationship of social determinants, weight status, physical activity, and race/ethnicity on Type 2 diabetes diagnosis. This type of logistic regression have frequently been utilized to analyze the association of several predictor independent variables on a categorical dependent variable at a specific time (Rastogi & Singh, 2019).

Before the analysis, the assumptions of the logistic regression were verified. According to Rastogi and Singh (2019), the first assumption was that the dependent variable should be dichotomous. This was met due to the Type 2 diabetes diagnosis status being a dichotomous variable – Yes or No. The second assumption was that there should be one or more independent variables. A total of eight predictor variables were examined in the analysis. The third assumption was that there should be independent observations. Each participant provided a unique response to the data set, and one response did not influence another response. The fourth assumption was that there should be at least 15 occurrences. All the variables had at least 15 occurrences. The fifth assumption, the absence of multicollinearity, was verified through the use of variance inflation factors (VIFs). All the variables had VIFs lower than 10, indicating that the assumption for the absence of multicollinearity was met (Rastogi & Singh, 2019). In a research study, it was important that multicollinearity was checked. Vatcheva, Lee, McCormick, and Rahbar (2016) explained that multicollinearity occurred when several predictor variables in a model are highly correlated. If multicollinearity was not checked, the study results could be flawed due to bias, incorrect *p*-values, affect significance values, and thereby the hypotheses (Vatcheva et al., 2016). According to Rastogi and Singh (2019), the sixth

assumption was that there should be no significant outliers. Due to the use of all categorical data, there were no outliers in the data set. The last assumption was that there should be a linear relationship between any continuous variables and the dependent variable's logit transformation. There were no continuous variables in the study (Rastogi & Singh, 2019).

A series of chi-square tests were utilized to examine the two-way associations of the Type 2 diabetes variables. This was a preliminary test to determine if there were any association between the nominal variables (Leon-Guerrero & Frankfort-Niachmias, 2017). Table 4 presents the chi-square tests. There was a significant association between income and Type 2 diabetes ($\chi^2 = 16.12$, $p = .003$). There was a significant association between education and Type 2 diabetes ($\chi^2 = 13.66$, $p = .001$). There was a significant association between employment and Type 2 diabetes ($\chi^2 = 53.92$, $p < .001$). There was a significant association between BMI and Type 2 diabetes ($\chi^2 = 77.01$, $p < .001$). There was a significant association between physical activity and Type 2 diabetes ($\chi^2 = 9.87$, $p = .002$). There were no significant associations between country of residence and Type 2 diabetes ($\chi^2 = 0.61$, $p = .435$), health insurance status and Type 2 diabetes ($\chi^2 = .11$, $p = .742$), and race/ethnicity and Type 2 diabetes ($\chi^2 = 4.91$, $p = .178$). According to Leon-Guerrero and Frankfort-Niachmias (2017), chi-square tests were appropriate to use for the purpose of finding simple associations. However, although they can show if there was an association, they do not show the strength of the association or if the significant outcomes were applicable to the population. Further, this test is sensitive to sample size (Leon-Guerrero & Frankfort-Niachmias, 2017).

Even though the country of residence, health insurance, and race/ethnicity were not significant, these variables were included in the full binary logistic regression. Results from past studies cited in the problem statement and literature review have shown that these variables were associated with Type 2 diabetes.

Table 4

Chi-Square Tests by Type 2 Diabetes Status

	Type 2 diabetes status			
	Yes	No	χ^2	*P*
Income			16.12	.003
Less than $15,000	110	712		
$15,000 to $24,999	77	596		
$25,000-$34,999	30	211		
$35,000-$49,999	17	188		
$50,000 or more	16	280		
Education			13.66	.001
Did not graduate high school	38	180		
Graduated high school	69	467		
Attended/Graduated college/technical school	143	1340		
Employment			53.92	<.001
Employed	77	1028		
Unemployed	59	371		
Homemaker	70	444		
Retired	44	144		
Country of residence			0.61	.435
Puerto Rico	209	1621		
U.S. Virgin Islands	41	366		
Health insurance status			0.11	.742
Yes	231	1824		
No	19	163		
BMI (reference: Underweight/normal weight)			77.01	<.001
Underweight/n weight	30	651		
Overweight	72	685		
Obese	148	651		
Physical activity			9.87	.002
Had physical activity or exercise in last 30 days	126	1207		
No physical activity or exercise in last 30 days	124	780		
Race/Ethnicity (reference: Hispanic)			4.91	.178
Hispanic	215	1658		
White only, non-Hispanic	1	52		
Black only, non-Hispanic	31	257		
Other race/multiracial, non-Hispanic	3	20		

A binary logistic regression was conducted to examine the predictive relationship of social determinants, weight status, physical activity, and race/ethnicity on Type 2 diabetes diagnosis. The outcome variable Type 2 diabetes status was coded 0 = no Type 2 diabetes and 1 = a diagnosis of Type 2 diagnosis. The analysis was performed in IBM SPSS 25. After running the binary logistic regression, the first analysis, Block 0, showed only the null model with no predictor variables.

Next, looking at Block1 in the full regression, Table 5, the Omnibus Table of Model Coefficients showed the complete set of predictors against the null model. It was a likelihood ratio chi-square test that compares the null model and the model with all of the independent variables. It showed the overall significance of the model. In looking at the model row, the model was statistically significant ($p < .05$) and was an improvement on the fit of the null model (Laureate Education, 2017d).

Table 5

Omnibus Test of Logistic Regression Model Coefficients

Source	χ^2	*Df*	*P*
Block	143.724	17	<.001
Model	143.724	17	<.001

Table 6 showed the Model Summary Table. The results of the overall logistic regression were statistically significant, $\chi^2(17) = 143.72$, $p < .001$, Nagelkerke $R^2 = .124$, suggesting that collectively there was a significant predictive relationship between the predictors on Type 2 diabetes diagnosis. The Nagelkerke R^2 indicated that the predictor variables could explain approximately 12.4% of the variance in Type 2 diabetes diagnosis. This was a small variance and demonstrated that there are more significant

predictor variables to explain Type 2 diabetes diagnosis in women. Due to the significance of the overall regression model, individual predictors were examined further (Laureate Education, 2017d).

Table 6

Logistic Regression Model Summary

Source	-2 Log Likelihood	Cox & Snell R^2	Nagelkerke R^2
Step 1	1422.95	.062	.124

Table 7 showed the Hosmer and Lemeshow Table. The Hosmer and Lemeshow test assessed the goodness of fit for the logistic regression model. The findings of the Hosmer and Lemeshow test were not statistically significant, $\chi^2 = 5.16$, $p = .741$, indicating a good model fit. (Laureate Education, 2017d).

Table 7

Hosmer and Lemeshow Test

Source	χ^2	*Df*	*P*
Step 1	5.16	8	.741

Table 8 showed the Classification Table. In the full regression, this table showed 88.8 % of the sample participants were correctly predicted in the model.

Table 8

Classification Table for Logistic Regression Model

Observed		Predicted Type 2 Diabetes Diagnosis No	Yes	Percentage Correct
Type 2 Diabetes Diagnosis	No	1987	0	100.0
	Yes	250	0	0.0
Overall Percentage				88.8

The Variables in the Equation Table provided information on the Regression Coefficients, the Standard Errors, the Wald Test, the Degrees of Freedom, and which independent variables were statistically significant ($p < .05$) and the Odds Ratios. Table 9 presented the results of the binary logistic regression.

Table 9

Variables in the Equation Table: Binary Logistic Regression Between Independent Variables and the Dependent Variable

Source	*B*	*SE*	Wald	*p*	*OR*	95% CI	
Income (reference: Less than $15,000)							
$15,000 to $24,999	0.06	0.18	0.10	.750	1.06	0.75	1.50
$25,000-$34,999	0.19	0.25	0.58	.447	1.21	0.74	1.99
$35,000-$49,999	-0.08	0.32	0.06	.805	0.93	0.50	1.72
$50,000 or more	-0.46	0.32	1.98	.159	0.63	0.34	1.20
Education (reference: Did not graduate high school)							
Graduated high school	-0.36	0.23	2.38	.123	0.70	0.44	1.10
Attended/Graduated college/Technical school	-0.49	0.23	4.46	.035	0.61	0.39	0.97
Employment (reference: Employed)							
Unemployed	0.59	0.21	8.34	.004	1.81	1.21	2.70
Homemaker	0.53	0.21	6.55	.011	1.70	1.13	2.56
Retired	1.42	0.22	42.19	<.001	4.13	2.69	6.33
Country of residence (reference: Puerto Rico)							
U.S. Virgin Islands	0.04	0.38	0.01	.906	1.05	0.50	2.19
Health insurance status (reference: no)							
Yes	0.11	0.28	0.17	.684	1.12	0.65	1.93
BMI (reference: Underweight/Normal weight)							
Overweight	0.70	0.23	9.50	.002	2.02	1.29	3.15
Obese	1.48	0.21	48.77	<.001	4.38	2.89	6.63
Physical activity (reference: No physical activity or exercise in the last 30 days)							
Had physical activity or exercise in last 30 days	-0.26	0.14	3.15	.076	0.78	0.59	1.03
Race/Ethnicity (reference: Hispanic)							
White only, non-Hispanic	-1.46	1.05	1.92	.165	0.23	0.03	1.83
Black only, non-Hispanic	-0.00	0.40	0.00	.994	1.00	0.46	2.18
Other race/multiracial, non-Hispanic	0.27	0.68	0.16	.689	1.31	0.35	4.96

Note. Overall model: $\chi^2(17) = 143.72$, $p < .001$, Nagelkerke $R^2 = .124$

A binary logistic regression analysis was conducted to investigate [What is the predictive relationship between the social determinants (income, education level, employment status, country of residence, health insurance status), overweight/obesity , physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women?]. The outcome of interest was [Type 2 diabetes diagnosis status]. The possible predictor

variables were: [income, education level, employment status, country of residence, health insurance status, overweight/obesity, physical activity, and race/ethnicity]. The Hosmer-Lemeshow goodness-of-fit was [not] significant ($p > 0.05$) indicating the model was correctly specified. Additionally, the [-2 log Likelihood = 1422.95] and the [Nagelkerke R squared = .124]. The model resulted in the IVs (income, country of residence, health insurance status, physical activity, and race/ethnicity) not significant ($p > 0.05$), however, the IVs educational level (attended/graduated college or technical school), employment status (unemployed, homemaker, and retired) and BMI (overweight and obese) were found to be significant. Controlling for employment status (unemployed, homemaker, retired) and BMI (overweight and obese), the predictor variable, [educational level (attended/graduated college or technical school], in the logistic regression analysis was found to contribute to the model. The unstandardized B = [-0.49], SE = [.23], Wald = [4.46], $p = .035$. The estimated odds ratio showed a [negative] relationship of [less than 1.0] [Exp (B) = [0.61], 95% CI (0.39, 0.97)] for every one-unit reduction of [educational level (attended/graduated college or technical school)]. Controlling for educational level (attended/graduated college or technical school) and BMI (overweight and obese) the predictor variable, [employment status (unemployed, homemaker, and retired)], in the logistic regression analysis was found to contribute to the model. For unemployed the unstandardized B = [0.59], SE = [.21], Wald = [8.34], $p = .004$. The estimated odds ratio favored a [positive] relationship of nearly [two] fold [Exp (B) = [1.81], 95% CI (1.21, 2.70)] for every one unit increase of [employment status unemployed]. For homemaker, the unstandardized B = [0.53], SE = [.21], Wald = [6.55],

p = .011. The estimated odds ratio favored a [positive] relationship of nearly [two] fold [Exp (B) = [1.71], 95% CI (1.13, 2.56)] for every one unit increase of [employment status homemaker]. For retired the unstandardized B = [1.42], SE = [.22], Wald = [42.19], p < .001. The estimated odds ratio favored a [positive] relationship of more than [four] fold [Exp (B) = [4.13], 95% CI (2.69, 6.33)] for every one unit increase of [employment status retired]. Controlling for educational level (attended/graduated college or technical school) and employment status (unemployed, homemaker, and retired), [BMI (overweight and obese)], in the logistic regression analysis was found to contribute to the model. For overweight the unstandardized B = [0.70], SE = [.23], Wald = [9.50], *p* = .002. The estimated odds ratio favored a [positive] relationship of [two] fold [Exp (B) = [2.02], 95% CI (1.29, 3.15)] for every one unit increase of [overweight]. For obese the unstandardized B = [1.48], SE = [.21], Wald = [48.77], *p* < .001. The estimated odds ratio favored a [positive] relationship of nearly [four and a third] fold [Exp (B) = [4.38], 95% CI (2.89, 6.63)] for every one unit increase of [obesity].

Summary

This study analyzed which social determinants of health had an association with the high rate of obesity and Type 2 diabetes status in women in the Caribbean islands of Puerto Rico and the U.S. Virgin Islands. In this chapter, the findings of the data analysis were examined. Frequencies and percentages were utilized to demonstrate the trends in the demographic variables.

To address RQ1, descriptive statistics were utilized to explore the results in the sample by nationality. Overall, in the total sample of participants 250 (11.2%) had Type 2

diabetes, 1,987 (88.8 %) had no Type 2 diabetes. Most of the sample 799 (35.7%) were obese, followed by 757 (33,8 %) who were overweight. As it related to prediabetes status, 1,698 (78.9 %) had no prediabetes, 282 (12.6%) had prediabetes, and 257 (11.5 %) did not respond. Looking at each country of residence, approximately 11.4 % of Puerto Rico and 10.1 % of U.S. Virgin Islands samples had a Type 2 diabetes status. In the Puerto Rico sample, approximately one-third of the sample was categorized into each of the BMI categories: underweight/normal weight 584, (31.9%), overweight 621, (33.9%), and obese 625, (34.2%). In the U.S. Virgin Islands sample, the obese group was the most prevalent 174, (42.8%). In Puerto Rico, 11.4 % was diagnosed with prediabetes versus 17.9 % in the U.S. Virgin Islands.

To address RQ2, chi-square tests and a binary logistic regression were conducted to examine the associations between the social determinants of health (income, education level, employment status, country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women. The overall logistic regression results were statistically significant, suggesting that collectively there was a significant predictive relationship between the predictors on Type 2 diabetes diagnosis. Education (attended college/graduate/ technical school) was a significant predictor variable in the model, indicating that participants who attended college/graduate/technical school were less likely to have Type 2 diabetes in comparison to those who did not graduate high school. Employment (Unemployed or unable to work) was a significant predictor variable in the model, indicating that participants who were unemployed or unable to work were more likely to have Type 2

diabetes in comparison to those who were employed. Employment (Homemaker) was a significant predictor variable in the model, indicating that participants who were homemakers were more likely to have Type 2 diabetes in comparison to those who were employed. Employment (Retired) was a significant predictor variable in the model, indicating that participants who were retired were more likely to have Type 2 diabetes in comparison to those who were employed. BMI (Overweight) was a significant predictor variable in the model, indicating that overweight participants were more likely to have Type 2 diabetes compared to those underweight or normal weight. BMI (Obese) was a significant predictor variable in the model, indicating that obese participants were more likely to have Type 2 diabetes compared to those underweight or normal weight.

In Chapter 5, the data analyses' findings will continue to be explored along with recommendations and implications for social change for Caribbean women. The limitations identified in this study and proposals for future studies will also be discussed further.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

I examined the association of several social determinants of health (income, educational attainment, employment status, health insurance status) along with overweight/obesity, physical activity, and race/ethnicity on the Type 2 diabetes status of women in Puerto Rico and U.S. Virgin Islands. I conducted this study to address the lack of information on the role of income, occupation, educational attainment, and ethnicity in the high prevalence of obesity and Type 2 diabetes in women in the Caribbean. Caribbean women are currently three times more obese than men and one and a half times likely to have Type 2 diabetes, according to Sobers-Grannum et al. (2015). The only other place with such dire statistics was Southern Africa (Sobers-Grannum et al., 2015). This study provides information that expands health leaders' understanding of why Caribbean women are at such high risk for Type 2 diabetes. Understanding whether and how these social determinants are associated with the Type 2 diabetes in Caribbean women may help health leaders to write more effective health policies, design gender-specific interventions, allocate resources, prioritize decisions, and develop evidence-based health education programs.

RQ1 was, What is the prevalence of Type 2 diabetes, overweight/obesity, and prediabetes among Caribbean women of the different nationalities in the study sample? The results showed that in the sample the overall the prevalence of Type 2 diabetes was 11.2 %. Additionally, 35.7% of the sample were obese, 33.8 % were overweight, and 12.6 % had prediabetes. Further examination showed that in Puerto Rico, 11.4 % of the

sample had a status of Type 2 diabetes, 33.9 % were overweight, 34.2 % were obese, and 11.4 % had prediabetes. In the U.S. Virgin Islands, 10.1 % of the sample had a status of Type 2 diabetes, 33.4 % were overweight, 42.8 % were obese, and 17.9 % had prediabetes

RQ2 was, What is the predictive relationship between the social determinants (income, education level, employment status, country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women? The results of the overall logistic regression were statistically significant, $\chi^2(17) = 143.72$, $p < .001$. This model's results explained 12.4 % (Nagelkerke R) of the variance in Type 2 diabetes status in women. The model correctly classified 88.8 % of the cases. There were eight predictor variables, and three were statistically significant: educational level (attended/graduated college or technical school), employment status (unemployed, homemaker, and retired), and BMI (overweight and obese), as shown in Table 9. Women who attended college or graduated technical school were less likely to have Type 2 diabetes than those who did not graduate high school. Women who were unemployed or unable to work or working in the home were nearly twice as likely to have Type 2 diabetes while being retired increased the odds to over four times more likely to have Type 2 diabetes than those who were employed. Those who were overweight were two times more likely while being obese increased the odds to over four times more likely to have Type 2 diabetes than those underweight or normal weight. As a result of this analysis, the null was rejected, and the alternative hypothesis was accepted.

Interpretation of the Findings

I used a quantitative, retrospective, and non-experimental research design involving secondary data to investigate the relationships between the social determinants of health along with obesity, physical activity, ethnicity, and Type 2 diabetes status in Caribbean women. These cross-sectional data sets were sourced from the CDC's BRFSS survey for Puerto Rico and the U.S. Virgin Islands. The data were publicly available on the CDC's website. According to the CDC (2019a), the BFRSS data are collected in the 50 states and territories such as the U.S. Virgin Islands and Puerto Rico. The data were collected using telephone surveys (CDC, 2019a). I received IRB approval from Walden University to conduct the study. Because the CDC data sets are publicly available, an application to use the data was not necessary.

To answer RQ1, concerning the prevalence of Type 2 diabetes, obesity, and prediabetes, I divided the number of persons who were classified in those categories by the total number of women in the sample, presenting the resulting value as a percentage. The focus was on all women (18 to 64 years) with and without a Type 2 diabetes diagnosis. The analysis included running frequency distribution, cross-tabulation tables, and descriptive statistics using the IBM SPSS 25 software.

In the analysis for RQ2, I used binary logistic regression to investigate if the independent variables (income, educational attainment, employment status, health insurance status), along with overweight/obesity, physical activity, and race/ethnicity were associated with a diagnosis or non-diagnosis of Type 2 diabetes in Caribbean women. Binary logistic regression analysis allowed for the prediction of the likelihood of

the women in the sample being placed in one of these two groups based on the analysis of the independent variables (see Shrestha, 2019). This type of logistic regression has been widely used to analyze the association of several predictor independent variables on a categorical dependent variable at a specific time (Rastogi & Singh, 2019).

Some of the results found in this dissertation were similar to those found in other studies. In the literature review, the PAHO (2015) stated that in 2014, the prevalence of Type 2 diabetes in Puerto Rican females was 16.4%; the prevalence of obesity and overweight was 65.6%. Also, persons aged 55 to 64 years had the highest prevalence of obesity at 35.2%. The PAHO estimates for overweight and obesity were close to what was found in this dissertation; however, the prevalence of Type 2 diabetes found in the dissertation was lower. Additionally, in a convenience sample of 380 participants in primary care clinics in San Juan, Puerto Rico, Mattei et al. (2018) reported lower rates of overweight/obesity, a higher prevalence of Type 2 diabetes, and a slightly higher prevalence of prediabetes. The participants in Mattei et al.'s were aged 30 to 75 years. The age differences in Mattei et al. could account for the differences. Also, the study participants in Mattei et al.'s study were selected from the capital city of San Juan and not from all over the island.

Type 2 diabetes is also a rising problem in the U.S. Virgin Islands. According to McDonald et al. (2017), the prevalence of diabetes in 2010 was between 8.2 to 11%. The results found in the study were within this range. However, the CDC (n.d.) estimated that in 2016, the prevalence in women in this territory would be approximately 12.7 % with a range between 9.8% and 16.2%. The prevalence of prediabetes in women was estimated

to be 13.8% with a range between 10.3 % to 18.2 % (CDC, n.d.). The findings from this study indicated a prevalence of Type 2 diabetes of 10.1 % and for prediabetes 17.9 %. The results fell within the ranges estimated by the CDC.

RQ2 was, What is the predictive relationship between the social determinants (income, education level, employment status, country of residence, health insurance status), overweight/obesity, physical activity, race/ethnicity, and Type 2 diabetes diagnosis in Caribbean women? The results of this study showed that educational attainment was a significant predictor variable in the model, indicating that participants who attended college/graduate/technical school were less likely to have Type 2 diabetes in comparison to those who did not graduate high school (OR = 0.61; p = .0.61). There is a dearth of information on the association of educational attainment and Type 2 diabetes status in the Caribbean (Sobers-Grannum et al., 2015). However, Howitt et al. (2015) stated that a lower socioeconomic status was associated with Type 2 diabetes in both lower-income, middle-income, and developed countries. In women, a Type 2 diabetes diagnosis was exacerbated by having lower educational attainment (Howitt et al., 2015). Similarly, according to Aguayo-Mazzucato et al. (2019), among Hispanics in the United States, education played a vital role in Type 2 diabetes status. Aguayo-Mazzucato et al. discussed that a diagnosis of Type 2 diabetes status was found in 15% of those with less than high school attainment versus 7% in those with a bachelor's degree or more (2019).

Being unemployed or unable to work was a significant predictor variable in the model, indicating that participants who were unemployed or unable to work were more likely to have Type 2 diabetes than those who were employed (OR = 1.81; p = .004).

Unemployment as a homemaker was a significant predictor variable in the model, indicating that participants who were homemakers were more likely to have Type 2 diabetes than those employed outside the home (OR = 1.70; p = .011). Being retired was another significant predictor variable in the model, indicating that participants who were retired were more likely to have Type 2 diabetes than those who were employed (OR = 4.13; p = .001). Like Sobers-Grannum et al. (2015), Bennett et al. (2015) stated that information regarding how socioeconomic status and its association with Type 2 diabetes as it regards occupation and employment status in the Caribbean is scarce (Bennet et al., 2015; Sobers-Grannum et al., 2015). In looking at similar communities in the United States, Estrella et al. (2018) analyzed participants 18 to 78 years, with 7,043 females and 4,797 males. The authors examined employment status as it related to behaviors such as obesity, tobacco use, physical activity, and health statuses such as hypertension, high cholesterol, and diabetes. Estrella et al. found that women who were homemakers, unemployed, middle-aged, or older were at higher risk of raised blood sugars and tendencies toward lower physical activity levels. Estrella et al. acknowledged that since many studies were not conducted in this area, it may be challenging to thresh out the complex and not so clear associations between health status and employment status. Although past studies have included Blacks and Whites, non-Hispanic; many studies did not include the Hispanic population (Estrella et al., 2018). Further studies are needed in the Caribbean with participants of different ethnicities.

Additionally, overweight was a significant predictor variable in the model, indicating that overweight participants were more likely to have Type 2 diabetes

compared to those who were underweight or normal weight (OR = 2.02*; p* = .002). The presence of obesity was a significant predictor variable in the model, indicating that obese participants were more likely to have Type 2 diabetes compared to those underweight or normal weight (OR = 4.38; *p* = .001). Aguayo-Mazzucato et al. (2019) reported that overweight and obesity are serious health problems in communities and were some of the most modifiable risk factors for preventing Type 2 diabetes (2019). According to Sobers-Grannum et al. (2015), Caribbean women were at high risk for obesity 3.10 (95% CI 2.43, 3.94), and this risk was attributed to a high prevalence of physical inactivity (2015). Interventions designed for women are needed in these territories.

The Findings in Relation to the Theoretical Framework

The theoretical framework used for this study is the SEM. According to Kilanowski (2017), Urie Bronfenbrenner first introduced this model in the 1970s to explain humans' development over the lifespan. The model demonstrates that as individuals live and develop, they do so in a changing environment that influences their human development. Kilanowski explained that the theory depicts the individual in the center of several interlocking circles that have a relationship with each other. Figure 1 shows the CDC's adaptation of the SEM. The overlapping circles shows the individual in the center of interpersonal, community, organizational, and policy spheres. Kilanowski stated that the areas next to the individual that includes relationships, and the environment are the factors that exerts the strongest influences. As the system expands, the individuals are exposed to settings such as where they go to school, work, pray, play,

or assemble. All these social, cultural, physical, and political interactions can negatively or positively impact the health outcomes of the individual (Kilanowski, 2017).

There were eight predictor variables, and three were statistically significant: educational level (attended/graduated college or technical school), employment status (unemployed, homemaker, and retired), and BMI (overweight and obese), as presented in Table 9. Women who attended college or graduated technical school were less likely to have Type 2 diabetes than those who did not graduate high school. Women who were unemployed or unable to work or working in the home were nearly twice as likely to have Type 2 diabetes while being retired increased the odds to over four times more likely to have Type 2 diabetes than those employed. Those who were overweight were two times more likely to have Type 2 diabetes, while being obese increased the odds to over four times compared to those underweight or normal weight. Additionally, the results for RQ1 showed that in the sample, the overall prevalence of Type 2 diabetes was 11.2 %., 35.7% were obese, 33,8 % were overweight, and 12.6 % had prediabetes. The SEM framework offers constructs for addressing how these results can be addressed substantively to prevent Type 2 diabetes in women (CDC, 2017). Dr. Yob explained that collaboration across the social-ecological framework was vital for best practices (Laureate Education, 2015g). This dissertation will look at the individual, community, and policy levels of influence.

The first circle of influence is the individual level. According to Albright (2015), addressing all levels of the SEM would help to prevent Type 2 diabetes. The individual cannot manage alone; supporting all levels of this multi-level model would provide the

balance where persons with diabetes can control the disease, and those without diabetes can practice preventative measures. Albright described that it was important for women to have the knowledge and self-efficacy to engage in healthy lifestyle actions such as being educated beyond high school, maintaining a normal weight, and controlling blood sugar values at the individual level. These skills and knowledge about Type 2 diabetes are vital and needs to be shared, especially with unemployed, unable to work, retired women, and homemakers. This action would enable these women to make the right decisions about their health status (Albright, 2015).

The next level of the SEM to be addressed is the community level. Overweight and obesity are two of the most modifiable risk factors to prevent Type 2 diabetes (Walker et al., 2016). Interventions to address overweight and obesity are engaging in physical activity and eating a healthy diet (Legetic et al., 2016). The neighborhood or community in which a woman lives has an association with quality of life and health status. Dendup et al. (2017) described that other studies had associated Type 2 diabetes with individual risk factors that are biological and behavioral, along with environmental factors that are independent of the individual. The physical environment can be protective or increase the risks for Type 2 diabetes. The physical environment can reinforce healthy behaviors or lead to unhealthy choices Persons living in areas where the physical environment has sidewalks, open spaces, and parks may be encouraged to walk more. These attributes affect tendencies towards overweight and obesity. Therefore, the safety and physical characteristics of a woman's neighborhood can influence the choices

women make and, as a result, positively or negatively impact the risks for Type 2 diabetes (Dendup et al., 2017).

One of the last constructs of the SEM includes public policy's role in treating and preventing Type 2 diabetes. According to Salihu et al. (2015), public policy can provide regulations for ensuring that girls graduate high school and offer incentives for young women to attend college or technical school. In the U.S., the Minnesota Department of Health (MDH, 2020) analysis showed that women who attended or graduated college or technical college were less likely to develop Type 2 diabetes. The results of several past studies have also shown that women who attended or graduated college or technical college were less likely to develop Type 2 diabetes. Diabetes education programs and obesity prevention programs should be developed for both territories and address all women. Greater effort should be made to reach those who are unemployed, homemakers, unable to work, and retired. Further opportunities are also needed for women to be employed if they so desire (Minnesota Department of Health [MDH], 2020).

To address overweight and obesity, several practical policy options are available to the governments of Puerto Rico and the U.S. Virgin Islands. One policy measure would be building sidewalks, parks, jogging trails, and convenient/accessible places to exercise going forward (Salihu et al., 2015). Further, Sobers-Grannum et al. (2015) also stated a need for specific policies for the prevention of obesity and Type 2 diabetes in women. To understand the dynamics of why women are at such risk, this issue needed further research (Sobers-Grannum et al., 2015). Albright stated that to support the individual, social environments, the physical environment, the policy environment need

to provide health education and health promotion for disease prevention. Health policies are needed to impact behaviors that are associated with obesity, detrimental personal behaviors, and the physical environment. These policies should include strategies to impact obesity, such as consumption of healthy foods, energy consumption, tackling food insecurity, and engagement in physical activity (Albright, 2015).

Limitations of the Study

This study has several limitations. The data used for this study was secondary data from the CDC. This information was not collected using direct observations. All the variables were collected using telephone interviews, and the respondents could have had trouble recalling personal information. Also, there could have been some uneasiness or discomfort in answering some of the questions such as income, weight, educational attainment, and health status due to many factors such as stigma. This study also did not take into consideration some risk factors for developing Type 2 diabetes, such as culture, nutrition, family history, gestational diabetes, and many environmental factors that can influence the development of Type 2 diabetes. Also, due to the cross-sectional nature of the BRFSS data, causal relationships could not be drawn from the results. The data used was only from 2016. Since Puerto Rico was part of the data set, a large proportion of the participants were Hispanic, which could have impacted the outcomes.

Several advantages of this study were that the data sets for this study were publicly available, and there was no need to gain permission to use the data. Also, the BRFSS data resulted from telephone surveys that have been collected since 1984 and used by many researchers who have found the information credible. Over the years,

several studies that have used BRFSS data. Tran et al. (2019), have reported that they found the data reliable. The authors mentioned that other researchers have found that the BRFSS data and those that used actual clinical data from participants to have R squared values of 89 to 92 %. In one study using the Massachusetts BRFSS data, Tran et al. reported that the researcher only found a five percent difference in diabetes and obesity rates with clinical data collected in the same area (Tran et al., 2019). The CDC (2019a) also outlined that the data was raked and weighted to represent the population (2019a).

Recommendations

This study's findings provided valuable information regarding which risk factors for Type 2 diabetes are associated with developing Type 2 diabetes for women in Puerto and the U.S. Virgin Islands. Some results showed that the overall prevalence of Type 2 diabetes was 11.2 % in the sample. Additionally, 35.7% were obese, 33,8 % were overweight, and 12.6 % had prediabetes. Further examination showed that in Puerto Rico, 11.4 % had a status of Type 2 diabetes, 33.9 % were overweight, 34.2 % were obese, and 11.4 % had prediabetes. In the U.S. Virgin Islands, 10.1 % had a status of Type 2 diabetes, 33,4 % were overweight, 42.8 % were obese, and 17.9 % had prediabetes. These are not good statistics. Overweight and obesity were previously identified by Sobers-Grannum et al. (2015) as known risk factors for Type 2 diabetes in Caribbean women (2015). Overweight and obesity are two of the most modifiable risk factors for preventing Type 2 diabetes. The results of the logistic regression showed that women who were overweight were two-fold and those who were obese were four and one-third times more likely to develop Type 2 diabetes. This was true for 69.5 % of the sample.

Puerto Rico previously published a Chronic Disease Action Plan for 2014 to 2020 and an Obesity Prevention Action Plan in 2016. These plans are supported by the PAHO and the Food and Nutrition Commission (PAHO, 2015). On the other hand, the department of health of the Virgin Islands has adopted the National Diabetes Prevention Program which is a program at the CDC. They also developed a Chronic Disease Prevention Program. Both of these programs offer health information classes for persons living in the territory free of cost (United States Virgin Islands Department of Health [USVIDOH], n.d.) Every effort should be made to inform the population about these programs so that those who need this information can take advantage of the knowledge that these programs can provide to enable individuals to enjoy better health and prevent Type 2 diabetes and other NCDs.

All efforts should be made to enact the policies in the plans for Puerto Rico to address the situation of obesity and the high rate of Type 2 diabetes in women. The department of health and other stakeholders involved in public health in the U.S. Virgin Islands need to publicize their efforts to curb Type 2 diabetes and other NCDS. Some recommendations from the PAHO and the FAO were that the region's governments urgently required to implement policies in collaboration with the ministries of agriculture to provide nutritious, healthy food, tackle food insecurity, and ensure that this supply was sustainable (PAHO, 2019a). A second recommendation from Alleyne (2019) recommended that prevention should be promoted, especially to the younger population before the disease developed. Physical education and exercise programs in schools should be a priority, and ramifications of consuming of unhealthy foods should be part of health

education and promotion efforts (Alleyne, 2019). The health departments need to provide clearer health messages and enact policies to address overweight and obesity, since these are known to be associated with Type 2 diabetes development. Thirdly, recommendations offered by Legetic et al. (2016) are that governments should enact inter-ministry public policies (agriculture, finance, health, public planning, and education) that can help tackle obesity (2016). Involving all agencies of government, not just the departments of health, in the fight against Type 2 diabetes.

There is also a lack of current peer-reviewed studies for these two territories. Puerto Rico had several more current sources of data than the U.S. Virgin Islands. At present, researchers at the Eastern Caribbean Health Outcomes Network (ECHORN, n.d.) explained that Yale University and the National Institute for Minority Health Disparities (NIMHD) are conducting a longitudinal study in the Caribbean countries of Barbados, Puerto Rico, Trinidad, and the U.S. Virgin Islands. The cohort study started in 2017 and will last for five years. The researchers are collecting data from adults over 18 years of age who live in these Caribbean countries to examine the risk factors for NCDs, such as cardiovascular disease, Type 2 diabetes, and cancers. Several studies have already emerged from ECHORN. The collected data will be of enormous benefit to these Caribbean nations and will provide more information for the field in the future (Eastern Caribbean Health Outcomes Network [ECHORN], 2019). More longitudinal studies, like ECHORN, are also needed and include other Caribbean nations. Qualitative studies are also required to add more clarity to why women are at such high risk for obesity and Type 2 diabetes. Sobers-Grannum et al. (2015) stated that such studies are needed since

the problem was complex and may have a relationship with women's roles in Caribbean society (Sobers-Grannum et al., 2015). More evidence can only benefit the health outcomes for women.

Puerto Rico and the U.S. Virgin Islands are territories of the United States. They also operate under the same health policies of the U.S. government. According to Ogilvie et al. (2018), these two territories should be striving to achieve the objectives laid out in Healthy People 2020. Ogilvie et al. found that these two countries were behind the U.S. states in reaching several Healthy People 2020 goals pertaining to diabetes care. The recommendation from Ogilvie et al. was that these territories needed to implement policies to assist with achieving these goals. The departments of health in these two territories have access to resources at the CDC and other US. health institutions. Albright (2015) explained that the staff at the CDC developed a National Diabetes Prevention Program (National DPP). This program provides directions for how to implement prevention programs and interventions for Type 2 diabetes. These two territories although they are using some of the resources of this program should more aggressively avail themselves of these guidelines and resources to educate their communities on how to prevent Type 2 diabetes, raise awareness and education about the dangers of prediabetes, and adopt the evidence- based interventions to tackle the modifiable risk factors of Type 2 diabetes such as overweight and obesity (Albright, 2015). The statistics for the prevalence of prediabetes, overweight and obesity are alarming knowing their ramifications on health outcomes.

To address overweight and obesity, there are several evidence-based interventions available through the CDC and other institutions with similar goals. Some further recommendations offered by Legetic et al. (2016) are that governments should enact inter-ministry public policies that can help tackle obesity. An example was to collaborate with the departments of agriculture to address food insecurity and the ministry of planning to help design healthy living spaces that promote walkability, safe public spaces for exercise so that adults and children can play and engage in physical activity while feeling safe (Legetic et al., 2016). Involving all government agencies, not just the ministries of health, in the fight against Type 2 diabetes and other NCDs, made a lot of sense. Along the same lines, Alleyne (2019) recommended that the region's governments address health problems such as Type 2 diabetes by pooling its resources from all government areas, such as agriculture, health, finance, urban planning, and commerce (2019). The Caribbean is a melting pot with similar cultures. If these governments can collaborate successfully, assistance to communities can effect social change.

Lastly, the study showed that women who attended or graduated from college or technical college were less likely to develop Type 2 diabetes. As a result, the governments of Puerto Rico and the U.S. Virgin Islands need to ensure that girls graduate high school and go on to technical schools or college. Diabetes education programs and obesity prevention programs should benefit all women. More significant effort should be made to reach those who are unemployed, homemakers, unable to work, and retired (Minnesota Department of Health [MDH], 2020). Unemployed women, unable to work, and homemakers were twice as likely to develop Type 2 diabetes while women who were

retired were four times more likely. Urgent work is needed to address the social determinants of health for the women of Puerto Rico and the U.S. Virgin Islands whether it was through policies, programs, or gender specific interventions.

Implications

The study results were that 68.6 % of Puerto Ricans and 56.0 % of U.S. Virgin Islanders attended or graduated college or technical school. This statistic is a good start. However, 55.5 % of Puerto Ricans versus 29.2 % of U.S. Virgin Islanders were unemployed/unable to work, homemakers, or retired. Also, the prevalence of overweight/obesity in Puerto Rico was 68.1 %, and for the U.S. Virgin Islands, 76.2 %. When it came to prediabetes, the prevalence in Puerto Rico was 11.4 % and in the U.S. Virgin Islands 17.9 %. These two territories need to aggressively attend to the public health issues of unemployment, prediabetes, overweight/obesity, and Type 2 diabetes. Addressing these health issues is a pressing health issue.

This research has implications for positive social change for women in the Caribbean territories of Puerto Rico and the U.S. Virgin Islands. According to Dr. Iris Yob in Laureate Education (2015g), after research studies are finished, they provide evidence-based research for health practitioners; ministries of health, civic organizations that promote policies, and health educators who implement interventions for diabetics. Dr. Yob explained that instead of just hoping or believing, the information that results from studies are based on evidence and provide valuable information to stakeholders (Laureate Education, 2015g). This study showed that educational attainment, employment status, overweight, and obesity have an association with the high rates of

Type 2 diabetes in women in Puerto Rico and the U.S. Virgin Islands. Health workers can use this information to start positive social change among the organizations that work with women with Type 2 diabetes (Laureate Education, 2015g). Dr. Yob explained that collaboration across the social-ecological framework should take place for best practices. This collaboration will start the ripple effect of social change to start and eventually grow into a wave (Laureate Education, 2015g). Policies going forward should advocate for girls and women to be educated past a high school diploma, and where possible, women should be given opportunities to continue to higher education.

Women from all walks of life should be made aware of the fact that the rise in the prevalence and incidence of Type 2 diabetes is an urgent issue for Caribbean women (Bennett et al., 2015). The study results showed that employment status (unemployed, unable to work, homemaker, and retired) was associated with the development of Type 2 diabetes. It was essential to consider these factors to provide appropriate interventions for women in the community (Brathwaite & Lemonde, 2017). Interventions should target women in these categories to let them know that they are at higher risk of developing Type 2 diabetes. Programs and resources should be made available for raising awareness among these groups.

Also, two of the most modifiable risk factors for developing Type 2 diabetes, are overweight and obesity and both were statistically significant. Tackling overweight and obesity are areas where much progress can be made to reduce Type 2 diabetes (Aguayo-Mazzucato et al., 2019). Researchers using the ECHORN data have already provided valuable information for the field. According to Hassan et al. (2018), weight

misperception was common among the study participants. The authors reported that 54 % of overweight and 23 % of those who were obese did not realize that their weight was not normal. Hassan et al. stressed that this factor was important since those who had weight misperception were 85% less likely to engage in weight loss programs (Hassan et al., 2018). Type 2 diabetes is a preventable condition. According to the CDC (2019b), the evidence was that if women exercised at least 30 minutes a day, five days a week, and lose five to seven percent of their body weight, this can prevent or lower the risks of developing diabetes. The evidence was that this action could reduce the risk as much as 58 to 71 % if the woman is under age 60 (CDC, 2019b). The health departments in these two territories will need to promote these messages to the target group and provide safe, accessible green spaces and areas for women to engage in physical activity.

As it relates to prediabetes, attention is also needed in this area. There are several risk factors in previous studies that have been found to have an association with prediabetes. Hostalek (2019) stated that Hispanics have an increased risk of being diagnosed with prediabetes in comparison with Whites, Blacks, South Asians, and Native Americans. Other risk factors are educational attainment, knowledge/awareness, and obesity. Hostalek explained that a diagnosis of prediabetes increased the risks of developing Type 2 diabetes, other NCDs, and complications exacerbated by Type 2 diabetes. Some of these are cardiovascular disease, gestational diabetes, kidney disease, neuropathy, and diabetes retinopathy. Also, Hostalek went on to explain that a diagnosis of prediabetes is also a public health issue. Twenty-five percent of individuals with prediabetes will develop full-blown Type 2 diabetes in three to five years after diagnosis,

and 75% will do so over the lifespan. However, the way prediabetes is diagnosed varies among different institutions, such as the WHO and the ADA. Some institutions use fasting plasma glucose (FPG), some use impaired fasting glucose (IGT), and others use the results of glycated hemoglobin (HbA1c). As a result, there is confusion on which method was better for prediabetes diagnosis (Hostalek, 2019). Lifestyle interventions are needed to address this known risk factor and policies implemented to define clear guidelines for the health sector to diagnose prediabetes since these different benchmarks gave wide-ranging results.

Conclusions

The purpose of this study was to examine the association of several social determinants of health, which were income, educational attainment, employment status, health insurance status, country of residence, along with overweight/obesity, physical activity, and race/ethnicity on the Type 2 diabetes status of Caribbean women. The study was conducted to address the problem that Caribbean women are currently three times more obese than men and one and a half times likely to have Type 2 diabetes, according to Sobers-Grannum et al. (2015). Several other researchers, such as Bennet et al. (2015) and Guariguata et al. (2018), also concluded in their studies that women were at excess risk for obesity and developing Type 2 diabetes. This dissertation found that obesity increased the likelihood of Type 2 diabetes four and one third. Recommendations were that further peer-reviewed research was needed to provide more evidence for the field. Also, policy initiatives are needed to address these dire statistics to improve the health status and quality of life for women (Bennet et al., 2015; Guariguata et al., 2018)

The study results showed that educational attainment, employment status, overweight, and obesity have an association with the development of Type 2 diabetes. According to the PAHO (2015), the health department in Puerto Rico is already aware that they need to take action and have written a Chronic Disease Action Plan for 2014 to 2020 and an Obesity Prevention Action Plan in 2016. The U.S. Virgin Islands do not have similar plans, however, they have established a Chronic Disease Program and adopted the National Diabetes Prevention Program from the CDC. They are also currently seeking opportunities to implement the Walkability Program from the CDC to encourage the population to engage in physical activity by walking more in their communities (USVIDOH, 2017), However, both territories are taking part in a five-year longitudinal study conducted by Yale University to conclude in 2022. The peer-reviewed information that will be published due to the ECHORN study will provide evidence-based results to assist these territories in addressing the dire statistics of obesity, Type 2 diabetes, which are also risk factors for cardiovascular disease which is currently responsible for a high death rate in women (ECHORN, n.d.).

Lastly, further research is needed to determine the other risk factors for Caribbean women developing Type 2 diabetes. The results of this study showed that only approximately 12.4% of the variance in Type 2 diabetes diagnosis could be explained by the predictor variables of income, education level, employment status, country of residence, health insurance status, overweight/obesity, physical activity, race/ethnicity, and Type 2 diagnosis status of the women in the sample. Other risk factors may be

gestational diabetes, prediabetes, hypertension, poor diets, food insecurity, and family history. There is much research to be carried out in the future by researchers.

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Appendix: The BRFSS Data Set Variables

The BRFSS Dataset Variables

Diabetes Status:
Question: "(Ever told) you have diabetes (If ´Yes´ and respondent was female, ask ´Was this only when you were pregnant?"
1 – Yes
2 - Yes, but female told only during pregnancy
3 - No
4 – No, prediabetes or borderline
7 – Don't know/Not sure
9 – Refused

Prediabetes:
Question: "Have you ever been told by a doctor or other health professional that you have pre-diabetes or borderline diabetes (if "Yes" and respondent was female, ask: "Was this only when you were pregnant?"
1 – Yes
2 – Yes, during pregnancy
3 – No
7 – Don't know/not sure
9 - Refused

Income:
Question: Income categories
1 - Less than $15,000
2 - $15,000 to less than $25,000
3 - $25,000 to less than $35,000
4 - $35,000 to less than $50,000
5 - $50,000 or more
9 - Don't know/Not sure/Missing

Educational Attainment:
Question: "Level of education completed?"
1 – Did not graduate High School
2 – Graduated High School
3 – Attended College or Technical School
4 – Graduated College or Technical School
9 – Don't Know/Not Sure

Employment Status:
Question: "Are you currently..?"
1 – Employed for wages

2 – Self-employed
3 – Out of work for 1 year or more
4 – Out of work for less than 1 year
5 – A homemaker
6 – A student
7 – Retired
8 – Unable to work
9 - Refused

Nationality/Country of Residence:
These were:
Puerto Rico
U.S. Virgin Islands
"State FIPS Code"
72 – Puerto Rico
78 – US Virgin Islands

Health Insurance Status:
Question: "Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service?"
1 - Yes
2 - No
7 - Don't know/Not sure
9 - Refused

Physical Activity:
Question: During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?"
1 – Yes
2 – No
7 – Don't know/Not sure
9 - Refused

Body Mass Index:
Question: Four categories of Body Mass Index (BMI)
1 – Underweight
2 – Normal Weight
3 – Overweight
4 - Obese
9 – Don't know/Refused/Missing

Race/Ethnicity:
Question: Five-level race/ethnicity category.
1 – White only, Non-Hispanic
2 – Black only, Non-Hispanic
3 – Other race only, Non-Hispanic
4 – Multiracial, Non-Hispanic
5 - Hispanic
9 – Don't know/Not sure/Refused

Age:
Question: Two level age category
1 - Age 18 to 64
2 – 65 or older
3 - Don't know/Refused/Missing

Sex
Indicate sex of respondent
1 – Male
2 – Female
9 – Refused